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Science and the Community

INCREASING public attention is being given to the ways in which science might assist in the solution of social and ethical problems; and there is a further welcome sign of growing recognition that scientific workers can no longer disavow responsibility for the consequences which attend the application of their discoveries in social and industrial life. The discussions provoked by the addresses of Sir Alfred Ewing and Prof. Miles Walker at the British Association meeting at York last year indicate that the challenge voiced in these addresses fell on receptive ears, and addresses by Sir Frederick Gowland Hopkins and Sir Josiah Stamp at the British Association meeting at Leicester this year again focused attention on the relationship between science and our present social and economic conditions. In these addresses there is implicit a fundamental challenge to the whole system of British politics, economics and education, and if society is now forced to consider the relative place of science, both in the organisation and development of the world order, and in the preparation of its individual members to enjoy the privileges and to discharge the responsibilities inherent in a society based on scientific achievements, the decision is one for society as a whole and not for any one section.

A recent series of articles contributed by Mr. Ritchie Calder to the *Daily Herald* revealed the extent to which men of science are interested in social problems arising out of their researches, and are seeking to discover means of controlling the forces they have released and thus building up a scientific civilisation. The advantages which the advent of the machine has brought to mankind are reviewed, and the problem of employment which machine production has brought is not allowed to disguise its immense value in liberating man from drudgery, in rendering obsolete unpleasant and dangerous occupations which took unjustifiable toll of human effort and health and life—a charge which should rightfully be brought against the system which operates the machine.

The bearing of mechanisation on production and employment brings us face to face with the problems which arise from the lessening ratio of workers engaged in actual production to those engaged in clerical work or distribution. The mechanisation and rationalisation of distribution, so ardently advocated by many, coupled with the

mechanisation of office work, which is already taking place, may yet present us with our largest problem in the displacement of man by the machine. The danger in the situation as visualised by economists like Mr. G. D. H. Cole is that unemployment tends to perpetuate itself by cancelling purchasing power. Production can only increase demand when the amount of production is determined, not by purchasing power, but by the needs of mankind. Such a system can only be achieved through a planned economic system in which scientific workers and technicians are able to devote their energies to increasing productivity, without the unhappy consciousness that they are thereby making even more posts redundant.

This conception of national planning, under which not merely the quantity of production but also its distribution among all members of society are considered, may well afford men of science and inventors the widest and happiest opportunities of serving humanity. It brings us, however, face to face with the fundamental challenge which discussions of this kind during the last two years, whether before the British Association, in the House of Lords or elsewhere, have thrown down to our present system. The eagerness with which in some quarters the opportunity has been seized of rebuking scientific workers for undue arrogance in aspiring to a large share of administrative responsibility even in this scientific age suggests indeed that such rebukes have been administered less in sincerity than to avoid confronting the breakdown of unrestrained individualism in the face of the forces released by science.

One of the fundamental truths of the situation is the need of thorough-going co-operation on an international as well as a national scale. Without such co-operation, mankind cannot continue to enjoy the advantages of the machine age before his selfishness and individualism involve him in catastrophe. Without such co-operation the planning which is an essential first step to recovery cannot be undertaken. The real mischief is caused by any section of the community which refuses to consider any interests beyond its own, or to allow the evaluation of the whole range of factors—scientific, technical, social, economic, administrative—upon the accurate assessment of which wise decision and action depend.

Within such limits there are many and important contributions which could be made by science, as indeed is suggested in the series of articles to which we have referred. There is a large number of problems such as those of transport, water-supply and land drainage, atmospheric pollution, the grid system, town and country planning, disarmament and unemployment in which the technical factors are basic. These factors, even where sufficiently determined, have rarely been adequately presented and considered. Mr. Alan Chorlton's plea for greater co-ordination of our public services—light, heat, power, including both gas and electricity, and water-supply—in his presidential address to the Institution of Mechanical Engineers, for example, has been criticised less on his technical facts than as opposed to the individualism upon which our past achievements are based.

At this point alone, there is fundamental educational work to be carried out by scientific workers in bringing the community to appreciate the changed conditions under which it lives and the necessity of evolving a higher and more complex organisation adequately ministering to its new needs. Exposition of the fundamental factors of the present situation, in the way in which Prof. J. T. Shotwell, for example, has set forth the changes which have led man to the step of renouncing war as an instrument of national policy, is an essential preliminary to the programme of action outlined by Mr. H. W. J. Stone in his recent article (*Progress*, **2**, No. 7, 1933) on "Science in Parliament". The electorate must appreciate the general importance of scientific principles in every department of modern life and the necessity for trained intelligence guiding our administrative decisions and legislation, before it is likely to pay much heed to the representations of science on particular matters.

This is a matter of general education, the responsibility for which lies largely on the shoulders of the individual scientific worker. Much more than this is required, however. While the task of education proceeds, the re-orientation of scientific thought, its organisation for an attack on the social problems created by the application of scientific discoveries, should already be productive of results, at least indicating lines of work, fields in which investigation is urgently required as a basis for further action, others in which the facts need sorting out and a reasoned statement presented as a basis for wise action.

There is in such a programme no claim for omnipotence or omniscience on the part of the scientific worker. There is implicit the assertion

that the scientific and technical factors cannot be neglected if we are to solve our problems and evolve a new order of civilisation, and equally a repudiation of the suggestion so sedulously sown in some quarters that a scientific worker is less qualified than his fellow men to exercise his trained intelligence in public affairs, whether as administrator, representative or elector. If civilisation is to be preserved, we must find a place in its direction for accurate knowledge and trained intelligence. Only so can we avoid the disastrous consequences which many so-called social reforms are likely to involve because they are in fact both anti-social and anti-scientific.

The programme thus roughly sketched is perhaps nearer realisation than is at first apparent. Our political institutions it is true have still to adjust themselves to the new situation, but the great changes in human government predicted by General Smuts will assuredly come to pass. Functional relations of science to the new State have to be explored from both sides. On one hand, the scientific worker himself has to develop the outlook and the attitude of mind which will fit him to take part in the affairs of State. The unrest and turmoil in the scientific world to which Mr. Calder directs attention are a token that this task will be increasingly undertaken by the man of science.

On the other hand, the administrator and statesman have to learn of the scientific worker to bring to bear in the affairs of State the outlook and method of ascertaining facts which are characteristic of science, and to assist in the evolution of machinery or organisation through which the technical expert can exercise his proper influence and policy, whether in national or international affairs. Already definite progress is being made towards functional self-determination in various spheres, and once the work of educating society to the place of science in the new order is well in hand, the organisation and functioning of the State should become more scientific, impartial and business-like, and less political in the old partisan sense.

We have stressed the place of education in this programme because it is indeed fundamental. Only as the true place of science in our civilisation is perceived can we expect the continued support for those long-range investigations in sociology and the basic sciences of man which are fundamental to any wise ultimate policy. The continued endowment of the social studies already being carried out by the universities, or of the researches into anthropology which have so greatly assisted wise administration of native races in tropical Africa, depends upon the support of an educated public opinion as much as upon the willingness of the scientific worker to enter this field and discover the facts upon which wise policies are to be based.

There is indeed a fruitful field in which, as suggested already in these columns, such organisations as the Royal Society, the British Science Guild, the Federation of British Industries, the Association of Scientific Workers, the Rotary Movement, the Workers' Educational Association, and others might join together unofficially to support the educational work needed to make scientific methods understood and their influence effective. Apart from the influence the man of science brings to bear on the fellow citizens with whom he is in contact in or out of working hours, or the value of his own scientific work, upon his loyalty and idealism and enthusiasm depend the success of his professional organisations. Through them alone can he demonstrate effectively to society the existence of professional ideals of service and vocational responsibility, and win the confidence which is essential if these wider fields of service are in turn to be entered and the attendant responsibilities worthily discharged. To none more surely than the man of science is society entitled to look for the courage, confidence and vision which are adequate not merely to prevent us slipping back into destructive individualism but also to lead mankind forward to the full enjoyment of those rich resources with which science has endowed us.

Fruit Production and Preservation

(1) *The Apple*. By Sir A. Daniel Hall and M. B. Crane. Pp. 235+12 plates. (London: Martin Hopkinson, Ltd., 1933.) 10*s*. 6*d*. net.

(2) *Principles of Fruit Preservation: Jam Making, Canning and Drying*. By T. N. Morris. (Monographs on Applied Chemistry, Vol. 6.) Pp. xiii+239. (London: Chapman and Hall, Ltd., 1933.) 15*s*. net.

(1) A NEW volume from the pen of Sir Daniel Hall is always an event in the horticultural or agricultural world. Apart altogether from the substance, one is sure of a book delightful to read for itself alone. The latest book, however, appears at a time when fruit-growing in Great Britain, stimulated to no small degree by the

propagandist activities of the recently defunct Empire Marketing Board, is experiencing a definite recrudescence, so that a double importance is attached to its publication. The British public is becoming slowly educated to the knowledge that British fruit can be, and often is, better than the best of the imported, and will learn in time to ask for home-grown produce, not because it is patriotic to do so, but because it is the best. That time, however, will not come until the market has been purged of the high percentage of definitely low-grade produce that still comes from many orchards. The dissemination of knowledge of better methods of fruit-growing is the essential requirement among producers, and this new book should do much to help.

The keynote in the modern science of fruit-production is an understanding of the genetical mechanism underlying the varying behaviour of varieties. The fruit is the culmination of the reproductive process, and it is only by a knowledge of the inherent characters that go to its make-up that we can hope to produce improved varieties and to obtain the best results from those we have. The John Innes Horticultural Institution is responsible for the greater part of our knowledge of the cytology and genetical mechanisms of tree fruits, and to Mr. Crane we owe a large share of that knowledge; it is fitting, therefore, that a considerable part of the book should deal with this aspect of apple-growing.

The practical grower, for whom it is claimed the book is written, may make somewhat heavy weather of the first five chapters. Excellently as the explanation of cytological principles and chromosome behaviour is done, to one entirely unversed in the subject who may never have heard even of a nucleus, the close following of the argument may seem a difficult task. That is, however, no reason why it should not be attempted, and nothing can be lost in the endeavour. For the serious student these chapters present an admirable résumé of the subject.

The remainder of the book, dealing with the practical side of apple production and its foundation on scientific knowledge, is plain sailing, and gives in clear and simple form an introduction to the best methods of propagation, planning, planting, cultivation, pruning, disease control, and picking and handling. In the chapter on pests and diseases, more might with advantage have been said of that increasing major pest, the Apple sawfly, and the latest and most effective means of control now worked out by the Long Ashton Station. The list of recommended commercial varieties has been selected by reference to six of the leading fruit-growers, and those suggested for the private garden are far more suitable for the purpose than many published lists.

One criticism may be permitted; a greater number of illustrations would enhance the value of the book. In the chapter on propagation, for example, the only methods illustrated are whip and tongue grafting, and budding. No illustration is given of crown grafting, and indeed the method is not mentioned in the text, in spite of its utility in the renovation of old orchards and the replacement of unproductive trees. Again, the principles of pruning might be more easily explained by a few diagrams or plates.

The criticism is, however, perhaps unjust, as the book is not intended by its authors to be a work of reference, but rather as an introduction to the scientific principles of apple-growing and a guide to the literature on the subject.

(2) From fruit production to its preservation is a logical step, but the volume by Mr. Morris on "Principles of Fruit Preservation" is of an entirely different type from the one just considered. They are alike only in so far as both aim at a presentation of the latest scientific work on their respective subjects. Mr. Morris's book, like its companion volumes in the series of Monographs on Applied Chemistry, is essentially a textbook and work of reference, although the subject is so logically and lucidly presented that it repays continuous reading. In the words of the general editor of the series, "Such books are essentially written by experts for other experts in related fields of science, or for the well-educated layman whose thirst for new knowledge has not been quenched by the more sensuous outpourings of the ephemeral press".

The book is divided into five parts. Part I deals with jams and fruit jellies, and gives a clear explanation of the factors involved in the pectin-sugar-acid gel, including the hitherto unpublished work of Dr. W. G. Ogg, which has thrown much light on the conditions affecting gel formation. Consideration is given to the preservation of fruit for jam-making and the methods and problems of jam-manufacture. Part II is an excellent account of the canning of fruit, with a critical consideration of causes of spoilage, especially the factors involved in the production of hydrogen-swells. In this section a chapter is added on fruit bottling. Part III deals with dried fruits, the methods of drying,

principles of dehydration, and the storage of the products. Part IV contains chapters on the causes of discolouration in preserved fruits and the vitamin content of canned and dried fruits. An unusually good subject index makes reference to any section easy, and is followed by an author-index, an excellent plan which should be more widely adopted.

Plus ça change . . .

(1) *Witchcraft and Demonianism: a Concise Account derived from Sworn Depositions and Confessions obtained in the Courts of England and Wales.* By C. L'Estrange Ewen. Pp. 495+8 plates. (London: Heath Cranton, Ltd., 1933.) 25*s*. net.

(2) *Psychical Research: the Science of the Super-Normal.* By Prof. Hans Driesch. Authorised translation by Theodore Besterman. Pp. xvi+176. (London: G. Bell and Sons, Ltd., 1933.) 5*s*. net.

(3) *The Supernormal: a Critical Introduction to Psychic Science.* By G. C. Barnard. Pp. 256. (London: Rider and Co., 1933.) 7*s*. 6*d*. net.

(4) *Leaves from a Psychist's Case-Book.* By Harry Price. Pp. 404+32 plates. (London: Victor Gollancz, Ltd., 1933.) 15*s*. net.

ONE of the most curious features of the human mind is its capacity for dividing itself into water-tight compartments, and of entertaining contradictory beliefs at the same time. There is a lack of logical unity; and anthropologists are fond of illustrating this theme from their experiences with savages.

Civilised man is, however, scarcely more logical or consistent than the savage. It is true that, through the beneficent influence of scientific thought, many of his intellectual processes are carried out on a logical and reasonable basis. There are still some parts of the world where the intellect can develop unhindered by the trammels of theological or political dogmas. Astronomy has taken the place of signs and portents: the Prince of the Power of the Air has had to acknowledge the supremacy of a copper rod: 'visitations' from the Deity are promptly notified to the M.O.H.; and even the mysteries of creative power are becoming less occult through the good offices of *Drosophila*. It is only in the emotional life that supernaturalism still holds sway. Indeed, it is in one sense fashionable to possess a mind in which such a cleavage is apparent. Its dangers are scarcely apprehended. With the savage there is no conflict between the intellectual and emotional life as exists in the civilised individual. The latter is living in a world transformed by science from which he cannot escape even if he would. His emotional life, however, is anchored to age-long superstitions, which derive their nourishment from the search for life and immortality. These four volumes illustrate this theme with startling clarity.

(1) Mr. Ewen, in his admirable account of the official records of witchcraft in England and Wales, has shown how the horrors and tragedies which accompanied the trials were indissolubly linked with Christian demonology, and how the minds of the judges were almost wholly under the domination of fantastic beliefs in the reality of supernatural powers. Many of them were reasonable men in everyday life, but they became monsters or maniacs because their emotional pattern left them no alternative. Science might transform their material life as it has done our own, but if the roots of their emotional life were not transplanted to a healthier soil the same flowers, or rather fungi, would continue to flourish. Hence we have the extraordinary spectacle of Elisabeth Frauncis in 1566 with her clever cat which spoke good English in a hollow voice, and the British spiritualist of 1933, with his cleverer dog, which hummed the "Moonlight Sonata". We see Mr. Stranguidge, about 1650, tearing his trousers as he catches them on Shelford steeple when flying by on a black pig; and in modern Italy we see a nobleman transported from the séance room and, having, it is presumed, suffered dematerialisation, turning up again in the granary on the top of the oats. We see young witches all through the trials vomiting up cutlery and hardware: and to-day we see Mrs. Victoria Duncan vomiting up much cheese-cloth. Certainly as a prologue to modern psychical research Mr. Ewen's book could scarcely be surpassed. Little has changed but the methods of the opposition. The modern witch is no longer persecuted but honoured. Greedigut and Pyewackett have been rechristened Phinuit and Harmony. In 1600 Dr. John Lambe diagnosed diseases without seeing the patient; modern wizards do the same to-day calling it 'absent treatment'. "Plus ça change, plus c'est la même chose!"

In order to compare the new witchcraft with the old and to observe their fundamental points of similarity, the student could scarcely do better than read these four volumes. One fact will

emerge which will compel attention. It is that here we are dealing with highly obscure and extremely complex phenomena, which assume the pattern of the mould into which they are forced; and they will be never understood so long as that mould is cast according to a system of supernatural beliefs which the intellect has long outgrown.

(2) Dr. Driesch, in his little guide to psychical research, although writing as a confirmed vitalist, has endeavoured to present the material in such a way that it may stimulate other workers less willing to accept the theories which to him appear satisfactory. He shows himself very cautious in certain directions and exhibits a praiseworthy eclecticism, although his preference for the work of the English investigators might be considerably lessened were he better acquainted with their publications.

In discussing the mental phenomena, Dr. Driesch finds that a general theoretical uniformity in the entire field can best be attained by assuming as a foundation the doctrine that body and mind are two different entities; and his acceptance of telepathy compels him to hold the view that minds are able mutually to affect one another and transfer knowledge in the mental field. Of the physical phenomena he says little, but it is clear that he is not satisfied. He has not Mr. G. C. Barnard's faith in the investigator, for as Mr. Harry Price has put it, "sometimes it is the investigators themselves who play tricks"!

(3) Mr. Barnard, in his account of the supernormal, has clearly attempted to be both impartial and critical, but it is to be feared that he has not succeeded. The book is of some importance and interest for that reason. For it is a good example of the way educated and intelligent writers are being gradually accustomed through persistent propaganda to accept as established the reality of 'phenomena' for which there is scarcely a vestige of reliable evidence. Even Dr. Driesch, who calls himself a critical sceptic, declares that the experimental facts, in which telepathy and thought-reading unite, are quite certain. In support of his statement he quotes various publications, among them being the records of certain experiments in which there was no attempt whatever to enforce the most elementary control conditions. Similarly, in mentioning clairvoyance, he describes a recent case in such a way that it is difficult to think that he has even read it with care; and in support of his views on what he calls the "higher problems", he cites the work of two of the most dubious performers in sealed-letter reading and telepathic dermographism.

(4) Mr. Harry Price knows better. In this book on his psychic experiences he lets in the fresh air. With a humorous twinkle in his eye he takes us behind the scenes and shows us all the fraud and folly of the spiritualist racket. "Ninety-nine per cent of the phenomena which we hear about are due to fraud," he declares, and with the same half-serious, half-humorous air he takes us to see them. We visit Mrs. R. with her familiar, Dr. Lazarus, who raps in her thorax; Mrs. S., whose "teleplastic pseudopods" fade away when there is the possibility of their being seen; Mrs. Duncan, who, having visited the white sales, presents the results of her purchases—(well chewed)—to a gaping circle of psychical researchers; Little Peggy, the sweet child spirit, who turned out to be the medium's under-vest with a hole in it; and finally Mr. E., the famous "animated squib", whose luminous phenomena were going to overturn all our biological and physiological ideas on the subject. This person had long puzzled psychical researchers, but in 1924 it was discovered that a little ferro-cerium and a bit of steel would go a long way, and the revision of the biological sciences might be delayed. Ferro-cerium was found in 1924 and again in 1931, but the "squib" continues to emit sparks, although Mr. Price suggests that it might be somewhat damp by now.

In his book of four hundred pages Mr. Price will have told many all that they will ever wish to know about psychical research. A publicist, above all, he cannot refrain from exploiting the news value of his narrative. Thus his work loses that sense of proportion that would give it permanent value. The fact that he exposes one medium and gives another a certificate is of merely transitory interest. The major issues elude him.

It was only by ridding our ideas of the physical world of supernatural elements that order began to emerge out of chaos. It will be by the same process that we shall be able to understand the mental phenomena in witchcraft and modern spiritualism. Some progress has already been made. The hypnotic sleep is no longer considered to be the work of demons. There are even some psychical researchers who do not believe that all automatic writing is due to spirits. The need for inquiry and investigation is urgent. When that inquiry is carried out in accordance with the method which has already yielded such a rich harvest in other directions, progress will not long be delayed.

Phosphoric Esters in Metabolism

The Significance of Phosphoric Esters in Metabolism. By Prof. Robert Robison. (Christian A. Herter Lectureship on Pathological Chemistry, New York University.) Pp. ix+104+8 plates. (New York: New York University Press; London: Oxford University Press, 1932.) 8*s*. 6*d*. net.

THE importance of phosphorus in metabolism, both in its inorganic and organic forms, had long been recognised, but a new chapter in the understanding of vital reactions was opened by the discovery at the Lister Institute of the part played by compounds of phosphoric acid and sugar in the process of alcoholic fermentation. The painstaking researches of Harden and his assistants, begun just thirty years ago, have proved beyond doubt that the complex series of reactions which take place when sugar is fermented to carbon dioxide and alcohol involve at an early stage the formation of several phosphoric esters: it is these which break down to simpler products, setting free the phosphoric acid to take part once more in the series of reactions. From beer to bones is at first a far cry, but such has in fact been the sequence of discovery, for the knowledge of hexose phosphates, and the enzymes which serve to build and to destroy them, has enabled Robison to elucidate very largely the mechanism of bone formation. His achievement is no small one; it began with the discovery of an enzyme in the bones of young rats capable of decomposing phosphoric esters and so precipitating phosphoric acid salts *in situ*.

Prof. Robison has put his story together in book form after delivering three Herter lectures in New York. He discusses first the natural phosphoric esters in their broader aspect, next the calcification of cartilage and bone, and finally the calcification *in vitro*, this chapter being fully illustrated by drawings of sections, which afford the histological evidence for his deductions. Very properly, the story is told mainly from the more personal point of view, the author dwelling, as he states, on the problems which seem to offer some possibility of discovering how the esterification of phosphoric acid in plant and animal assists in the various processes of their metabolism. As a consequence the book is most stimulating, and it should be widely read, both by the many interested in this field, and by students as an example of a model series of researches.

There are two other classes of phosphoric esters which are to-day in the forefront of chemical interest, namely, the phospholipins, held to play an important rôle in the transport of fatty acids and in their oxidation in the animal body, and the nucleic acids, which are composed of a pentose joined to a purine or pyrimidine base and to phosphoric acid. There is evidently some definite co-ordination between phosphoric acid and carbohydrate in the cell which plays a leading part in initiating chemical change: it appears probable that a fuller understanding of these problems will not long elude the investigators who are so zealously studying them. E. F. A.

Short Reviews

Fishes: their Journeys and Migrations. By Prof. Louis Roule. Translated from the French by Conrad Elphinstone. Pp. x+270. (London: George Routledge and Sons, Ltd., 1933.) 12*s*. 6*d*. net.

THIS book, as its main theme, discusses the vital impulses dominating the periodic movements of certain species of fish. Throughout, the narrative is illustrative of the French aptitude for relating the incidence and play of the natural and external forces of Nature, whilst in harmony, at the same time, with imaginative conceptions and discriminative fancy. The depths of the sea and the waters of rivers include fish, for example, salmon, eels, shad, which form subjects for a story of events embodying descriptive skill and insight. Certain deep-sea fishes, the habits of which maintain adjustments to their environment, are considered, among these, cod, herring, mackerel, tunny. In a foreword Prof. Roule remarks that the migratory fish comes from the sea to the running water of the river under its own power; the migratory bird flies from one hemisphere to another, with only its wings to carry it.

A chapter, "At the Foot of the Dam", enables the author to adopt to good purpose an imaginary interchange of conversation with a chosen friend along a river-bank one spring morning in Brittany. The journey of the salmon is the topic; the dam is the rendezvous. "Beneath the blazing sun the water streamed over the dam evenly and without stopping. The great fish continued jumping, leaping . . . as though they tried to see beyond the dam what there was behind the barrier. And the object of this journey the production of young, the conservation and perpetuation of the species."

Prof. Roule is eager in support of the fascinating experiences of mackerel-fishing for the amateur

with a trailing line. Beginning when the dawn breaks, navigation under sail may itself be fertile in adventure. Recent extension of fishing with drag-nets and suitable appliances enables professional fishermen to operate in depths which are winter quarters for the species. Much has been heard lately of 'big game fishing' off the Dogger Bank. The tunny has a chapter to itself.

T. E. J.

The Mathematical Atom: its Involution and Evolution exemplified in the Trisection of the Angle. A Problem in Plane Geometry solved by Julius J. Gliebe. Third edition revised. Pp. iv+87. (San Francisco: St. Boniface Franciscan Friary; London: Technical Records, Ltd., 1933.) 10*s.* 6*d.* net.

THIS is an enlarged and beautifully produced edition of a pamphlet which has been circulated before under the simpler title "The Trisection of an Angle". Since Euclid cannot be supposed to have thought that he was giving anything but a selection of geometrical facts, it is legitimate to add to his postulates others that he did not perceive, and, in particular, to introduce the postulate that the author's construction is valid. This, of course, puts the matter beyond argument. The author relies on graphical evidence, and since his construction is in effect an identification of $\sin\alpha/(2+\cos\alpha)$ with $\tan\frac{1}{3}\alpha$, where α is one eighth of the angle to be trisected, it is not surprising that the evidence seems adequate. To do justice to the author's style, a quotation must be made: "I have the honor of introducing to the mathematical world"—on another page he speaks of "students of geometry and miscellaneous circles generally"—". . . a new kind of Triangle . . . The *Golden Mean Triangle* will serve to show that even the *scalene triangle* is not to be classed among the lower host of things, 'the loose, the lawless, the exaggerated, the insolent, and the profane' . . . It can be mathematically demonstrated that the scalene triangle is capable of being invested with a certain charm and comeliness distinctly its own, by being brought into perfect relation to the GOLDEN MEAN, which lies at the heart, or at least within easy reach of every blessed one of them—whether it be lank or plump, slender or buxom, microscopic or telescopic."

E. H. N.

Psychoanalysis To-day: its Scope and Function. Edited by Dr. Sándor Lorand. Pp. xv+370. (London: George Allen and Unwin, Ltd., 1933.) 18*s.* net.

THIS volume consists of a collection of twenty-five contributions from various representative psychoanalysts; and, while for the most part concerned with general (Freudian) psychoanalytical theory, deals also with its applications to mental hygiene and education, nervous and psychic ailments, anthropology, religion, literature and criminology.

Psychoanalysts are nothing if not enthusiastic for their theories, and the writers of these chapters are no exception to the rule. The topics are not critically treated, but are handled in an expository and didactic manner, and should prove of interest to many others than physicians and professional psychologists as giving a bird's-eye view of the very extended field that psychoanalysis seeks to cover. The reader may find that he cannot agree with all the interpretations of fact that are given and all the claims that are made for the Freudian theories, but he can scarcely fail to discover that they are not merely "pansexualism" but contain many grains of valuable truth.

Applied Gyrodynamics: for Students, Engineers and Users of Gyroscopic Apparatus. By Prof. Ervin S. Ferry. Pp. xiv+277. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 25*s.* net.

SINCE the days of Kelvin, gyrodynamics has exercised a fascination on the minds of a small but powerful group of mathematicians, and it is pleasant to see that interest maintained and to record the publication of a volume dealing with the subject which concerns itself with the spins of bodies of molar magnitude and is not at all exercised about the spins of sub-molecular masses.

Prof. Ferry begins at the beginning with a chapter devoted to definitions and to the principles of elementary dynamics. He then gives sixty pages to a consideration of the motion of a spinning body under the action of a torque, and in the remaining chapters applies the principles so developed to the gyroscopic pendulum, gyroscopic anti-roll devices for ships, navigational compasses and gyroscopic stabilisation.

A most useful book, giving a sound training in the principles of rigid dynamics and some of the most important of its applications.

A. F.

Makers of Astronomy. By Dr. Hector Macpherson. Pp. vii+244+8 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 7*s.* 6*d.* net.

THIS little book contains the substance of two courses of lectures given at the Royal Technical College, Glasgow, in 1930–32, dealing with the lives and work of astronomers from the time of Copernicus down to the present time. It is divided into eight chapters, entitled "The Pathfinders"; "Isaac Newton"; "After Newton"; "The Herschels"; "In Herschel's Footsteps"; "Pioneers of Astrophysics"; "Watchers of the Skies"; and "Explorers of the Universe".

Though the book is intended to be of a more or less popular character, and will therefore be of interest to amateur astronomers, the notices of modern work will be valued by many. There can be few writers more intimately acquainted with the biographical side of astronomy than Dr. Macpherson, and we are glad to be able to place this volume side by side on the shelves with his "Astronomers of To-day", published twenty-eight years ago.

Seasonal Weather and its Prediction*

By SIR GILBERT T. WALKER, C.S.I., F.R.S.

THE economic importance of seasonal weather is obvious to most men who have lived in the tropics, and its scientific problems are full of interest. Unfortunately there is an additional motive for study, the threat of dangers ahead. For the difficulties of long-range forecasting are not in general adequately recognised, so that some of the most progressive countries in the world are inclined to make predictions on an insecure basis; their technical staff does not realise that though the prestige of meteorology may be raised for a few years by the issue of seasonal forecasts, the harm done to the science will inevitably outweigh the good if the prophecies are found unreliable.

In a country where conditions are so changeable from day to day as they are in England, it is natural that we should think in terms of wet or fine days rather than of wet or dry periods; but in the greater part of the British Empire the different seasons are much more sharply defined, and so their dominant features stand out more clearly. Also the variability of their seasons from year to year is in general materially greater than here.

In agricultural countries in which a failure of the rains involves a national calamity, the desirability of making preparations in advance led long ago to efforts at prediction; and the demand has been so great that the supply has been forthcoming before its quality would bear the most cursory examination. The causes of unusual seasons seem hopelessly obscure to the layman; and hence primitive ideas, surviving in the depth of our natures from untold ages of magical practices, still come to the surface in connexion with it. The almost universal idea that weather must repeat itself after a certain number of years finds its origin, I imagine, ultimately in the ancient belief in the control of our affairs by the heavenly bodies with their definite cycles—a belief which clearly shows itself in the supposed influence of the moon on the weather. Be that as it may, the faith in periods is so deep-seated that even in scientific discussions the ordinary tests for validity are very often ignored: more than once I have seen in journals of repute the artless remark of an author that if he were to limit his methods to those which would satisfy the criteria of reality, he would obtain few results of interest!

It will be convenient if I may here introduce a technical phrase. If we have series of values of two factors the variations of which are connected, there will be a certain proportion of the variations of each which are associated with those of the other, and this proportion is called the correlation coefficient between the series. If it is nearly unity the numbers vary closely together; if it is small there is little relationship between them; and if it approaches −1 the relationship is close, but one series goes up when the other goes down.

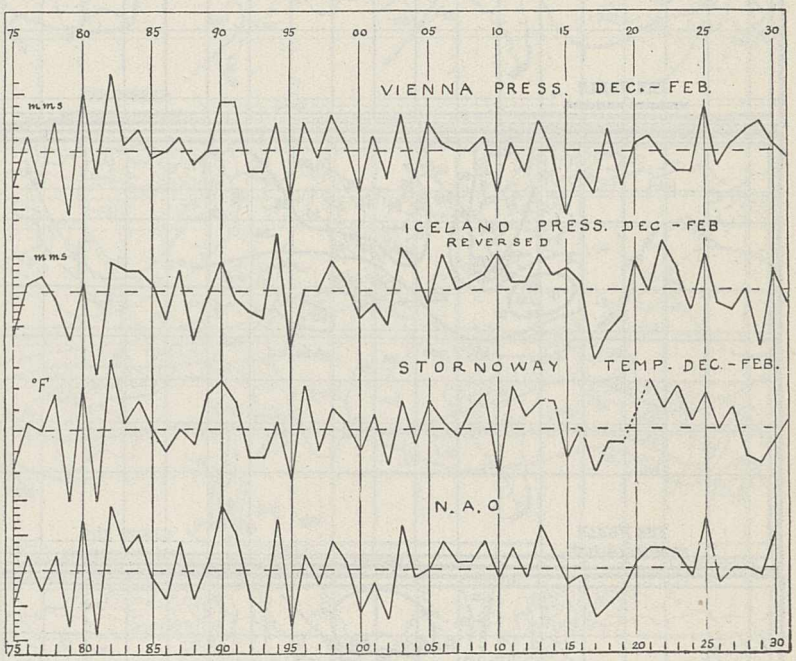

FIG. 1. N. Atlantic oscillation.

Let us now consider some of the results of the analysis of seasonal features. It has long been known that in the North Atlantic Ocean there are two types of winter. In one, pressure is high near the Azores and south-west Europe, and low in Iceland, while temperatures are high in north-west Europe; in the other type, all these features are reversed. (See the three upper graphs in Fig. 1.) Let us plot the variations in successive winters, December to February, of the quantities which increase together, such as Vienna pressure and Stornoway temperature, and also of the quantities which decrease when the former increase, such as Iceland pressure, reversing the latter so as to secure similarity of the graphs. We could then draw a graph which is the mean of all, and could

* From the presidential address before Section A (Mathematical and Physical Sciences) of the British Association at Leicester, delivered on September 8.

regard it as expressing the variations of the North Atlantic fluctuation as a whole. (See the lowest graph of Fig. 1.)

Now instead of graphs we actually use numbers. Having found by preliminary investigation the stations which are most representative, we calculate the figures in successive years for the North Atlantic oscillation as a whole, and then work out the correlation coefficients of this with the pressures, temperatures and rainfalls of all the places in which we are interested. These coefficients are plotted in Fig. 2, in the top chart of which we see that the rise of pressure with a positive fluctuation is greater so far east as Vienna and so far west as the Bermudas than it is at the Azores. There is also to be seen in the second chart conspicuous warmth in the east of the United States as well as in north-west Europe, and marked cold to the south-east of the Mediterranean as well as along the north-east of North America. On rainfall, in the lowest chart, the influence is less widespread.

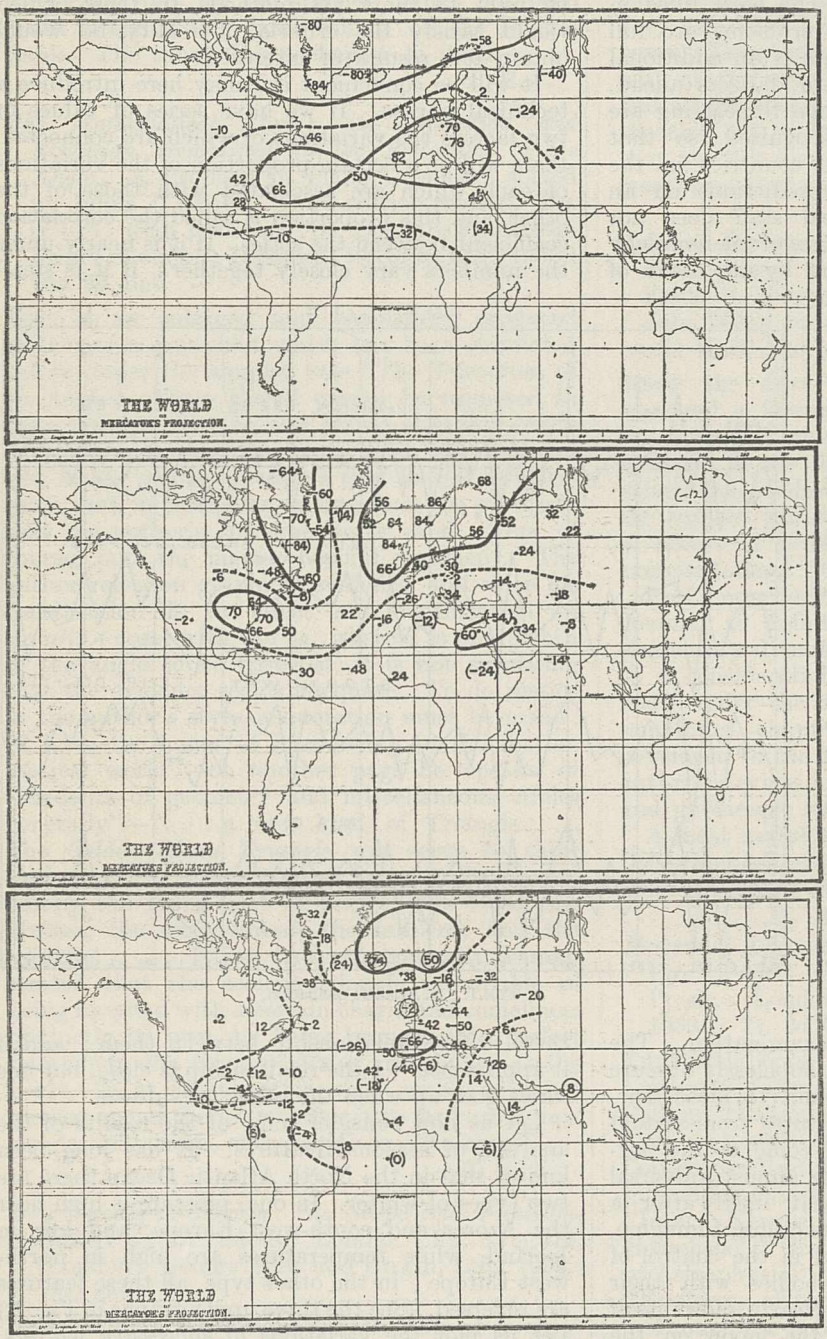

FIG. 2. Relations of N. Atlantic oscillation with contemporary pressure, temperature and rainfall of December to February. Numbers based on series shorter than 30 years are in brackets; those for areas are in circles.

The North Pacific Ocean, in spite of its limited access to the Arctic seas, is subject to fluctuations very similar to those of the North Atlantic. A similar treatment shows that increased pressure gradients go with high temperature to the north-east and south-west, and low temperature to the north-west and south-east.

The largest known system of related seasonal weather is that called the 'southern oscillation' (or 'southern fluctuation'), which has features in the southern summer of December–February (Fig. 3) somewhat different from those of the southern winter of June–August. At both times of the year the fluctuation is called positive when pressure is high in the southern Pacific and low in the Indian Ocean, and temperature is mostly low in the tropics; but the economic importance is in connexion with rainfall, for the fluctuation has a correlation coefficient of more than 0·8 with the summer rainfall of north-east Australia, more than 0·7 with the monsoon rainfall of India and with the Nile floods, 0·6 with the rainfall of large areas in South America, and more than 0·5 with that of a region in South Africa.

A surprising fact comes out on comparing the numerical series giving the characteristics of the summer and winter values of this fluctuation, the control of the southern winter on the succeeding summer being expressed by a coefficient of 0·82.

The immediate effect of this is that numerical values of the winter oscillation give us a means of predicting three months in advance, at any rate approximately, the summer values of the oscillation and therefore of the pressure, temperature and rainfall associated with them. We can plot the relationships of the values of the pressure, temperature and rainfall of December to February, with the numbers indicating the fluctuation of the previous June to August: and we get a diagram like Fig. 3 but with coefficients reduced to about four-fifths of the size. These express relationships which have held for about fifty years, and show that we have arrived, not at a mathematical figment, but at a physical reality that should have commercial value.

This method of prediction can be improved on by study of the relationships of individual areas. For example, the coefficient of 0·64 of rainfall of north-east Australia with the oscillation of the previous winter becomes 0·79, when we base it on previous pressure at Honolulu, Port Darwin and South America; a comparison of the actual rainfall with that given by the formula is shown in Fig. 4. Similarly, the 0·56 of South Africa becomes 0·72. But a certain amount of the improvement effected in this way by selecting the biggest factors is bound to be fictitious, even when there appear to be adequate independent reasons for thinking that the relationships are real; and, if this precaution is ignored, the more promising the formula, as indicated by the closeness of its apparent relationship, the greater is the likelihood of disappointment.

It must be admitted that a real control of 0·7 by previous conditions is about as good as is now available for forecasting, and the difference between the actual and the forecast amounts will still be considerable; so predictions can only be issued with restraint if public confidence is to be won. The natural consequence is silence, except when the indications are markedly favourable or unfavourable.

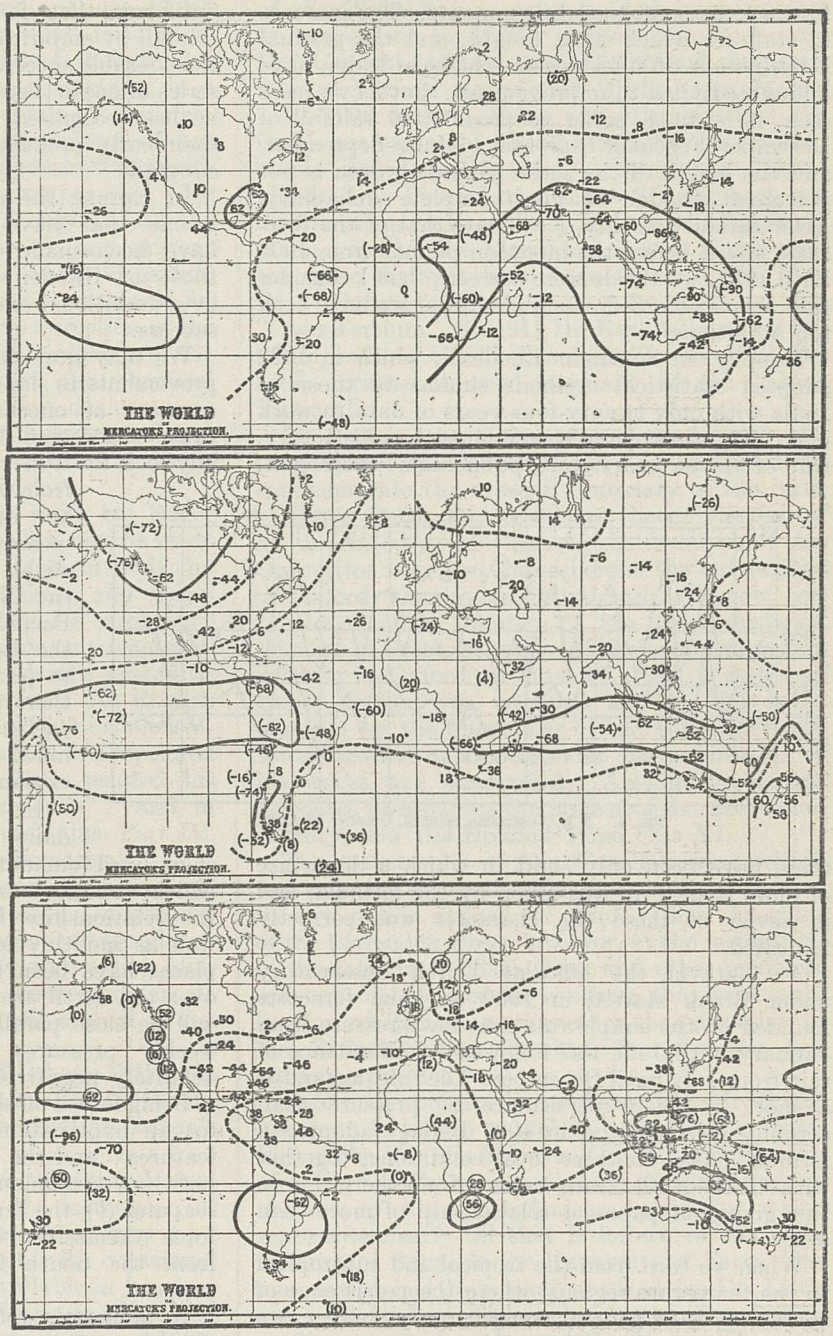

FIG. 3. Relations of southern oscillation of December to February with contemporary pressure, temperature and rainfall.

Let us now turn from the academic to the practical, and see how far these theoretical methods justify themselves in actual experience. I believe that the earliest regular seasonal forecasts based on meteorological instead of astrological data were those of the Indian monsoon of June–September, started half a century ago in India by H. F. Blanford, and depending mainly for their success on the ill-effect upon the monsoon of excessive winter or spring snowfall in the

Himalayas. Eliot continued the monsoon forecasts from 1887 until 1903, but data in those days were scanty; he attempted far too much detail, his mode of expression was somewhat pontifical, and the newspapers became sarcastic; so latterly he sought immunity from criticism by printing the forecasts as confidential documents. The increase of staff for which Eliot fought, and the gradual introduction of statistical methods in India, have undoubtedly led to improvement; but as we have seen, it is much easier to predict the rainfall of December–February than that of June–September, and the length of the series of Indian data is not yet great enough to give complete reliability. After careful scrutiny, I estimate that of the forecasts issued before the monsoon periods from 1905 until 1932 two-thirds were correct; but I consider that this is not good enough and that we have been too ambitious.

Happily, in Southern Rhodesia, which in 1922 adopted statistical methods similar to those of India with only twenty-four years of data to work upon, the results have been eminently satisfactory. Out of eleven years since publication was begun,

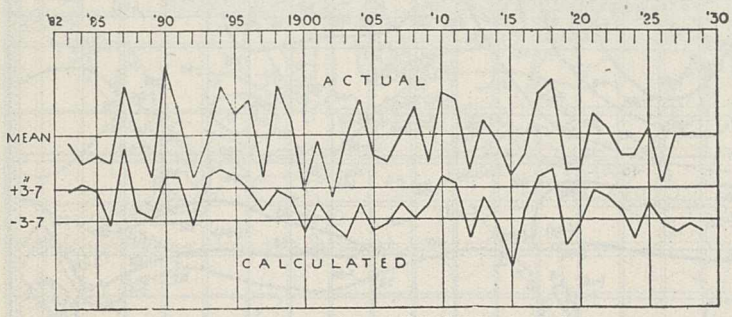

FIG. 4. N.E. Australian rainfall, October to April.

there have been only eight in which a departure of more than 3 in. was given by the formula, and in seven of these the character was correctly indicated.

At Batavia, the efficient Dutch observatory under Braak started in 1909 to issue forecasts founded on the simple rule that low pressure from January until June was followed by abundance of rain from July until December. The rule demanded a more complete persistence of pressure than actually prevails, and in 1927 Berlage adopted a formula based on three local conditions, together with data of the rare rains of northern Peru: this gives, on paper, a relationship of more than 0·8.

When we turn from the tropical and subtropical to the temperate regions, where the persistence of conditions is in general conspicuously smaller, we must expect greater difficulties in making long-range forecasts. In America the relations between weather and crops have probably been worked out more scientifically than in any other country, so that the commercial value of reliable prediction has long been recognised; and not only by farmers, but also by those interested in water supply, in power schemes, in transport and in commerce generally. Thus one of the Californian hydro-electric companies makes its own forecasts, because it may spend four million dollars more for crude oil in a dry than in a wet year.

Undeterred by the difficulties, G. F. McEwen, of the Scripps Institution of Oceanography in California, has for some time been forecasting rainfall by empirical methods, and at first attained considerable success, largely on the basis of a short series of ocean temperatures. These, however, as he has recognised, have not of late made good their early promise, and new methods have been adopted.

In Europe the only seasonal forecasts known to me that have a scientific foundation, and have been made for a number of years, are those of Sweden and Russia. They are not over-ambitious and have met with gratifying success.

We may now pass to the consideration of improvements in our methods, and the fundamental question at once arises: What is the physical cause of seasonal fluctuations? We should naturally look for it in variations in the energy received from the sun, and it is surprising that an increase in solar activity as measured by sunspots produces a slight decrease in the circulations in the North Atlantic and the North Pacific. In the southern fluctuations the tendency of numerous spots is to produce positive values, but even there the biggest seasonal correlation coefficient is only 0·26, which is much too small to provide the explanation that we seek.

In order to ascertain whether daily pressures are produced by short-lived emanations from the sun, like those which produce magnetic storms, tabulations of the relationships between daily and weekly, as well as monthly and seasonal, values at distant places have been made; for if the daily values over the earth are controlled from outside, there will be close parallelism between these daily and weekly pressures. But the result has been definitely negative.

Being forced off short-lived phenomena, we search for an explanation in terms of slowly changing features; and the variations from year to year in both (*a*), the amount of pack ice in the antarctic sea, and (*b*), the temperature of the Pacific Ocean, force themselves on our attention. But data from the South Orkneys and Samoa give no support.

A moment's reflection will convince us that there is ample scope for new developments. There are variations of rainfall over large areas, which are scarcely affected by the three big fluctuations; and there are indications of pressure fluctuations in the antarctic which have not as yet been adequately explored. Thus any who may be tempted to tackle the problems will find no lack of material.

The Writings of Roger Bacon

WHILE the work of St. Albert the Great (Albertus Magnus) and St. Thomas Aquinas has been printed in its entirety many times, Bacon (1214–92) is known to us by a small fraction of his teaching. His independence of thought, his insistence on observation and experiment as a check on the Aristotelian teaching of the day, while they are one of the chief sources of our interest in him, were principal causes of the opposition he aroused among his contemporaries. He was the first man in modern Europe to see the need for accurate study of foreign and ancient languages, and to lay down the canons of textual criticism. His work on optics was a textbook for two centuries. He advocated the correction of the calendar. He was the first geographer of the Middle Ages. He systematised the chemical knowledge of his time, and attempted a complete theory of chemical change. But these were claims on posterity, they did not fit in with the ideals of the educational system of his day.

The first publication of any work by Roger Bacon was his "De secretis operibus naturæ et de nullitate magiæ", printed at Paris in 1542 by Oronce Fine, and many times since, and translated into French and English. Its popularity was probably due to Bacon's repute as a magician.

In 1590 the treatise "De retardandis senectutis accidentibus" was printed in Oxford. An English translation appeared in 1683. In 1603 his alchemical works were printed at Frankfurt, and reprinted in 1620. In 1614 John Combach printed his "Perspectiva", and his "De speculis"; and in the same year a part of the Opus Majus, Part IV, under the title of "Specula Mathematica".

Towards the middle of the seventeenth century, Sir Kenelm Digby formed the intention of printing the complete works of Bacon, and a correspondence with Selden and Langbaine, who were aiding him, shows that some progress had been made in its preparation, but Digby's death put an end to the project.

In 1689 Wharton's edition of Usher's "Historia Dogmatica" and in 1705 Hody in "De Bibliorum Textibus" made considerable extracts from Bacon's criticism.

In 1733 Samuel Jebb printed the Opus Majus, Parts I–VI, omitting VII, at the instigation of Dr. Richard Mead, from a sixteenth century copy of a fifteenth century manuscript, with occasional use of the earlier manuscripts available in London. This edition was reprinted in Venice in 1753, and formed the basis of Dr. Bridges's edition of 1897.

In 1848 Victor Cousin directed attention to the considerable mass of unpublished treatises preserved in the Amiens manuscript, printing the chapter headings. In 1859 J. S. Brewer printed in the Rolls Series the "Opus Tertium", "Opus Minus" and the "Compendium Philosophiæ". In 1861 Emile Charles, in his life of Bacon, printed a number of extracts from unpublished manuscripts. In 1897 Dr. Bridges issued a new edition of the Opus Majus, supplemented by a volume of corrections in 1900. Almost simultaneously Dr. Gasquet printed an unpublished fragment from a Vatican manuscript of the Opus Majus.

In 1902 Messrs. Nolan and Hirsch issued the Greek grammars of Bacon. In 1906 Mr. Robert Steele issued at his own expense the "Metaphysica" as Fasc. I of a series "Opera hactenus inedita Rogeri Baconi". This was afterwards taken over by the Clarendon Press. Since then ten more fascicles have been issued. In 1909 Prof. Duhem printed a new fragment of the "Opus Tertium". In 1911 Dr. Rashdall printed the "Compendium Studii Theologiæ". In 1912 Dr. Little printed a new fragment of the "Opus Tertium".

In 1913 a committee was formed, with the president of the Royal Society as chairman, to commemorate the seventh centenary of the birth of Roger Bacon and to ensure the publication of his unprinted works. Among the members of this Committee were the Chancellors of the universities of Oxford, Cambridge, Edinburgh, Glasgow and London, and a number of the chief medieval scholars of Great Britain. At the commemoration meeting in Oxford on June 10, 1914, a statue of Roger Bacon was unveiled at the University Museum by the Chancellor of the University and the formation of a society for the publication of his works was announced. Among the foreign delegates present was the prefect of the Ambrosian Library, now His Holiness Pope Pius XI.

The catastrophe of the War, following within two months, diverted all energies and put an end to any public appeal for funds. The delegates of the Clarendon Press, however, at the inspiration of the late Sir William Osler and other medieval scholars, determined to continue the serial publication of Bacon's works under the editorship of Mr. Robert Steele, of which four fascicles had already appeared.

Before the publication of Fasc. VII, Mr. Steele had been fortunate enough to enlist the co-operation of the Rev. F. Delorme, O.F.M., now superior of the great Franciscan College at Quaracchi, in the task of editing the Amiens manuscript, which represents nearly all that is known of the early teaching of Bacon in the University of Paris. The manuscript had been photographed for Dr. Little and used by Prof. Duhem before the War, but its study presented serious difficulties. The four fascicles already published of treatises contained in the manuscript are invaluable as representing the current train of thought in Paris at the close of the first half of the thirteenth century. Two more remain to be published to complete a task the difficulties of which can scarcely be overestimated.

The portions of Bacon's writing that have already appeared in the "Opera hactenus inedita", Series I–XI, amount to more than two thousand pages of text with introductions and notes, including a verification of the quotations from Aristotle and other authors. This is a greater amount of Bacon's writings than all his previous editors together have published. The introductions include two monographs, on the "Secretum Secretorum" and on the calendar. In addition, a number of illustrative texts have been printed for the first time, including the earliest Latin version of Aristotle's metaphysics. They have been copied from the manuscripts by the editor, except the medical works edited by Dr. Little and Dr. Worthington.

When in 1931 the Delegates of the Clarendon Press were forced to suspend for a time the issue of Bacon's unpublished works, they had in their hands the texts for two fascicles—the "De Causis" of some 165 pages of text and the second "Physics" of some 420 pages, which would have completed the editing of Bacon's lectures at Paris preserved in the Amiens manuscript.

In addition to these, texts are ready for printing of two of Bacon's logical treatises, amounting to 220 pages, his alchemical treatises 150 pages, and his "Communia Mathematica" more than 300 pages.

There remain to be copied—the "Summa Grammatice", estimated at 150 pages, the "De somno et vigilia", estimated at 100 pages, and the "De sensu et sensato", estimated at 150 pages.

The "Compendium Theologiæ", Part V, and the "De Principiis Naturæ" have been copied out, but the problem of their relationship to the "Communia Naturalium", of which they reproduce parts, still remains for investigation. If printed in their entirety they would amount to 200 pages or less. There are in addition to these a few fragments amounting to twenty pages at most.

This will conclude the work of publication, with the exception of works only to be found in the Vatican library, the publication of which Monsignor Pelzer has reserved to himself since their discovery in 1914. They are: (1) the missing part of the Metaphysica (Fasc. I); (2) missing parts of the Opus Minus (mainly alchemical); and (3) the remainder of the Opus Majus, Part VII. They are to be published in the "Studi e Testi".

Exclusive of these, there thus remain to complete the publication of Bacon's works about 1,900 pages, say six fascicles, of which more than 1,250 pages could go to press at once. The Delegates have not at present been able to undertake their production beyond Fasc. XII, which will be issued early in 1934.

It is scarcely too much to say that the completion of this work, so well begun, depends on the life of the present editor, who is in his seventy-fourth year and has made the study of Bacon his principal object for many years.

Obituary

Sir Alexander Houston, K.B.E., C.V.O., F.R.S.

WITH the passing of Sir Alexander Houston on October 29, the world of water purification has suffered a very severe loss. During the first three decades of the present century his name has dominated all questions relating to the scientific treatment and purification of water, and the world-wide reputation which he rapidly came to enjoy was abundantly earned and more than deserved. His passing is a no less severe loss to the large circle privileged to enjoy the personal charm of his friendship; and the debt owing for the kindly help which has emanated from him can now only be repaid to posterity.

Having been born in 1865, Sir Alexander Houston almost attained the allotted span, and it may be said of him that, unlike many other great men, he lived to see the fruition of his early labours. After taking his medical qualifications at Edinburgh in 1889, he devoted himself for a few years to post-graduate work there in the field of public health. Fortunately he was able to apply this work in the service of the Local Government Board, and we early see his footsteps directed into the paths which were ultimately to lead to such great heights.

Perhaps Houston's first scientific work connected with water was an investigation of moorland waters in relation to lead poisoning, which he carried out for that Board. The work extended over several years and the reports are to be found as appendices to the annual reports of the Medical Officer of the Local Government Board. Other work in public health problems which he carried out at the same period was all characterised by the same painstaking thoroughness which is evident in the reports on moorland waters. We note in this work, which related to such subjects as water-cress, milk, shellfish and sewage, the evolution of the trained bacteriologist and a gradual accumulation of experience, which made Houston the man most eminently fitted to undertake the great and responsible work of watching over the purity of London's water supply, which was entrusted to him by the Metropolitan Water Board in 1905. Mention should also be made of the valuable contributions which he made to our knowledge of sewage disposal problems whilst he acted as bacteriologist to the Royal Commission on Sewage Disposal appointed in 1898.

Throughout this period of Houston's service with Government departments on public health matters, one recognises that the application of bacteriological science was the keynote of his investigations, but it was not as the mere specialist that he looked at these problems. His outlook was of the widest and was seasoned with that

romanticism which is a necessity to the preservation of a well-balanced scientific mind. In this connexion his later annual reports to the Metropolitan Water Board, and especially "The Romance of the New River", which was included in his annual report for 1926, are specially worthy of perusal.

With reference to Houston's work since 1905, no phase of water purification has been left untouched, and his annual reports and research reports furnish an inspiration to the student and a fund of valuable information to the specialist. His scientific work since 1905 was characterised by several outstanding features. In the first place we owe to Houston the first attempt at the scientific rationalisation of the bacteriological examination of water, and his classification of the various types of *B. coli* conveyed in the word 'flaginac' serves to indicate his profound interest in the minutest detail. One of the last scientific services which Houston rendered to the Government was to serve on a small committee which is endeavouring to secure a greater uniformity in the bacteriological examination of water supplies. The practice of the Metropolitan Water Board laboratories has been largely adopted in other laboratories, but there is nevertheless a want of uniformity throughout Great Britain which Houston deprecated. His investigations into the beneficial effects of 'storage' on polluted river waters are classic, and his 'excess-lime' method of treating water in order to render it safe for human consumption is now the basis of the treatment of the river water supplied to the growing population served by the Southend Waterworks Company.

One may be permitted to doubt whether the immense economic saving resulting from the introduction of chlorination has even yet been realised, but it is to Houston that the development of this method of water treatment is to be ascribed. It was at Lincoln during a typhoid epidemic in 1905 that Houston, with the assistance of his colleague Dr. G. McGowan, first used bleaching powder on a large scale for the treatment of a water supply in Great Britain and it was at that time regarded as an emergency measure. Later experience has confirmed chlorination as an established line of defence in the forces which are marshalled to safeguard the purity of our water supplies; moreover, its introduction has in many cases resulted in large economic savings either by avoiding large expenditures on pumping, by allowing filter beds to be renewed at less frequent intervals, or in other ways. It is most instructive to visit the chlorination plants of the Metropolitan Water Board; they afford a valuable object lesson of the minute attention which has to be given to safeguarding the purity of a water supply.

With the introduction of chlorination to overcome one difficulty, Houston found himself faced with another in the precautions which had to be taken to avoid taste and odour in the chlorinated water. This difficulty has now been overcome, thanks to a good deal of painstaking research carried out in the Metropolitan Water Board laboratories, and such expressions as superchlorination, de-chlorination, chloramine treatment serve to call these experiments to the mind of those engaged in dealing with water supply problems. Houston's investigations into the rapid filtration of river water are likely to have a very extended application which will result in very large economies in expenditure on water purification. By these experiments a revolution has been effected in the method of slow sand filtration introduced by Simpson more than a hundred years ago. By the rapid pre-filtration of water through sand, an effluent can be produced which can then be treated at a comparatively high rate on existing slow sand filters and in this way a perfectly safe water can be obtained. The filter house of the Metropolitan Water Board at Kempton Park has Houston's pre-filtration studies as its foundation, and further extensions in this direction are now contemplated by the Board.

Enough has been said to indicate how monumental have been Houston's contributions to our knowledge of water treatment, and his fertile ideas contributed to the maintenance of the health not only of the Metropolis which he served directly but also of the whole of the civilised world. He unreservedly placed his knowledge at the disposal of the Water Pollution Research Board of the Department of Scientific and Industrial Research, having been invited by the late Lord Balfour to serve as a member of the Board when it was formed in 1927.

Houston's personal charm compelled the loyalty of his staff, who mourn his passing and who during the past quarter of a century laboured not in vain. The results of these labours have been freely published to the world and they form a solid foundation on which to build in the future. Reference should be made to his valuable monographs: "Studies in Water Supplies", 1914; "Rivers as Sources of Water Supply", 1917; "Rural Water Supplies and their Purification", 1918; and to his annual and research reports as Director of Water Examination to the Metropolitan Water Board. As already stated, Houston lived long enough to see the fruition of some of his work, and in such cases it falls to the lot of a great man to be honoured in his own time. These honours he appreciated; his fellowship of the Royal Society in 1931, and the recognition bestowed upon him by his old University so late as the end of June of this year, afforded him special pleasure.

A great man has passed away. H. T. C.

WE regret to record the death on October 29, two days after reaching his sixty-first birthday, of Dr. Jan B. Novak, general secretary of the Czech Academy of Science. Dr. Novak had made a study of the history of science in Central Europe and was an authority on the period of Rudolf II (1576–1612).

News and Views

Sir Gilbert Walker, C.S.I., F.R.S.

THE Royal Meteorological Society has awarded the Symons Gold medal for 1934 to Sir Gilbert T. Walker. The medal is awarded biennially for distinguished work in connexion with meteorological science and will be presented at the annual general meeting of the Society on January 17, 1934. Sir Gilbert was senior wrangler (1889), fellow and lecturer in mathematics at Trinity College, Cambridge, and Adams prizeman in 1900. He is author of many works on dynamical aspects of physics, including problems relating to the electromagnetic field and similar subjects, and meteorology. He has published numerous pioneer papers through many years on correlation as a means of dealing with seasonal variations of weather, and for forecasting the Indian rains. These papers have culminated with contributions on "World Weather" in *Memoirs of the Royal Meteorological Society*. Extracts from his presidential address before Section A (Mathematical and Physical Sciences) of the British Association meeting at Leicester on September 8, appears in this issue of NATURE (p. 805).

FOR twenty-one years, Sir Gilbert Walker was director of one of the chief meteorological services of the world, and in difficult circumstances. Although cut off from ready communication with meteorologists in other parts of the world, the India Meteorological Department, under his direction, made important contributions to the furtherance of weather science. The functional success of a large weather department depends so much upon cordial relations between staff and administrative head, and especially upon a sense of efficient direction, that it may be relevant to quote from a Government of India Report relating to Sir Gilbert's retirement from India :—". . . For him personally the whole department retains the liveliest affection and regard ; his kindly sympathy tided over many a period of depression in work, and his enthusiasm, strong sense of reason, and grasp of the true bearings of emerging results were responsible for the noteworthy advances which marked his regime". Sir Gilbert has been president of the Royal Meteorological Society, and since retirement from India has, as professor of meteorology in the Imperial College, actively carried on his weather researches.

Prof. Emile Borel

PROF. EMILE BOREL, who has just delivered a course of three lectures on applications of statistics to economic and meteorological forecasting at the London School of Economics, is a man of many talents and of distinguished achievements in the fields of mathematics and politics. To mathematicians he is known as a master of the theory of probability and the theory of functions, on which he has written many books, while politicians acknowledge him as one of the prominent deputies of the French Chamber and an enlightened Minister of Marine. Prof. Borel's mathematical genius revealed itself very early. Born in 1871 at Saint-Affrique, a village in the Aveyron of which he is mayor, he studied at the Ecole Normale Superieure, Paris, taking his degree of doctor of mathematics in 1894. A few years later, he won successively the four much coveted prizes offered by the Academy of Sciences (Grand Prix des Sciences Mathématiques, Prix Vailland, Prix Poncelet and Prix Petit d'Ormoy). He was not forty years of age when he entered the Paris Academy of Sciences, of which he will be installed as president in January next. An honorary doctor of Trinity College, Dublin, he has a large number of distinctions from various universities and scientific institutions. He is honorary director of the Ecole Normale Superieure, and professor of the calculus of probability and mathematical physics in the University of Paris.

Proposed New Ascent into the Stratosphere

DR. M. COSYNS is actively preparing for a new ascent to the stratosphere. He has just completed a short visit to England when he visited Prof. P. M. S. Blackett of Birkbeck College, Prof. W. Wilson of Bedford College and the laboratory of Lord Rutherford in Cambridge for the purpose of discussing some technical details of his venture. Dr. Cosyns went up with Prof. Piccard on the second ascent last year of the latter. A former pupil of the eminent Belgian scholar, Dr. Cosyns is a qualified engineer and is attached to the research laboratory of the "Fondation Medicale Reine Elisabeth" in Brussels. During the twelve hours he spent with Prof. Piccard in the stratosphere, he was in charge of the instruments fixed in the gondola for observational purposes. The results obtained have confirmed those obtained by other methods by Millikan and Regener. The three important conclusions reached were : (1) variation of ionisation with atmospheric pressure has been established with precision up to an altitude of 16,500 metres ; (2) the equivalent (in mgm. Ra. $m.^{-2}$) of cosmic radiation is about three times as great when measured by the counter method as that observed when the ionisation method is used ; and (3) the counters indicate that the cosmic rays do not come from any specific direction. Incidentally, Prof. Piccard and M. Cosyns carried out some interesting observations in other fields. An account of the main results obtained during Prof. Piccard's two ascents is given in the *Bulletin de l'Académie Royale de Belgique* (*Classe des Sciences*) under the title "Etude du rayonnement cosmique faite à bord du F.N.R.S. par M. Cosyns, P. Kipfer et A. Piccard" (**19**, No. 2, 214–240 ; 1933).

MANY anticipated results, however, were not obtained, so Dr. Cosyns proposes going up again next April. He will be accompanied by an assistant, as Prof. Piccard will not take part in the expedition. The two principal problems will be : (1) to examine the direction and intensity of the cosmic rays and (2) to get some good records of the effects of cosmic

radiation by means of a Wilson chamber. Special instruments have to be designed, not only to suit the experiments, but also to fit into the tiny gondola of the balloon. Dr. Cosyns's visit to England was in connexion with this practical side of the preparations. In other fields, Dr. Cosyns plans to investigate, during his ascent, the energy of the total radiation of the sun, in order to determine the calorimetric intensity and the pressure of light of the sun. He will also collect, at various altitudes, samples of air for subsequent analysis. Another practical problem he has to solve is how to enable his balloon to ascend uniformly and slowly, and how to stabilise it eventually at certain heights, his reason being that taking observations during the rapid ascent of the balloon cannot be accurate enough to allow him to draw any final conclusions. Of course, once the balloon has reached the stratosphere, it is almost perfectly steady.

Anniversary Meeting of the Royal Society

IN connexion with the anniversary meeting of the Royal Society which will be held on November 30, when the medals for the year will be awarded (NATURE, November 11, p. 740), it is interesting to note that in the allotments of one hundred years ago, November 30, 1833, the Copley medal was not awarded. The Royal medals bore, for the first time, on the obverse, the effigy of King William IV, his Majesty having confirmed and continued the royal grants of George IV, his predecessor. At this anniversary meeting, however, the ten Royal medals adjudged during the lifetime of George IV were available for distribution to the original recipients, or their representatives, who were able to attend, this curious anomaly being due to the circumstance that the dies had never been completed, for reasons beyond the control of the Royal Mint. The names of the selected men of science in the different periods were: Dalton and Ivory (1826); Davy and Struve (1827); Encke and Wollaston (1828); Charles Bell and Mitscherlich (1829); Brewster and A. J. Balard (1830). Royal medals were not given in 1831 or 1832. The recipients of the Royal medals for 1833 were (1) Prof. A. de Candolle, of Geneva, for his valuable researches and investigations in vegetable physiology, as detailed in his work "Physiologie Végétale", and (2) Sir John F. W. Herschel for his paper "On the Investigation of the Orbits of Revolving Double Stars", published in the *Memoirs of the Royal Astronomical Society*. Herschel was at the time at the Cape of Good Hope. The foregoing medals were presented by the president, H.R.H. the Duke of Sussex.

Action of Radium on Malignant Cells

DURING the past year, the Imperial Cancer Research Fund has lost the help of two of its most distinguished officers—Sir Frederic Hallett, who has acted as secretary since the initiation of the scheme, and Sir George Makins, who has for many years been its treasurer and wise counsellor. The report of the director discloses another period of steady progress, mostly, at the moment, in analysing the ways in which radium affects cancer cells. To some degree the influence of radiation is indirect, and the tumour cells are destroyed by their blood supply being cut off owing to the action of the radium on the vessels of the host. But there is also a direct action on the cells themselves, and Dr. Cramer and Mr. Crabtree have been concerned in attempting to analyse this by finding how far the influence of radium is modified by treating the cells with other reagents. If their results do not solve the problem, they show at any rate that it is of unexpected complexity. Thus hydrocyanic acid and low temperatures increase susceptibility to radium, while absence of oxygen increases resistance. Both hydrocyanic acid and anaerobiosis produce increased glycolysis, whence it appears that radium does not act via the glycolytic mechanism. This is corroborated by the discovery that iodoacetic acid and sodium fluoride, which inhibit glycolysis, have no influence on the resistance to radiation. It is also of interest to note that Dr. Ludford's distinction between normal and malignant cells, based on the inability of the latter to segregate trypan blue, has turned out not to be universally applicable, so that it is still true that no one has defined any criterion by which a cell as such may be known to be malignant.

The Study of Insects

PROF. G. D. H. CARPENTER delivered the first part of his inaugural lecture as Hope professor of zoology in the University of Oxford, on November 17. After speaking of the important part played by the study of insects in the solution of some of the chief problems in biology, he went on to deal with questions of parasitism and symbiosis; pointing out that in some cases of close association, both parties are benefited, while in others the entire advantage is enjoyed by one party at the expense of the other. The case was mentioned of the termites, which are enabled to subsist on nitrogen-free material, for example, cotton-wool, in virtue of the Protozoa inhabiting their intestines; these latter having apparently the power of fixing free nitrogen from the air. The importance of insects as carriers of disease was exemplified with many illustrations; and stress was laid on the necessity of a careful study of the habits of the insects concerned, by engineers and others engaged in the control of such maladies as malaria, sleeping-sickness and plague. Without sufficient knowledge, more harm than good may be done by the efforts of health officers. Further points made by Prof. Carpenter included the evolution of the alleged use of 'tools' by burrowing Hymenoptera; of the 'symbolic marriage gifts' offered by the empid flies; and the function of colours in courtship, as to which some recent views were criticised. Finally, the influence of insects in the production of flowers was adduced as a further illustration of the great part performed by insects in the world of Nature.

Academic Assistance Council

A MEETING of the Academic Assistance Council, under the presidency of Lord Rutherford, recently reviewed the work accomplished during its first six

months in assisting university teachers and investigators who, on grounds of race, religion or political opinion, are unable to carry on their work in their own countries. The Council has collected records of about one thousand displaced scientific workers and scholars. One hundred and thirty-two have been given temporary research facilities in the Universities and University Colleges of Belfast, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Hull, Leeds, London, Manchester, Nottingham and Oxford. In forty-two instances the Council has made maintenance grants for one year; such grants are limited to £250 a year for a married and £182 for an unmarried person. Donations received by the Council up to November 4 amounted to £9,695 14s.; this includes a donation of £500 from the Council of Trinity College, Cambridge. Unless a further substantial sum is available the Council can make no more grants. The Council is making inquiries throughout the world to discover permanent or semi-permanent openings for displaced academic workers, and every care is being taken not to prejudice the interests of university teachers or others intending to follow an academic career. The Council intends to appeal immediately for further funds, but to avoid a multiplication of public appeals of a similar character it has decided to issue its own in co-operation with the International Student Service, the Refugee Professionals Committee and the Germany Emergency Committee of the Society of Friends. Contributions—earmarked if desired for the Academic Assistance Council—may be sent to Mr. Walter Adams, the General Secretary of the German Refugees Assistance Fund (Academic and Professional) at 232, Abbey House, Westminster, S.W.1. (Telephone: Victoria 5927.)

Permanent Documents

THE preservation of documents, pictures and other records of historical importance is a problem of grave importance to librarians and others. The Royal Photographic Society in 1927 appointed a committee to recommend methods for the preservation of photographic records (*Phot. J.*, **67**, 498–499; 1927). The report of this committee contained a very useful set of recommendations. It directed attention, however, to the fact that photography itself is so young that little can be said as to the ultimate 'staying power' of photographic records. The problem of permanence usually involves two main factors; the behaviour of the base and that of the characters or designs recorded upon it. The common bases used in photography vary greatly in stability, as may be judged by mentioning a few; glass, paper, celluloid. On the other hand, different types of photographic image show just as great variety. Other records, not photographic, present similar variations.

USUALLY the methods yielding records of outstanding resistance to chemical ageing, such as tile-making, etc., are troublesome, if only for the great bulk of the product. An invention by Mr. Everard Digby, 6 Queen Anne's Gate, London, S.W.1, appears to have opened a new field for those who anticipate preserving records for all time. The process is based on photography and lends itself to the reproduction of any designs in line or half-tone, as well as to the reproduction of printed or other characters. All the advantages of accuracy are thus obtained. The novelty in the process consists in the use of gold and platinum as the working materials. In the examples which Mr. Digby has already shown, the main substratum is made from sheets of 14–18 carat gold 0·004 in. in thickness. Upon these are placed, in perfect contact, thin films of polished platinum. The characters or designs are then formed as matte areas on the polished platinum. The inventor claims that such metallic sheets will be immune from almost every possibility of chemical disfigurement. In addition they would not be so much exposed to the danger of being thrown away as being of no value.

Conference of Australian Physicists and Astronomers

THE fourth conference of Australian physicists and astronomers, arranged by local members of the Institute of Physics, was held in Melbourne on August 15–18, and was attended by fifty delegates from various parts of the Commonwealth. In his presidential address on "The Place and Value of Physical Science in the Modern State", Prof. Kerr Grant stressed the value of the study of pure science as a training for orderly and objective thinking. He showed that every advance in applied science is based on discoveries made in pure science, and urged the cultivation of scientific investigation for its own sake. An address on "Contemporary Physics" was given by Dr. H. S. W. Massey and a discussion took place on the organisation of the observatories in Australia (see NATURE of April 23, 1932), a question which had been referred to the conference by the Commonwealth Government. A description of the results obtained in the investigation of the effects of fading and of atmospherics in the reception of broadcast signals was given by the staff of the Radio Research Board. Because of the high incidence of thunderstorms in Australia, atmospheric interference is an important problem in broadcasting, and the results obtained with two cathode ray direction-finding stations and a narrow sector continuous recorder over a period of more than two years are yielding information of considerable value. A number of papers were also read describing research work in progress on the motions of electrons in gases, on the thermal conductivities of gases, on long wave-length X-rays, and on the oscillations produced by a valve oscillator. The radon purification plant in use in the Commonwealth Radium Laboratory, and that proposed for use in Perth, were described and discussed.

Progeny Records at Live-Stock Sales

IT can be safely stated that the majority of the great 'improvers' of our breeds of live-stock were familiar with the criterion of judging the value of a sire by his progeny. In recent years, particularly as regards the breeders of dairy cattle, there has

been an increasing appreciation of the value of the progeny test. To assist breeders in this matter, the Hertfordshire Institute of Agriculture held on November 20 an auction sale, the catalogue of which is before us, of a number of young bulls, sons of "proven sires": this term connotes a bull whose unselected daughters are considered to have given a satisfactory yield. This enterprise is to be commended, though it is legitimate to wonder whether, in view of recent research, too much emphasis is not being laid upon the paternal grandsire of the heifers which the purchasers of these young bulls hope to breed. Greater value would be attached to the sale if daughters of proven sires were also on offer. Inevitably it has not been found possible to set a high standard, and critics of the catalogue should lay less emphasis on the fact that the average yields of the daughters of these seven proven sires have in no case reached 1,000 gallons, and rather be content with the fact that there has been made available an array of not only interesting but also reliable facts. There would, however, appear to be no excuse for describing as a proven sire a bull whose daughters' average yield was only 800 gallons and some 15 per cent less than that of their dams. Some officially recorded pigs were also sold. While this was not the first sale of this nature, the venture is likewise to be commended since it demonstrates a resolve on the part of some breeders to work, not by eye alone, but by scientific methods based principally on the rate of live-weight increase and carcass measurement. In view of the reorganisation of the pig industry in Great Britain, the movement is a timely one.

The Smithfield Club

THE effect of music upon fatted cattle, sheep and pigs will again be tried at the London Smithfield Club show in the Royal Agricultural Hall, Islington, on December 4–8 next. Milch cows have given a greater volume of milk under the influence of soothing music. This year, scientific investigators in animal foods and nutrition at Smithfield Show are to see whether beasts, which usually lose weight when appearing in fat stock exhibitions, cannot be made to maintain their rate of daily growth, when band music produced from gramophones and loudspeakers is played to keep them from becoming upset by the mobbing received from visitors. The King has entered 29 head of fat cattle, sheep and pigs, and the Prince of Wales, the Duke of Rutland, the Countess of Lonsdale, Lady Loder, Lord Danesbury and Lord Derby will also submit stock before the judges.

Annual Report of the Meteorological Office

THE annual report of the Director of the Meteorological Office to the Air Council for the year ended March 31, 1933, deals with the seventy-eighth year of the Meteorological Office. Details of the work of the various branches of the Office show that requests for meteorological information have again increased substantially in number over those received in the preceding year. The reorganised forecast branch at Adastral House, Kingsway, alone dealt with nearly sixteen thousand, and the numerous local centres of the aviation branch, with more than thirty-seven thousand, without counting weather reports passed to aircraft in flight. The British climatology division disposed of more than two thousand general or scientific inquiries for particulars of past weather, many of which were required for legal purposes. The report states that the year has been one of consolidation of the numerous changes and developments of the years since the War, and that the figures quoted illustrate the general appreciation shown of the increased facilities for the provision of meteorological information that have resulted therefrom. The advancement of meteorological knowledge by research has not been neglected as a result of attention to the immediate needs of the public, a number of special investigations being carried out, for example, at Kew; the importance of the work of the expedition to Fort Rae, North West Territories, Canada, in connexion with the programme of the Second International Polar Year, has led to the inclusion of a special section giving an account of that work. This shows that success has been achieved in maintaining autographic records of the magnetic elements, of atmospheric electricity and of the more ordinary meteorological quantities, as well as in the ambitious scheme of auroral study. Although great doubt had been felt as to the chances of retrieving instruments carried by sounding balloons, several have been recovered with records reaching well into the stratosphere.

Secondary Sections of the British Grid System

NEARLY all the British grid operates at a pressure of 132 kilovolts. Two sections operate at 66 kv. and 33 kv. respectively, and there are a few relatively unimportant sections which operate at smaller pressures. In a paper read to the Institution of Electrical Engineers on November 9, Mr. C. W. Marshall describes the 66 and 33 kv. sections. In the scheme of the Central Electricity Board, there are 221 miles of 66 kv. lines and 1,319 miles of 33 kv. lines. Unlike the main grid, these subsidiary lines are mainly used for transmission purposes. The standard conductor material from which they are made is steel-cored aluminium. The minimum clearance between any line conductor and the earth in still air under maximum temperature conditions (50° C.) is 20 ft. If they have to cross Post Office lines then, whenever possible, the P.O. lines are interrupted and cables substituted for them at the crossing. If this is not possible, a guard is provided under the power lines. In this case the minimum clearance between guard and Post Office lines is 3 ft. and between guard and power lines 4 ft. When the power lines cross a railway, the minimum clearance is 24 ft. above rail level. Lattice steel towers are the standard for all the Board's 66 kv. lines and, with one exception, for all the 33 kv. lines also. During the period of the activities of the Board, the development of cable technique has been very rapid. The first cables were made with solid dielectrics, the single core oil duct type came next, then the three

core oil duct and finally the 'gas pressure' three phase cable. Operating experience is still too scanty to allow definite conclusions to be drawn as to their relative merits. Hitherto they have only been used in situations like central London which preclude the use of overhead lines.

Kaiser Wilhelm Gesellschaft

NEARLY forty pages of parts 21–23 of *Die Naturwissenschaften*, 1933, are devoted to an account of the activities of the Kaiser Wilhelm Gesellschaft during the period April 1932 until March 1933. The financial stringency has been felt during the year just as much as it was last year, and research work has had to be cut down to a minimum in several departments. It has also affected the membership, which has fallen from 829 to 786. At the headquarters—Harnack House—five evening lectures on scientific subjects and five of a popular character have been delivered, and four have been given in other towns of Germany. Many members of the staff have also been invited to address scientific gatherings outside Germany, and several have accepted permanent posts in the United States, Switzerland and Sweden. 230 foreign men of science have during the year put up for short periods at Harnack House, as compared with 242 the previous year, and 190 meetings of other societies have been accommodated as against 212 during the previous year. 445 additions have been made during the year to the library. Information of this general nature is followed by a short account of the work done in each section of the Association and a list of the publications emanating from it.

History of Fever Treatment in London

IN an article entitled "Willan and Bateman on Fevers" in the October issue of the *British Journal of Dermatology*, Dr. J. D. Rolleston maintains that Robert Willan (1757–1812), in addition to being the father of British dermatology, was also a pioneer in epidemiology at a time when infectious diseases were more prevalent and severe than at the present day. In addition to his work on vaccination, of which he was a warm advocate, and his observations on scarlet fever and measles, by his work on cutaneous diseases and his reports on diseases in London in 1796–1800, Willan played a prominent part in the establishment of the first fever hospital in London. Apart from the smallpox hospital at King's Cross, which had been in existence since 1746, at the beginning of the nineteenth century, London did not possess a fever hospital of any kind, and it was mainly in consequence of the prevalence of typhus fever at the end of the eighteenth and beginning of the nineteenth centuries that hospitals under the name of 'houses of recovery' were established throughout the country. They were first opened at Chester, Manchester, Liverpool, Norwich, Hull, Dublin, Cork and Waterford, and later, owing to the advocacy of Willan and other distinguished physicians, the example set by the provinces was followed by London. In 1802 the Society for Bettering the Condition of the Poor fitted up in Gray's Inn Road a private house as a hospital for poor patients, to which Willan was appointed the first physician, and was succeeded two years later by Bateman, who held the post for twelve years.

Need for Flexibility in International Agreements

MR. W. WATKIN DAVIES, in an article on "Justice in International Affairs" published in the *Hibbert Journal*, **31**, No. 4, argues that justice in the international sphere, based on treaties and conventions, is not adequate, and the machinery which enforces it is likely to develop into the most abominable tyranny, if it is not supplemented by something else. In a world where changes occur in different countries at different times, it is folly on the part of statesmen to make peace settlements which they declare to be final, without at the same time providing for future prevention of political and economic grievances. Changed circumstances give rise to legitimate national aspirations. Mr. Davies gives examples from past and from contemporary history to show how changes in population render geographical boundaries unsatisfactory. Remedies other than acquisition of new territory, such as increased efficiency in production or colonisation, are of little avail at present because of the prevailing economic nationalism. There remains one way out: for nations sooner or later to take their fate in their own hands and break the law, by resorting to war. If economic and political hostility is to be avoided, flexibility must be introduced into our international system. An institution must be set up—it already exists in a very crude form in the League of Nations—the task of which will be to revise treaties from time to time, and to readjust national boundaries, redistribute economic resources, regulate migration in the interest of the world as a whole, and generally to reconsider every reasonable national aspiration. The way is indicated by Article XIX of the Covenant.

Man and Machine

IN the *Quarterly Review* for October 1933, Mr. W. F. Watson contributes an interesting article on "The Machine and its Purpose" in which he combats the view so often taken for granted that machinery involves dull, monotonous work which 'dehumanises' the worker, robs him of interest in his job and crushes individuality. The machine, he admits, continually encroaches on the sphere of certain crafts and changes the form of others, but at the same time it has created new crafts involving a high degree of skill, initiative and individuality, such as that of jig, tool, fixture, mould, die and gauge makers. Passing on to consider the machine operator, he argues that a person who controls a machine with ease, skill and precision is the master of that machine, not its slave. The man who is master of his job, no matter how elementary it be, must of necessity take some interest in it. Moreover, modern industrial investigations such as those of the National Institute of Industrial Psychology have led to an appreciation of the importance of the 'human factor' and have shown how to counteract the effects of monotony.

Monotonous work may not destroy individuality since as a result of the advance of education the average British workman is learning to employ his leisure properly. Mr. Watson contends that machinery has lightened work so that the worker leaves the factory at the end of the day mentally fresh and often eager to apply his mind to other spheres of activity.

Oil and Pollution

THE desire for an international conference on the oil pollution of the seas has become increasingly evident since the failure of the Oil in Navigable Waters Act of 1922 and the Washington Conference of 1926 to cope with the trouble, which not only affects sea-birds and fish but also involves economic loss and other dangers. The menace and trouble to bird-life has been abundantly shown (*Bird Notes and News*, **15**, No. 6. 1933) by bird-protection societies in Great Britain, and at the request of the Board of Trade, the Royal Society for the Prevention of Cruelty to Animals has circulated its coastal branches for recent data to indicate increase or decrease in recent years. Prof. Rudolf Drost says the menace to birds at Heligoland is at its greatest in winter, and it is not unusual to find 50 dead guillemots in a single day (*Bird Notes and News*, **15**, No. 5), and Dr. G. W. Field (*Bird Lore*, Sept.-Oct., 1932) says a continuous oil-film stretches at least 500 miles outside New York harbour and off Cherbourg, France, and a continuous sheet 100 miles in diameter was seen by him between France and Newfoundland. In a pamphlet on "The Bacteriology of Pollution in Relation to Inshore Fisheries", issued by the South Wales Sea Fisheries District Committee, 1930, Commander E. Kirkpatrick, fishery officer, directed attention to the failure of inshore fishermen through pollution, and to eye-trouble and blistered arms of stake-net fishermen in the South Wales area due to contact with glutinous, oily and acid matter when cleansing nets from the tarry residue borne on the tide. The oil trouble was first noticed on the Lancashire coast affecting sea-birds in 1916, when it was attributed to oil from submarines, but in P. J. Ralfe's 1931–1932 report on the "Birds of the Isle of Man" it is noted that "very little has been heard of oiled birds".

Sensitivity of Fish to Earthquakes

Two Japanese seismologists, Dr. Shinkishi Hatai and Dr. Noboru Abe, observed that catfish (Siluridæ) in natural conditions showed signs of restlessness about six hours before earthquake disturbances were registered on their recording apparatus. Since catfish are, ordinarily, placid unresponsive creatures, experiments were made to test this seeming responsiveness (Science Service, Washington, D.C.). Catfish placed in an aquarium were tested three times a day by tapping on the supporting table. When no earthquake was impending, the fish moved lazily or not at all; but about six hours before a shock the fish jumped when the table was tapped, and sometimes swam about agitatedly for a time before settling down upon the bottom again. Several months' testing showed that in a period when 178 earthquakes of all degrees of severity had been recorded, the fish had correctly predicted 80 per cent of the shocks. They showed no discrimination in their movements between slight local shocks and more serious distant shocks. The experimenters think that the catfish are made sensitive through electrical changes in the earth, since it was only when the aquarium was electrically earthed, through the drain-pipe, that they responded to a coming earthquake.

Announcements

PROF. F. J. M. STRATTON, professor of astrophysics in the University of Cambridge, has been elected a corresponding member of the Instituto de Coimbra, Portugal.

MR. E. F. REID has been awarded the Coopers Hill War Memorial prize of the Institution of Civil Engineers for 1932 for his paper on "Failures in Steel and Cast-Iron Mains and Provision for their Protection". This prize was founded by the Coopers Hill Society in memory of Coopers Hill men who lost their lives in the War.

SIR JAMES FRAZER has been offered a grant of £400 a year for three years by the Drapers' Company, as a mark of the Company's recognition of his conspicuous contributions and distinguished services to science and to literature, for the purpose of providing himself with such expert secretarial assistance as will enable him to continue the scheme of work on which he has recently embarked and which, by reason of his failing eyesight, he might otherwise be unable to complete.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant to take charge of the Electrical Engineering Department in the Technical College, Wolverton—The Principal (Dec. 1). A veterinary officer to the Herefordshire County Council and the Hereford City Council—The Clerk of the County Council, Shirehall, Hereford (Dec. 2). A medical inspector of factories—The Industrial Division, Home Office, London, S.W.1 (Dec. 4). A woman bacteriologist and lecturer in bacteriology at the Royal Free Hospital and London (R.F.H.) School of Medicine for Women—The Secretary, Royal Free Hospital, Gray's Inn Road, London, W.C.1 (Dec. 4). A chief veterinary officer to the Staffordshire County Council—The Clerk of the County Council, Stafford (Dec. 5). Two veterinary inspectors to the Derbyshire County Council—The Clerk of the County Council, County Offices, St. Mary's Gate, Derby (Dec. 11). A scientific research fellow at Girton College, Cambridge—The Secretary (Feb. 1). A publicity and organising officer for the National Institute of Industrial Psychology, Aldwych House, London, W.C.2—The Principal. A regius professor of botany in the University of Aberdeen—The Private Secretary, Scottish Office, Whitehall, London, S.W.1.

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.*]

Sir Edward Frankland Memorials at Lancaster

THE note under the above heading in NATURE of November 11 contains a minor biographical inaccuracy which I should like to correct. The statement that my father studied chemistry under Tyndall is erroneous, for he and Tyndall first made each other's acquaintance, leading to a lifelong friendship, when they were young schoolmasters in 1847 at Queenwood College, Hampshire. At this time my father had already been a student and assistant under Playfair, who held the appointment of 'Organic Chemist to the Government Department of Woods and Forests', and whose laboratory in 1845 consisted mainly of the underground kitchen and scullery of a house in Duke Street, Westminster! It was in this laboratory that my father made the acquaintance of Hermann Kolbe, who was also an assistant of Playfair's, and it was Kolbe who induced my father to accompany him (Kolbe) to Bunsen at Marburg, where he was to see what an active research laboratory was like. On this occasion my father was only able to spend three months at the University of Marburg, but during this time he completed the joint investigation with Kolbe in which they discovered the classical reaction by which the fatty acids can be synthesised by means of the cyanides.

It may be pointed out that the now almost forgotten school at Queenwood, founded by Mr. Edmondson, of Preston, was on entirely original and pioneering lines, as special attention was devoted to science subjects. Thus, whilst my father gave instruction in chemistry, geology and botany, Tyndall took classes in mathematics and physics. Both young men were, however, fully conscious of their inadequate training, Tyndall in experimental science, and my father in mathematics. Accordingly, they entered upon a severe course of study, rising at four o'clock every morning and working until eight, Tyndall going through a systematic course of qualitative analysis under my father's direction, and my father in Euclid and algebra under the guidance of Tyndall. Any spare time my father also employed in chemical research. After sixteen months my father and Tyndall resigned their appointments and in June 1848 went together to Marburg. Passing through Paris on their way, they improved the occasion by listening to lectures by Dumas at the Ecole de Médicine, by Frémy at the Jardin des Plantes, and by other scientific notables, besides for the first time seeing an electric arc-lamp, and witnessing the ascent of a fire-balloon which was inflated by burning large quantities of straw, steeped in alcohol, in an iron brazier, which was not, however, attached to the balloon, but when the latter was duly filled with the heated air, the car was attached, the aeronaut stepped in and the balloon rose majestically to the accompaniment of cheers by the delighted spectators.

It was during this, my father's second visit to Bunsen's laboratory, that he made the important discovery of the organo-metallic compounds, which have been of such immense value in the development of synthetic organic chemistry, and incidentally led to my father's enunciation of the fundamental principle of atomic valency, which was communicated to the Royal Society on May 10, 1852, but the publication of which was delayed for a twelvemonth through the paper being inadvertently laid aside in the private drawer of the secretary (Prof. Gabriel Stokes), so little interested were the physicists of the time in the philosophy of the chemical atom!

It is noteworthy that one of these organo-metallic bodies (lead tetraethyl) under the trade-name of 'Ethyl' has become one of the organic compounds most widely known to the general public owing to its 'anti-knock' properties when mixed with the petrol employed in the internal combustion engine. The often ludicrous and flamboyant advertisements with which some of the competing oil companies seek to catch the eye show that these purveyors of the ethyl-mixture have evidently formed a shrewd estimate of the mentality of the average motorist!

Loch Awe, Argyll. PERCY F. FRANKLAND.
Nov. 13.

Disintegration of Lithium under Proton Bombardment

COCKCROFT and Walton[1] have shown that when lithium is subjected to proton bombardment, a group of particles of range less than 2 cm. is emitted in addition to the homogeneous group of range 8·4 cm.; the latter corresponding to the transmutation

$$^{7}_{3}\mathrm{Li} + ^{1}_{1}\mathrm{H} \rightarrow ^{4}_{2}\mathrm{He} + ^{4}_{2}\mathrm{He}.$$

These short-range particles were examined in detail by Rutherford and Oliphant[2], who showed that there may be present two groups of ranges 6·5 mm. and 11·5 mm.

Photographs of the tracks produced by these particles have been obtained by Dee and Walton[3] and by Kirchner[4]. The method, so far used, of bombarding a target *in vacuo* and allowing the products of disintegration to pass through thin windows supported upon a grid into the expansion chamber, is unsuitable for such experiments when very short ranges are produced. For example, even if particles were emitted in pairs in opposite directions, only relatively few such pairs would appear in the chamber, and where single particles were observed, it would be impossible to decide whether one member of the pair had hit the supporting grid, or whether the particles were not emitted originally in pairs from the target. To overcome these difficulties, experiments have now been made in which the proton beam is passed into the gas of the expansion chamber through a thin mica window and allowed to fall there upon a thin target of lithium oxide. Particles emitted from this target have free passage into the gas, greatly simplifying interpretation of the photographs.

As shown in the accompanying photograph (Fig. 1), a dense sphere of ionisation is produced by scattering of the protons in the gas, but in addition, short-range particles can be observed to extend beyond this sphere. In the first set of experiments, 22 such tracks have been obtained of which 14 occurred in nearly opposite pairs, having common points upon the target. Of the remaining 8 tracks, 5 were emitted in such directions that corresponding opposite tracks would have had equivalent paths in the target (before emerging into the gas of the chamber) much greater than the maximum range of the observed particles. It can thus be affirmed that in the majority of cases the particles are emitted in opposite pairs.

It is more difficult to draw a definite conclusion as to the ranges of the particles constituting a pair, owing both to the finite thickness of the target (3·5 mm. of air) and to the possibility that such a powder target may be far from uniform. Measurement of the sum of the ranges of the tracks produced in the chamber plus the equivalent path in the target (assumed uniform), reduced to air at N.T.P., gave the

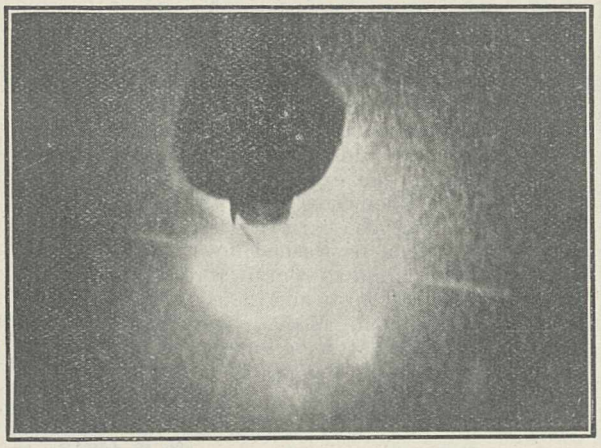

FIG. 1.

values 21·0, 20·4, 22·2, 22·0, 20·0, 26·6, 28·7 mm. (The latter two values were subject to greater experimental error than the former.)

To settle whether the reaction in question is

$$^{7}_{3}\mathrm{Li} + ^{1}_{1}\mathrm{H} \rightarrow ^{4}_{2}\mathrm{He} + ^{4}_{2}\mathrm{He} + \gamma \text{ radiation}$$

or $$^{7}_{3}\mathrm{Li} + ^{1}_{1}\mathrm{H} \rightarrow ^{5}_{2}\mathrm{He} + ^{3}_{2}\mathrm{He},$$

or some reaction in which neutrons are emitted, will require further work, using a thinner and more uniform target and a corresponding increase in proton intensity. It is, however, interesting to note that although in six pairs the angle between the tracks was greater than 175°, in one case this angle was 156°. The minimum angle which might be expected to conserve energy and momentum in the former reaction is 162° for the particular proton accelerating voltage used.

Note added to proof. Kirchner claims that the short-range group from lithium consists of a continuous distribution of ranges from 5 to 15 mm. (*Phys. Z.*, November 1933). Although in the experiments described above the ranges *in the gas* varied from 4·4 to 11·8 mm., no conclusion may be drawn as to the actual ranges of the particles emitted in the disintegration, as the observed range distribution could as well be explained by assuming a homogeneous group and correcting in each case for the possible path in the target. Kirchner makes no statement about his target thickness.

P. I. DEE.

Cavendish Laboratory,
Cambridge.
Nov. 11.

[1] NATURE, **131**, 23, Jan. 7, 1933.
[2] *Proc. Roy Soc.*, A, **141**, 722; 1933.
[3] *Proc. Roy. Soc.*, A, **141**, 733; 1933.
[4] *Naturwiss.*, Nr. 21, 676; 1933.

A Catalysed Reaction of Hydrogen with Water

IT has been recently observed by M. L. Oliphant that, when hydrogen is kept in contact with water for a few months, an exchange of atoms occurs between the hydrogen and the water[1]. We have now found that this reaction can be catalysed by platinum black, such as is used in hydrogenation.

In a quartz vessel (of 100 c.c. capacity) 8 c.c. of a 1·1 normal solution of sulphuric acid in water was introduced, together with 170 mm. of hydrogen containing 1·08 per cent of deuteronium (heavy isotope of hydrogen). A quantity of platinum black (0·47 gm.) produced by reduction of platinum chloride with formaldehyde was added and the mixture was shaken at room temperature for an hour. After this time, the hydrogen was completely removed from the vessel and its deuteronium content determined. It was found to have fallen off to 0·66 per cent. When hydrogen was similarly treated without addition of platinum black, no perceptible change occurred.

We suggest that the catalytic exchange of atoms between hydrogen and water caused by platinum black is due to the ionisation of hydrogen corresponding to the electromotive process of the hydrogen electrode. When a hydrogen electrode is in equilibrium with an aqueous solution, it constantly produces ions from the hydrogen, while an equal amount of hydrogen is formed from the ions of the solution. If the hydrogen contains deuteronium, this process leads to the replacement of deuteronium by hydrogen.

It seems that the slow atomic exchange between hydrogen and water previously observed may be due to some hidden catalyst acting in a similar way to that described here. It is possible that the walls of the vessel act as a weak ionising agent, since it is known that glass can form a hydrogen electrode.

We have to thank Prof. H. S. Taylor, of Princeton, for the deuteronium water used in these experiments. We produced our hydrogen by decomposing water with iron at about 500°. When an excess of water containing 1·8 per cent of deuteronium was used in large excess to iron, the hydrogen formed contained 1·1 per cent deuteronium. This shows that deuteronium water reacts with iron at a slower rate than ordinary water.

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M. POLANYI.

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Nov. 11.

[1] NATURE, **132**, 765, Oct. 28, 1933.

Formaldehyde in the Upper Atmosphere

IN a recent communication[1] Götz, Dobson and Meetham have reported that the average height of ozone in the atmosphere at Arosa, Switzerland, is about 20 km. This height is much less than the former estimates. Götz and Ladenburg[2] and Buisson[3] are in agreement with this view. Even at a height of 2–3 km. a perceptible amount of ozone may be present, but the highest concentration seems to be at a height of 15–50 km.

R. Mecke[4] has stated that the amount of ozone found in the lower layers of the atmosphere may be partly due to some ozone molecules dropping down due to gravity from the higher parts of the atmosphere and thus surviving their decomposition by ultra-violet light. According to R. Mecke, the probable mechanism for the formation of ozone from oxygen is as follows:

$$O_2 + O_2'' (<\lambda 2025) = O_3 + O'$$

Warburg[5], however, obtained ozone from oxygen even in radiations of wave-length 2530 A., although the beginning of molecular absorption of oxygen is assumed to be at 2020 A. According to Fabry and

Buisson[6], ozone showed marked selective absorption with a maximum between 2470 A. and 2480 A. Warburg studied the decomposition of ozone in radiations of wave-length 2530 A., which is strongly absorbed by ozone. R. Mecke is of opinion that the decomposition of ozone takes place as follows :

$$O_3 + h\nu\ (<\lambda 2655) = O_2'' + O'$$

We have continued our analyses of rain-water for formaldehyde and we have observed that all samples of rain-water contain formaldehyde in quantities varying from 0·00015 to 0·0012 gm. per litre. We have shown that the incidence of lightning discharge and thunderstorm does not increase the amount of formaldehyde present in rain-water. On the other hand, we have observed that the amount of formaldehyde present in rain-water is greater when the rainfall is preceded by some clear sunny days. Hence we are inclined to the view that formaldehyde in rain-water is obtained as a result of its photoformation from carbon dioxide and water in the atmosphere. It is well known that the reaction

$$CO_2 + H_2O + 112{,}000 \text{ calories} = H.CHO + O_2$$

requires ultra-violet of wave-length 2550 A. It is apparent that very seldom are all the active rays absorbed by a medium, and hence it seems that all short ultra-violet rays coming from the sun will not be absorbed by the ozone layer present in the atmosphere. Some of the short wave radiations are likely to pass through the ozone layer and decompose water into H and OH, and these hydrogen atoms may reduce carbon dioxide to formaldehyde. This reduction of carbon dioxide by atomic hydrogen may be accelerated by the solar radiation. The heat of dissociation of water into H and OH is 110,000 calories. In other words, the energy required in the formation of formaldehyde from carbon dioxide and water is practically the same as that required in breaking the H–OH link, which appears to be the first step in this process of photosynthesis. As the wave-length necessary for the formation of ozone (2020 A.) is shorter than that necessary for the formation of formaldehyde (2550 A.), it is expected that formaldehyde may be formed in the atmosphere at a height less than that of ozone.

Henri and Schou[7] and Herzberg[8] have shown that the ultra-violet absorption spectrum of formaldehyde vapour consists of thirty-five to forty bands between 2500 A. to 3700 A. with a maximum at 2935 A. characteristic of aldehydes. The predissociation limit of formaldehyde appears to lie between 2680 A. to 2660 A. with diffuse bands. On irradiating formaldehyde vapour with rays of wave-length between 2800 A. and 2650 A., Kirkbride and Norrish[9] obtained a quantitative decomposition of formaldehyde into carbon monoxide and hydrogen. It is apparent, therefore, that not only ozone but also formaldehyde present in the atmosphere absorbs short rays from the sun. Hence the absorption of solar radiations shorter than 2900 A., which has been so far attributed to the presence of ozone, may be partially due to the formaldehyde present in the atmosphere. The maximum absorption of formaldehyde is at 2935 A., whilst that of ozone appears to be at 2655 A. Hence it seems that the ultra-violet rays filtered through the ozone layer may be absorbed by the formaldehyde present in the atmosphere.

Just as there is an equilibrium in the atmosphere between the oxygen and the ozone, it is evident that the following equilibrium :

$$HCHO \rightleftarrows CO + H_2$$

may exist in the atmosphere. It is well known that the upper atmosphere is rich in hydrogen. Consequently, due to the presence of hydrogen, the photodecomposition of formaldehyde will be markedly hindered and an unappreciable amount of formaldehyde may exist in the atmosphere.

From the foregoing, it will be seen that the wave-length of radiations suitable for formaldehyde formation (2550 A.) and decomposition (2660 A.) are much nearer each other than those for the formation (2020 A.) and decomposition (2655 A.) of ozone. Hence there is a greater likelihood of the decomposition of the formaldehyde as soon as it is synthesised than in the case of ozone, but due to the presence of hydrogen an appreciable amount of formaldehyde is likely to remain undecomposed in the atmosphere.

Just as ozone can exist in the atmosphere at a height of a few kilometres above the earth's surface, formaldehyde can also exist at a similar height, and that is why it can be washed down by rain-water, which has been found to contain formaldehyde.

Several spectroscopists and meteorologists, notably Fabry and Buisson, Mecke, Dobson, Götz and Ladenburg, Helge-Patterson and others have studied the problem of ozone formation in the atmosphere. We invite their attention to the allied problem of formaldehyde production in the atmosphere.

N. R. Dhar.
Atma Ram.

Chemical Laboratory,
Allahabad University.
Oct. 3.

[1] Nature, **132**, 281, Aug. 19, 1933.
[2] *Naturwiss.*, **19**, 373 ; 1931.
[3] *Rev. Optique*, **12** ; 1933.
[4] *Trans. Faraday Soc.*, **27**, 375, 393 ; 1931.
[5] *Sitz. Akad. Wiss.*, 216, 1912 ; 644, 1913 ; 872, 1914.
[6] *C.R. Acad. Sci.*, **156**, 782 ; 1913.
[7] *Z. Phys.*, **49**, 744 ; 1928.
[8] *Trans. Faraday Soc.*, **27**, 378 ; 1931.
[9] *ibid.*, **27**, 404 ; 1931.

A New Method for determining the Concentration Gradient in the Ultra-Centrifuge Cell

The method for determining the concentration gradient in the ultra-centrifuge cell has to be chosen differently according to the different properties of the solution centrifuged, and the different purposes of the research. For substances with suitable absorption in the visible or ultra-violet wave-length region, the original photographic-photometric method of The Svedberg[1] has certain advantages, particularly in the case of solutions containing two or more components which possess absorption bands at different wave-lengths. It is then often possible to get the concentration curve for each component by taking photographs of the cell with light of different wave-lengths.

It has been shown in earlier publications[2] that the determination of the concentration gradient can be based on the curvature suffered by light on passing through inhomogeneous media. The method used, like the absorption method, provides a complete picture of the concentration distribution at any instant, such as is required in the study of sedimentation velocity. A transparent linear scale is placed on one side of the cell, and is photographed from the other side through the plane parallel walls. The curvature of light on passing through the solution in the cell causes deformation of the scale image. The resulting displacement of the scale lines is proportional to the gradient of refractive index and therefore of concentration in the column of

solution. In the ultra-centrifugal analysis of mixtures the components of which have similar light absorption, this refraction method gives higher accuracy than the absorption method; and it is the only possible one in cases where the light absorption in the available spectral regions is insufficient for the absorption method.

Another refraction method has now been worked out for the purpose of measuring the concentration gradient in the sedimentation equilibrium. Both

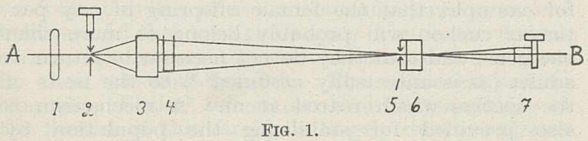

FIG. 1.

the previous methods require elaborate measurements to be made on the photographic plates. The new method makes use of the fact that in the study of sedimentation equilibria, an instantaneous picture of the whole concentration distribution is not required. Instead of this, the method gives in the simplest possible way a direct measurement of the gradient, and an easy control of the establishment of the equilibrium. In connexion with these refractometric methods, the work of Foucault[3], Töpler[4], Straubel[5] on the optical side, and of Wiener[6], Thovert[7], Clack[8] and others on the diffusiometric side, is of interest.

In Fig. 1, AB is the optical axis and (4) is a diffusion or ultra-centrifuge cell. The layers of constant concentration are parallel to this axis and perpendicular to the plane of the figure. (2) is a narrow slit, illuminated by a mercury arc lamp (1). The photographic lens (3) (focal length, 63 cm. 1 : 18) gives an image of the slit (2) in the plane of a slit diaphragm (5), at a distance 4·5 m. from the cell (4). The combination of the lens (6) (focal length, 100 cm.) with the screw micrometer eyepiece (7) acts as a telescope, which is focused on the cell. The slit diaphragm is fixed, but the slit (2) is mounted on a precision slide block, and its position is determined by a micrometer screw. It is obvious that if the light is deviated in the cell by different amounts at different heights, the otherwise sharp slit image at (5) will be displaced and broadened. The slit image may in this way reach a width of several centimetres, while the width of the diaphragm (5) is of the order of 1 mm. For each position of the slit (2) the diaphragm selects light of a certain deviation. There then appears in the eyepiece a narrow bright band, the position of which corresponds to the height in the cell where light is deviated to the selected extent. The whole concentration distribution in the cell can thus be analysed by moving the slit. The readings of the eyepiece micrometer screw give the position in the cell, and those of the micrometer screw, controlling the slit (2), give the corresponding light deviation. The slits must be broad enough to make the image in the eyepiece sufficiently bright and free from disturbing diffraction effects. On the other hand, they must be narrow enough to provide sufficient resolving power in respect of the light deviation. For studying the sedimentation equilibrium of a 1 per cent ovalbumin solution, using a cell of 6 mm. internal width and a centrifugal acceleration of 9×10^6 cm./sec.^{2}, suitable widths were found to be 0·25 mm. for the illumination slit and 2 mm. for the slit diaphragm. This gave a satisfactory image, and the resolving power, even with wider slits, was quite sufficient.

For the calculation of the molecular weight from the concentration gradients at equilibrium, I used the formulæ contained in an earlier paper (*l.c.* 1929).

OLE LAMM.

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University of Uppsala.
Oct. 18.

[1] The Svedberg, *Z. phys. Chem.*, **121**, 65; 1926.
[2] O. Lamm, *Z. phys. Chem.*, A, **138**, 313; 1928; and A, **143**, 177; 1929.
[3] L. Foucault, *Annales de l'Observatoire de Paris*, **5**, 197; 1859.
[4] A. Töpler, "Beobachtungen nach einer neuen optischen Methode". Bonn 1864.
[5] R. Straubel, *Bei. Geophys.*, Ergänzungsband 1, 299; 1902.
[6] O. Wiener, *Ann. Phys. Chem.*, **49**, 105; 1893.
[7] J. Thovert, *Ann. Phys.*, 9, 2, 369; 1914.
[8] B. W. Clack, *Proc. Phys. Soc. London*, **36**, 313; 1924.

Diagnosis by Sound Tracks

THE method of diagnosis by sound tracks introduced by F. Janvrin[1] provides not only for diagnosis of certain nervous diseases with microscopic accuracy, but also for the expression of the signs of the diseases in numerics, that is, in numbers obtained by measurement.

In the sound tracks reproduced in Miss Janvrin's communication, the width of the track shows that the original has been enlarged twice. From the time equation used in taking the records at the studio, we get the time equation 1 mm. = 0·00072 sec. for the figures. With this we determine the time from each sharp upward jerk of the track to the next one.

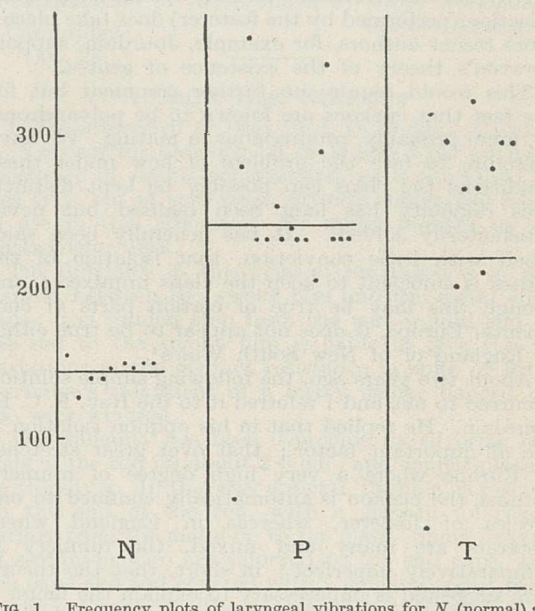

FIG. 1. Frequency plots of laryngeal vibrations for N (normal) and P and T (disseminated sclerosis).

This gives in each case the interval from the beginning of one puff from the larynx to that of the next. The reciprocal of this gives the frequency of the laryngeal vibration. The dots in Fig. 1 give the frequencies for the three tracks in Miss Janvrin's curves. The horizontal lines give the average frequencies. The deviation of each frequency from the average is obtained and the results are averaged as the 'average deviation'. This average deviation expressed as a percentage gives a measure of the variability of the action of the larynx.

The percentual variabilities for the Janvrin cases are N, 4 per cent; P, 17 per cent; T, 33 per cent. The reciprocal of the percentual variability

constitutes a good coefficient of consistency. For the Janvrin cases these coefficients are 25, 6, 3. The percentual variations are measures of ataxia; the coefficients of consistency are measures of eutaxia. The determination of laryngeal taxia thus becomes a quantitative one.

This is an illustration of the change that is occurring in replacing the often unreliable methods of clinical diagnosis by numerical expressions obtained from measurements.

E. W. SCRIPTURE.

[1] Janvrin, "Diagnosis of a Nervous Disease by Sound Tracks", NATURE, 132, 642, Oct. 21, 1933.

Inheritance of Egg-Colour in the 'Parasitic' Cuckoos

THERE are many kinds of cuckoos in the Old World with so-called parasitic habits, which are more or less catholic in their choice of fosterers. One female, however, in normal circumstances places all its eggs in the care of a single species of 'host', and as a rule its eggs show a higher or lower degree of resemblance to those of that species.

This mimicry of eggs is a well-attested fact and led A. Newton[1] to suggest that any particular species of cuckoo, for example, the common cuckoo of Europe (*Cuculus canorus* L.), is divided into a number of clans or *gentes*, one for each of the normal hosts, each of which has perfected a certain type of mimetic egg by natural selection. There is evidence that such selection (performed by the fosterer) does take place[2]. More recent authors, for example, Jourdain, support Newton's theory of the existence of gentes.

This would require no further comment but for the fact that cuckoos are known to be polyandrous, or, more probably, promiscuous in mating. We have therefore to face the problem of how under these conditions the clans can possibly be kept distinct. This difficulty has long been realised but never satisfactorily solved[3]. It has generally been said, albeit with little conviction, that isolation of the gentes is sufficient to keep the clans unmixed; and though this may be true of certain parts of continental Europe, it does not appear to be true either of England or of New South Wales[4].

About two years ago, the following simple solution occurred to me, and I referred it to the Rev. F. C. R. Jourdain. He replied that in his opinion isolation is the all-important factor; that over great stretches of Europe where a very high degree of mimicry obtains, the cuckoo is automatically confined to one species of fosterer, whereas in England where fosterers are many and mixed, the mimicry is comparatively imperfect; in short, that the theory here suggested is unnecessary to explain the facts.

In a recent paper[4], Chisholm raises the same problem in describing the habits of some nine Australian species, all parasitic, and leaves the 'pretty tangle' unsolved. I am therefore tempted, with due deference to the Rev. Jourdain's authoritative opinion, to publish my theory, since it has the advantage of being universally applicable whether right or wrong.

The factor for egg-colour, and the appropriate instincts regulating the egg's disposal, which must go along with it, may collectively be called the 'gens factor'. The different gens factors are presumably a series of multiple allelomorphs, which I suppose to be *sex-linked*, that is to say, located in the *X*-chromosomes. In birds, the female is the heterogametic sex; and thus the female cuckoo, having only one *X*-chromosome, can never be heterozygous for gens. The fact that the male has a pair does not matter because he does not lay eggs: he does not, in fact, belong to the gens at all.

It should be noted that the eggshell and its pigment are part of the parent and have nothing to do with the embryo inside. One female cuckoo will always lay exactly the same type of egg, a well-known observational fact.

It is impossible to go into the interesting implications of this type of inheritance here. It implies, for example, that the female offspring of any particular cuckoo will probably belong to more than one gens, and that they do not necessarily return as adults (as is universally assumed[4,5]) to the nests of the species which reared them. A mechanism is also provided for stabilising the population by damping the fluctuations caused by the host species, and at the same time allowing for a slow increase or decrease in response to permanent changes in their status. I might add that it seems likely from the evidence that there are some autosomal modifiers for gens, causing the observed differences between the eggs of individual females belonging to one and the same clan.

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Montreal.
Oct. 25.

[1] "Dictionary of Birds", p. 124; 1893.
[2] F. C. R. Jourdain, *Proc. Zoo. Soc.*, p. 648; 1925.
[3] W. P. Pycraft, "A History of Birds", p. 130; 1910.
[4] A. H. Chisholm, *Auk*, L., pp. 385–395; Oct. 1933.
[5] E. Chance, "The Cuckoo's Secret", p. 226; 1922.

Morphological Interpretation of Floral Anatomy

IN the recent issue of the *New Phytologist*[1], Mrs. Agnes Arber, in a paper dealing with the above subject, raises certain points which are of fundamental importance to all plant morphologists. She discusses the use of anatomical evidence in phylogenetic morphology and comes to conclusions which are directly opposed to one of the well-established doctrines of modern comparative morphology. To the question, "Are we to consider it proven that the vascular bundles are more 'conservative' than the external form, so that vestigial organs may be represented by their bundles, when all external trace of these organs has disappeared", her answer is that "we have no alternative but to discard the doctrine of the conservatism of the vascular bundles". Proceeding further, she says, "there seems to be no escape from the conclusion that there is a complete absence of positive evidence for the vestigial survival of vascular tissue after the organ which it supplied has ceased to exist". She admits that the general nature of the vascular scheme may have a certain systematic value and may serve to some extent as an indicator of trends in race history, but in her opinion there appears to be no basis, say, for the statement of Bower[2] that "anatomical characters and *of the vascular system* are apt to tardily follow evolutionary progress and thereafter to persist as vestigia" (italics mine).

Mrs. Arber appears to be partially right in this, especially because an unintelligent use of the above doctrine has sometimes led to the formulation of peculiar hypotheses, like the theory of carpel polymorphism, but her whole argument seems to be too much exaggerated. In her evidence she takes into consideration some highly specialised grasses, like

Luziola Spruceana, Papaveraceæ like *Hypecoum* and *Corydalis*, and genera like *Antirrhinum* and *Digitalis*, on which she has happened to work. She has consulted some old works on the Primulaceæ wrongly interpreted by the previous authors and on the theory of solid carpel and carpel polymorphism, in which no one believes except its author, but makes no mention of some other recent works, especially from the United States. A reference to these would have shown her that evidence for the conservatism of vascular bundles is not so entirely lacking as she believes and that vestigial organs even in the flowers of angiosperms are represented in several instances by their vascular bundles. The Salicaceæ are an example. Fisher[3] has shown that the simplicity of the flowers of this family is largely due to extreme reduction, and a vestigial vascular supply is present in many instances to organs now greatly reduced or entirely lacking. During the study of the scheme, Chute[4] has found that sometimes there are abortive ovules without vascular supply, but in other instances an ovular trace is found to a suppressed ovule. Investigating the floral anatomy of the Urticales, Bechtel[5] finds in several species vascular traces of suppressed perianth leaves, stamens and carpels. In this order the carpel is mostly bicarpellary, but there is a great tendency to the suppression of one carpel. In some instances it almost becomes unicarpellate, but vestigial bundles are always present to show the existence of the second carpel. In some cases the inner whorl of perianth has entirely disappeared, in other instances vestiges of its vascular supply remain. In *Stellera Chamaejasmæ* (Thymelaeaceæ), a plant I have studied, the corolla is entirely absent. There is, however, near the base of the flower a much reduced disc-scale. The vascular supply of this clearly indicates it to be a part of much reduced corolla.

All these examples are from the anatomy of the flowers of angiosperms, with which Mrs. Arber deals. As is well known, there are many more instances from other groups of vascular plants.

The position seems to be that it is not always essential for vestigial organs to be represented by their vascular bundles, but in many instances they are, and this seems to have been correctly stated by Bechtel in 1921. "In plant organs suffering reduction, the vascular system either disappears in advance of the organs, or persists as abortive bundles after the organs have disappeared."

A. C. JOSHI.

Department of Botany,
Hindu University, Benares.
Oct. 1.

[1] Arber, A., "Floral Anatomy and its Morphological Interpretation", *New Phyt.*, **32**, 231; 1933.
[2] Bower, F. O., "The Ferns (Filicales)", vol. 1, Cambridge, 1923.
[3] Fisher, M. J., "The Morphology and Anatomy of the Flowers of Salicaceæ, I and II", *Amer. J. Bot.*, **15**, 307, 372; 1928.
[4] Chute, H. M., "The Morphology and Anatomy of the Achene", *Amer. J. Bot.*, **17**, 703; 1930.
[5] Bechtel, A. R., "The Floral Anatomy of the Urticales", *Amer. J. Bot.*, **8**, 386; 1921.

IN common with other botanists whose student life began in the nineteenth century, I was brought up to believe that, in the flowering plants, an individual vascular bundle might survive after the complete disappearance of the organ which it supplied in some ancestral stage. In my earlier papers I subscribed to this belief; it is only gradually—and, I may say, with reluctance—that I have come to the conclusion that its foundations are insecure. On reading the work of those who still hold to it, one's first impression may well be that it is supported by ample evidence, but on analysis one finds that this impression is due to the fact that the existence of a lost, ancestral organ is postulated whenever, in the writer's view, it is required.

It is true that, in the paper which Prof. Joshi criticises, I have discussed the question mainly on the basis of my own observations; I have done this deliberately, because there are so many pitfalls in the study of 'vestigial' structures, that it is scarcely possible to arrive at a considered opinion about them, except at first hand. All students of floral anatomy are, of course, acquainted with the memoirs by Prof. A. J. Eames and the long series of papers by research workers at Cornell University who have been inspired by him. In the three papers from this series which Prof. Joshi cites, the idea that certain individual bundles may survive after the *total* disappearance of the organs which they once supplied—thus offering clues to ancestral structure—is throughout implicit. The writers tend to treat it, not as a hypothesis which demands proof, but as a postulate upon which further argument can safely be based. The question, which I have tried to raise, is whether there is sufficient positive evidence to make this assumption valid. Though my own experience has led me to think that there is not, critical study carried over a wider field may show that I am wrong. I hope that Prof. Joshi's letter may lead to a re-examination of the problem by other workers.

AGNES ARBER.

Cambridge.
Oct. 26.

A Simple High Resistance

I WAS interested to read Prof. Burbidge's account in NATURE for October 28 of a new type of high resistance of simple construction, as a resistance of this type, but of somewhat different design, has been in use in this laboratory for many months as an electrometer leak.

The difficulty in this type of resistance is in the contact between the smoke film and the metal end-caps; the sudden step from the wire-wound end of the rod to the smoke film is liable to give rise to variations in the contact resistance in spite of Prof. Burbidge's treatment of a heavy smoke deposit on the wire winding.

The difficulty has been overcome by silvering the ends of the rod for about 2·5 cm., and copper-plating on the silver. In this way a metal 'thimble' is formed on the end of the rod, with a smooth unbroken surface from the metal on to the glass. Short lengths of sealing-in wire are soldered to the end caps, and the caps and rod covered with a smoke deposit from burning camphor. The resistance is then washed in alcohol, warmed gently to dry it, and enclosed in a glass tube which is evacuated and sealed off.

The resistance in use here is of the order of 10^{10} ohms, and for this order of magnitude a glass rod is quite satisfactory. The length of the rod between the end-caps is about 10 cm. and its diameter 5 mm. The coating is firm and uniform.

No originality is claimed for this design of high resistance: a somewhat similar type was described some years ago in an American journal, but I have been unable to trace the paper.

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Nov. 8.

Research Items

Copper in Early Britain. Two communications on metallurgy in early Britain appear in the *Proceedings of the University of Durham Philosophical Society*, 9, Pt. 2. The first, by Dr. A. Raistrick and Dr. J. A. Smythe, describes a bronze celt, a fine specimen of the flanged type without stop ridge, found in the working of clay pits at Birtley. It falls naturally into a group of finds associated with the entry of the Bronze Age peoples into the area by way of the Wear Valley. The weight of the celt is 8 oz., its length 13·2 cm., and maximum width, cutting edge, 5·2 cm., flange 2·4 cm. A metallographic examination reveals that it is a bronze rich in tin, and the analytical results show that the copper and tin were of a high degree of purity. The metal had been cold-worked and afterwards annealed at a comparatively low temperature. In parts, particularly on the flanges, cold-working had followed the heat treatment. Tests for hardness with the Brinell machine gave the figures, in the thick parts 140, at the edge and sides 178, and at the flange 200. The second communication, by Mr. C. G. Whittick and Dr. J. A. Smythe, deals with a cake of copper from Carletown, Glasserton, Wigtownshire, of Roman origin. As it had been suggested that it might have come from the copper-mining area of Wales, it was compared with samples from four cakes found in North Wales and now in the British Museum. The Carleton cake appears to have been cast in a rude open mould or pan with edges expanding upward. In no case is there direct evidence of dating, though there is little doubt about the question of a Roman origin. The analysis and metallographic examination of the Carleton specimen agree in indicating that it is a lead-bronze alloy. A determination by recalculation of the character of the copper used shows that it is so similar to the four Welsh coppers as to make identity of origin extremely probable.

Binocular Perception of Flicker. Miss M. D. Vernon read a paper on the "Binocular Perception of Flicker" before Section J (Psychology) of the British Association at the recent Leicester meeting. The critical frequency (that is, the fusion point) of a white monocular flickering field has been found to depend only upon the brightness of the field, when wave-length, retinal area and state of dark adaptation are constant. If, however, a steady, non-flickering, plain or coloured field is presented simultaneously to the other eye, it is found that the critical frequency is modified. The critical frequency is reduced (1) when the steady field presented to the other eye is brighter than the flickering field; (2) when the steady field contains a black figure of varying complexity; (3) when the flickering field contains a black figure; but this effect is masked by the presentation of a plain, steady field to the other eye. The critical frequency is reduced considerably more when both fields are figured, and is greatly increased if both fields are made to flicker simultaneously at the same rate, but is reduced again if the fields are figured. The effect of the figures is not due to their interest and cognitive attentive value, since a plain black cross produces as great an effect as the drawing of an interesting real object. It is suggested that these phenomena may be explained in terms of (*a*) a conflict in the binocular percept between unlike monocular percepts, and a reinforcement between like ones, (*b*) a conflict in awareness between the different features of the binocular percept, that is, the figures and the flicker.

Hepato-Pancreatic Glands in an Indian Earthworm. K. N. Bahl and M. B. Lal (*Quart. J. Micro. Sci.*, 76, Pt. 1, June 1933) have investigated the structure and function of the intestinal glands of an Indian earthworm, *Eutyphœus waltoni*. The glands extend as paired structures from segments 79 to 83. As the two glands of a pair are fused in the mid-dorsal line, and the glands of successive segments are connected, the organ may be regarded as one large gland extending over five segments. It consists of lobules of glandular epithelium and interlacing lamellæ. The lobules are separated from one another by sinusoid capillaries and the two epithelial folds of a lamella enclose a blood-sinus. The gland cells resemble liver cells in shape and structure. The gland opens into the intestine by eighteen apertures, spread over five segments, and the apertures are lined with the ciliated gut-epithelium. The blood supply of the gland resembles a hepatic-portal system: blood is collected from the posterior segments (the last 109–127) of the worm into a ventral intestinal sinus which empties all its blood into the sinusoid capillaries of the gland. From the gland issue five pairs of intestino-dorsal vessels which carry all the blood from the glands into the dorsal vessel. The glands develop as dorsal outgrowths of the endodermal lining of the gut. They secrete no calcium, but a tryptic enzyme has been demonstrated. Thickly set glycogen granules are present in the gland cells. It is concluded that the glands are of the nature of a hepato-pancreas.

Pigments of Ascidians. Prof. Umberto Pierantoni (*Atti Soc. R. Napoli*, vol. 19, No. 3) has investigated the colour, which varies according to the season and environment, of *Botrylloides leachi*. The colour is due to the presence of pigment cells or capsules originating from blood cells at first freely moving in the blood sinuses, and later—when they have become reduced to pigment capsules—adhering to the walls of the peripheral sinuses. The pigment, which is of nuclear origin and is emitted from the nucleus into the cytoplasm, belongs to the group of melanins. When the process is completed, the entire cell, including the nucleus, has become transformed into a mass of pigment-granules, which the author regards as katabolic products of the cells or of the organism in general. The pigment of *Clavelina lepadiformis* is also contained in blood sinuses and is the product of wandering cells but is white, and the cells which produce it are amœboid. The pigment, which appears in vacuoles in the cytoplasm (and apparently the nucleus does not participate directly in the formation of the granules) is not a product of degeneration, but a secretion which accumulates and precipitates in the vacuole, leaving the nucleus intact. The chemical reactions of this white pigment show it to be composed of guanin.

Poisonous Snakes. The principal article in *Tabulæ Biologicæ Periodicæ* (2, No. 4, 1933) is by Th. A. Maass on poisonous vertebrates, part 1, *Ornithorhynchus* and the reptiles—*Heloderma* and the poisonous snakes. The account of the poisonous

Amphibia, fishes and invertebrates is to be included in the next volume. Information in tabular form is given upon the recognition characters of the more important genera and species of poisonous snakes. About 250 species are included in the table, the utility of which would have been further increased by an indication of the area of distribution of the respective species.

Mutations in Irradiated Tomatoes. Six mutations arising in tomatoes after treatment with radium are described by Dr. E. W. Lindstrom (*J. Heredity*, vol. 24, No. 4). Some fifteen or more monogenic mutations are already known in the tomato, scattered on six or seven of the twelve pairs of chromosomes in this species. All but one of the induced mutations are different from the natural ones. Three of them (virescent-white, yellow foliage and yellow seedlings) show chlorophyll deficiency, two are morphological (ridged or rough leaves, and rolled cotyledons with sparse, drooping foliage and slow growth). In another, the plant is greatly stunted and the flowers are sterile and never open. All showed normal chromosome counts and behaved as simple recessives in inheritance. Four of these mutations arose from the radiation of young growing tips and two from radiated seeds. Many other untested variations were also obtained. One plant, which was heterozygous for virescent-white, was chimeral in nature, having a light green sector in which the flowers also showed complete pollen abortion. The light green chloroplasts are interpreted as a cytoplasmic effect, and on a branch which reverted to full green the fertility of the flowers was also restored. These mutations will be useful for a further investigation of the chromosome map in tomatoes.

Copper and Colouration of Onion Scales. A point of both scientific and practical interest is dealt with in Bulletin 552 of Cornell University Experiment Station, in which Dr. J. E. Knott gives an account of manurial experiments upon the colour and thickness of onion scales. Colour in particular seems to be improved in many soils by the addition either of superphosphate or copper sulphate, the latter salt being most effective. A dressing of 200 to 300 pounds to the acre is recommended when onion scales are either thin or poor in colour.

An Interesting Hybrid Oak. Dr. William Trelease has described an interesting hybrid oak (*Proc. Amer. Phil. Soc.*, 72, No. 4, 1933) which, as is shown by the photographs, bears some acorns like those of one presumptive parent, the bur oak (*Quercus macrocarpa*) whilst other fruits have the glossy elongated acorns and shallow cups of the white oak. Such 'chimeral' behaviour, whilst familiar now in 'graft hybrids', arising as buds from the region of the graft union, is most unusual if not unique in a tree that should presumably have arisen from an acorn of hybrid origin. A full account of the tree is being published by its discoverer, Mr. Orpheus M. Schantz.

Dolerites of Spitsbergen. A general account of the geology and petrology of the dolerites of Spitsbergen, based on observations made during three field-seasons, has recently been given by G. W. Tyrrell and K. S. Sandforb (*Proc. Roy. Soc. Edin.*, 53, Pt. 3, No. 21, pp. 284–321 ; 1933). Most of the intrusions are sills. Four facies are distinguished : the normal type ; coarse gabbroidal and pegmatitic types ; basaltoid contact-rocks ; and endomorphic modifications known as 'white trap'. A feature of much interest is the co-existence of fresh olivine with a mesostasis containing abundant quartz. In the Carboniferous and Permian rocks the sills are uniform, non-transgressive and widely extended ; whereas in the Mesozoic formations they ramify as a network through the strata, and send off dyke-like protrusions into fractured and arched beds. It is believed that this contrast is due to injection under deep and shallow covers respectively. The consensus of evidence is that the intrusions and the accompanying basaltic lavas are to be dated as between late Jurassic and Lower Cretaceous. Useful comparisons, with new average analyses, are made between the Spitsbergen suite and the Mesozoic or near-Mesozoic dolerites and basalts of other regions.

Charging Water Drops. Prof. C. T. R. Wilson has suggested that rain drops may be electrified in falling through air which contains ions moving vertically under the action of an electric field. The drop will meet upward-moving ions, while if the electric field is not too large, the downward-moving ions will not be able to overtake it, and the drop will acquire an excess charge of the upward-moving sign. A direct experimental test has been carried out by J. P. Gott (*Proc. Roy. Soc.*, A, October). A vertical electric field was maintained between two large metal plates, ionisation was supplied by X-rays and drops were allowed to fall through holes in the two plates and were collected in a cylinder connected with an electrometer. The location of the ionising beam and the electric field employed were varied in different experiments, so that the drops in their passage between the plates were exposed to different types of moving ion streams ; the results obtained were in accordance with Wilson's predictions.

Reflecting Echelon Grating. W. E. Williams has recently published an account of the reflecting echelon designed by him and made by Messrs. Adam Hilger, Ltd. (*Proc. Phys. Soc.*, September). This apparatus demands a degree of perfection in the optical surfaces which is higher than that for any other optical instrument. Its construction is made possible by the fact that optically finished surfaces of quartz or fused silica will form an adherent contact without distortion. A number of plates are worked to flatness and equal thickness and mounted in adherent contact. The resolving power of the echelon is so high that special methods are necessary for testing the completed instrument, and these are described in some detail. In use the instrument is mounted in an air-tight chamber, since the definition is seriously affected by changes in barometric pressure occurring during an exposure. An image of the fringes is thrown on the slit of the auxiliary spectrograph by a lens or a concave mirror. The instrument may be used as a high resolving power instrument for fine structure work, or it may also be used for the accurate comparison of wave-lengths. An advantage claimed over the Fabry-Perot interferometer lies in the fact that the resolving power of the Fabry-Perot is limited by the reflecting power of the silver (or other) films, which falls off rapidly in the ultra-violet. The resolving power of the new instrument may be increased indefinitely by adding plates, while very high resolving power can only be obtained with the Fabry-Perot at the expense of separation of orders.

Work of the Rothamsted Experimental Station

THE work of the Rothamsted Experimental Station is mainly directed to obtaining exact information about soils and the growth of crops; information of a fundamental nature of this type is applicable wherever crops are grown and whatever the economic conditions prevailing at the time. Sir John Russell, in his report for 1932 (2*s*. 6*d*.), asks the question whether this type of experimental work is necessary in times of over-production. He replies to this by stating that it is in difficult times such as these that the need for exact information about crops and stocks is most urgent, as it enables farmers rapidly to alter their methods with the changing economic conditions. It might be added that the 'details' of crop husbandry, such as are accumulated at Rothamsted, help to provide a weapon for fighting the products of low cost mechanised farming abroad. The per acre costs on the small farms of Great Britain cannot be lowered much further, but, by attention to yield, the cost of the product can be kept down.

The results of the Station's work have gained wider interest amongst farmers since the acquisition of the Woburn Experimental Farm in 1926; experiments can thus be carried out on both the heavy soil at Rothamsted and on the light Woburn soil. This enables the relative suitability of the two soils to be assessed, not only for various crops under various meteorological conditions, but it also demonstrates the extent to which differences due to soil type can be smoothed out by manuring. Thus, in the six-course rotation experiments, while the yields of wheat and potatoes differ at the two farms, those of clover hay, barley, sugar beet and fodder crops do not differ so much.

Numerous trials with sugar beet, carried out between 1926 and 1932, are reported and commented upon; the responses to the various fertilisers are shown. The most interesting feature noted, however, is that factors not at present under control appear to play the chief part in determining the crop. Thus, at Rothamsted in 1932, this crop was grown in two fields not far apart and similarly manured. The yield of roots was very low in one and very high in the other. A similar occurrence was noted at Woburn. It is concluded that a new type of experiment is needed, different from the old fertiliser trial, and new methods are now under test at Rothamsted.

Other experiments with farm crops are discussed, and there is also an interesting summary of ten years' work on barley, carried out under the research scheme of the Institute of Brewing. Amongst the cereal trials, those on the growing of grain under mechanised conditions are likely to be of special interest. These are designed to show how to maintain fertility in a corn farm cultivated by machinery, and making little or no manure.

The range of problems dealt with is wide, and the laboratory section includes reports from the Soil Pathology and Entomology Departments. The Farm Director's report for the year is also included.

In the latter half of the report are given the yields from the plots in 1932, including those from centres outside Rothamsted. The latter form an interesting reflection of the work of the Statistical Department during the last few years. This work has resulted in a more critical outlook towards field experimental work throughout the country. Experiments designed on the Rothamsted lines are carried out by many institutions, and the results interpreted in the manner suggested by the designers of the trials. An additional indirect benefit results from this—greater co-ordination, not only in the method, but also in the selection of problems for field experimental work.

The report will prove valuable to farmers and to those engaged in research, and is indispensable to teachers of agricultural sciences.

E. J. R.

Biology of Brittle-Stars

IN papers recently published by Dr. T. Mortensen (*Vidensk. Medd. Dansk. naturh. Foren.*, vols. 93 and 96) are some remarkable additions to our knowledge of ophiurids. Perhaps the most interesting is the account of a new genus, apparently of Amphiuridæ, in which the female carries the male about with her in "a continuous erotic embrace". The male, the body of which has a diameter of about 1 mm. (one-fifth that of the female body) lives with his mouth turned towards the mouth of the female and his arms alternating with hers. This brittle-star, which Dr. Mortensen names *Amphilycus androphorus*, was found by him attached to the under side of the flat sea-urchin *Echinodiscus bisperforatus* on a sandy beach in Delagoa Bay.

This situation may explain how the animals get their food in spite of their mouths being turned to each other; Dr. Mortensen suggests that they feed on detritus whirled into their mouths by the ciliary currents of the sea-urchin's skin. It is possible that the male may be parasitic on the female, or on the way to becoming so, because its œsophagus is remarkably muscular and may act as a sort of sucking-pump. In any case one cannot help being reminded of the fishes with parasitic males described by Dr. Tate Regan.

This discovery led Dr. Mortensen to re-examine two ophiurids which were supposed to be viviparous: *Ophiodaphne materna* and *Ophiosphœra insignis*. These also make their home on sea-urchins, and the supposed young prove to be permanently attached males.

Although the three species just mentioned turn out not to be viviparous, a large number of viviparous ophiurids is known. Dr. Mortensen adds 4 to their number, thus bringing the total to 32, distributed among 12 genera. Of these no less than 25 are hermaphrodite, and in six of these the males mature before the females. Hermaphrodites are otherwise unknown among ophiurids. Here then is a problem of which the solution is still to seek.

Another ophiurid (also probably an amphiurid) attached to the under surface of a flat sea-urchin, apparently *Laganum depressum*, was found by Dr. Mortensen in the Sunda Strait, and is described as *Nannophiura lagani* n.g. et sp. It is the smallest brittle-star known, its body being only half a millimetre across, and it moves with great agility among the spines of the urchin "like a monkey in the trees of a tropical forest". The ends of its arms are exceedingly movable, "recalling a monkey's

prehensile tail"; they are flattened and furnished with minute hooks. The radial nerves of the arms are strongly developed. The tube-feet, though quite short, are strongly adhesive.

There is another ophiurid with a very small body, but in it the smallness is relative as well as absolute; indeed it "can hardly be said to have a disk" at all. This is *Ophiocanops fugiens*, first made known by Koehler and now re-described from better specimens by Dr. Mortensen. The chief features, unique among ophiuroids, are connected with the minute size of the body. The first is the position of the genital glands as a series of small isolated organs along each side of the arm, each opening separately on the side of the arm. The second is the continuation of the stomach as a sort of radiating intestine out in the arms, in the dorsal space, above the genital organs, for about two-thirds the length of the arm; its walls are much folded and it is supported by a horizontal mesentery. *Ophiocanops* may be related to the Ophiomyxidæ, but it is here separated as a new family.

It is, of course, well known that in some of the ophiuroids with branching arms—the Euryalæ—the genital glands pass into the arms, but the arrangement is quite different from that in *Ophiocanops*. In a paper describing several specimens from the Indo-Pacific, Dr. Mortensen shows that "all the Trichasterids have the gonads extending into the arms to a various degree". They do not branch, however, but lie side by side like a bundle of telegraph cables.

An ophiurid that has given rise to a good deal of discussion is *Ophiopteron*, which Ludwig described in 1888 as "eine neue wahrscheinlich schwimmende Ophiuridenform". The reason for the supposition was that the arm-spines were united by a fine membrane, so that each group looked like the foot of a duck. Ludwig's suggestion was therefore generally accepted, but Dr. Mortensen, who has repeatedly observed living specimens, has never seen *Ophiopteron* swimming. Actually it lives concealed in crevices. The arm muscles are not exceptionally developed, and swimming by an up and down motion of the arms seems out of the question. There remains, none-the-less, the possibility that swimming is effected by a waving movement of the spine-groups, and this is indicated by strong muscles and a definite articulation at the base of the spines. Further observations are required.

This, however, is not the whole story. Dr. Mortensen's re-examination of many specimens referred to *Ophiopteron* shows that they are the young stage of one or other species of *Ophiothrix*. All species of *Ophiothrix* do not pass through an *Ophiopteron* stage, but why any should do so, and what may be the use of the "fins", are questions still to be solved.

Manufacture of Phosphoric Acid

IN the *Chemiker-Zeitung* of September 6, Dr. Carl Heinrich discusses at length the merits of the two main processes which are used for the manufacture of phosphoric acid from calcium phosphate. The essential features of these two processes, which may be conveniently termed the wet and dry processes, are set forth in textbooks of inorganic chemistry. In the wet process, the phosphate is decomposed by sulphuric acid, whereas in the dry process, silica replaces sulphuric acid and the furnace may be heated either externally or by means of an electric resistance. In view of the increasing importance of the product as a fertiliser, it is desirable that a more complete comparison of these two processes should be carried out.

One of the chief drawbacks to the wet process is the solubility of calcium sulphate in the liquor. Nevertheless, it is possible to extract 95–98 per cent of the phosphoric acid by modern decantation methods. This acid may still contain calcium sulphate, sulphuric acid and other impurities, but these are without much significance if the acid is to be used for the manufacture of fertilisers. But for many other purposes a much higher degree of purity is necessary, and the dry process must then be adopted. Thus iron and aluminium are difficult to eliminate from the acid solutions, whereas unless they are present in excessive amount they cause no trouble in the dry process.

In the United States, the dry process is generally carried out in one operation and the electric furnace is used. In Germany, on the other hand, there are usually two stages and external heat is applied. In the former method, the vapours of phosphorus and carbon monoxide are burned in the upper part of the furnace, the phosphorus pentoxide being afterwards condensed in a separate chamber. In the two-stage process, the phosphorus is not burned until its vapour has been completely separated by condensation from other vapours, and the carbon monoxide is then available as fuel. In both methods, considerable difficulty is caused by the highly corrosive nature of the hot phosphorus pentoxide vapour. The electric furnace gives a much higher concentration of phosphorus and its oxide than the other furnace, but it must be pointed out that a one-stage process is not thermally economical as much heat is necessarily wasted. On the other hand, the electric furnace is not so well adapted to a two-stage process since the yield of carbon monoxide is usually small, so that its heat of combustion cannot be utilised.

Several advantages are claimed for the externally heated furnace and the two-stage process. Thus by eliminating air from the first chamber, a high temperature can be employed without any danger of forming the obnoxious colloidal mist of phosphorus pentoxide vapour, which will neither dissolve readily nor condense completely without the application of the costly Cottrell high-tension discharge. Moreover, any loss which might arise from the adoption of an additional operation is much more than compensated by the elimination of the loss caused through corrosion of the silicate lining of the furnace by the hot phosphoric oxide. The vapours of phosphorus and carbon monoxide are then completely separated and the former is burned in air while the carbon monoxide is used as fuel.

Whilst a direct comparison of the two methods under comparable conditions is not available at present, the author inclines to the view that the wet process is the more economical, whenever it can be usefully applied, although the product is apt to be less pure. On the other hand, since no steam is involved in the dry process, the latter can be adapted to the production of phosphoric acid of any desired concentration without the use of evaporation plant.

Humus Manufacture

AGRICULTURE in India is by far the main occupation of its teeming millions, and it is a form of agriculture which has not as yet been greatly modified by the impact of British administration, or markedly influenced by the development in scientific crop-production. The cultivator and his family, equipped with little but oxen and abundant leisure, wring a scanty existence out of a small-holding, which may be so small that the average for a province (U.P.) is only about 2½ acres. The admirable work of Mr. A. Howard, when director of the Institute of Plant Industry at Indore, in the advancement of Indian agriculture is well known. It was his aim to bring about a revolution in crop production by the gradual introduction of intensive methods, to raise production all over India, in dry as well as irrigated areas. Through such increased production, he hoped to provide for the social and material betterment of the rural population.

The most important limiting factor in crop production in India is unquestionably the supply of organic matter to the soil as humus, which in turn supplies the crop with the necessary nitrogen. In a lecture entitled "The Waste Products of Agriculture" delivered on November 15 at the Royal Society of Arts, Mr. Howard dealt with the so-called 'Indore' process for the continuous manufacture of humus material, by means of which the waste products of the farm are utilised, and their valuable constituents made available for the nutrition of crops. After mentioning first the various directions in which added humus influences soil fertility, he described the "humus factory" constructed by him at Indore and copied in many other parts of India, and indeed to some extent in Africa too.

In effect, Mr. Howard's process is the formation of a glorious 'shepherd's pie' of all decomposable material on the farm—weeds, cotton and other stalks, green manures such as sann hemp, cane trash, fallen leaves, etc. The significant part of the process lies in the fact that the humus factory adjoins the cattle shed. The cattle stand on an earth floor which absorbs the urine. The vegetable wastes are used as bedding for the cattle, and next morning this bedding is moved to shallow pits in the factory together with "at least a quarter of the cattle dung". (This commodity is too valuable as a fuel to be squandered in the production of fertiliser.) From time to time the earth floor of the shed is dug up and replaced. The urine-impregnated earth is ground up and carefully stored. Portions of it are sprinkled over the vegetable wastes in the pits, and the whole mass moistened with a slurry made from water, wood ashes, urine earth and an inoculum taken from an older pit. Thereafter the production of a satisfactory humus material depends upon proper management. Subsequent waterings at frequent intervals are most important, otherwise decomposition ceases. Complete turning must be carried out several times. At the end of three months, a brown-black product is obtained ready for use in the field.

The process is in effect a refined form of composting as practised by Chinese cultivators for centuries. It is now known that for the satisfactory decomposition of cellulose materials a certain quantity of microbial nutrients must be present, the chief of which is nitrogen, for conversion to microbial protoplasm. There is indeed a definite and ascertainable ratio between carbonaceous material decomposed and nitrogen utilised. Most plant materials other than green fresh tissues have a carbon-nitrogen ratio much lower than that necessary for their decomposition. The urine-earth and dung supplement the supply, and so facilitate decomposition. While in practice and from experience it may be possible to judge approximately the relative quantities necessary, the Indore process is not necessarily an economical one so far as nitrogen is concerned, or a particularly controllable one. However, it unquestionably meets the needs of Indian agriculture. There is no cost apart from labour and, on the family small-holding, this item disappears. Indeed, according to Mr. Howard, "The economies of the subject in reality concern the transformation of a portion of the abundant leisure time of the cultivator and of his family into valuable humus".

Apart from utilising vegetable wastes, the process has been modified for the treatment of sewage and municipal refuse, and at Indore City the waste products of 60,000 inhabitants have been dealt with very satisfactorily in this way. This is a more healthy and economic method than the trench system ordinarily employed in India.

The manufacture of humus on the same lines might be possible even where there is not an abundance of labour running to waste as in India, and, according to Mr. Howard, has been in unconscious operation on the grasslands of England, where the well-known effect of the droppings of cattle in stimulating the growth of grass appears to be due in part to the conversion of undecayed vegetable material in the sod to humus by reason of the nitrogen of the dung. In his words, "the chemistry of the cow-pat remains to be written".

A. GEOFFREY NORMAN.

University and Educational Intelligence

CAMBRIDGE.—The Raymond Horton-Smith prize for 1932–33 has been awarded to G. D. Kersley, of Gonville and Caius College.

The Governing Body of Emmanuel College is inviting applications for an external research studentship which will be awarded in July 1934. Applications (with evidence of qualifications, etc.) must be sent to the Master in time to reach him not later than June 30. Preference will be given to candidates who have already completed one, but not more than two, years of research. The studentship must be held at Emmanuel College, has a maximum annual value of £150, is awarded and normally held for two years, but may be renewed for a third. The studentship is not tenable by a woman or by a graduate of the University of Cambridge.

LEEDS.—The title of emeritus professor has been granted to the following, who have recently retired from the staff of the University: Prof. A. F. Barker (textile industries); Prof. J. F. Dobson (surgery); Prof. W. Garstang (zoology); Prof. J. Strong (education); and Prof. R. A. Veale (therapeutics, pharmacy and materia medica).

LONDON.—The following degrees have recently been awarded: D.Sc. in entomology to T. A. M. Nash (private study) for published work entitled (1) "The Ecology of *Glossina morsitans*, Westw., and

two possible Methods for its Destruction", (2) "A Contribution to our Knowledge of the Bionomics of *Glossina morsitans*", (3) "The Relationship between *Glossina morsitans* and the Evaporation Rate," (4) "Note on the Discovery of some Rock-Paintings near Kondoa Irangi in Tanganyika Territory". D.Sc. in chemistry on L. J. Burrage (King's College) for thirty-one works on "The Sorption of Gases and Vapours by Porous Solids". D.Sc. in embryology on Aziz Girgis (University College) for a thesis entitled "Development of the Heart in the Rabbit" (*Proc. Zool. Soc.*, Oct. 1930 and June 1933).

THE Institution of Naval Architects is offering the following scholarships for competition in 1934: naval architecture, Elgar scholarship (£130 a year for 3 years) and Vickers-Armstrong scholarship (£150 a year for 3 years); marine engineering, Yarrow scholarship (£100 a year for 3 years). Particulars can be obtained from the Secretary of the Institution, 2, Adam Street, Adelphi, London, W.C.2.

THE Le Play Society is arranging a visit to Rome during the Christmas vacation under the leadership of Prof. Hamilton Thompson. This visit will be of interest to students of medieval history, while classics scholars will have the help of local specialists both in Rome and Ostia. Further information can be obtained from Miss Margaret E. Tatton, The Le Play Society, 58 Gordon Square, London, W.C.1.

THE Association of University Teachers has an International Relations Committee which has organised visits to French, German and Scandinavian universities. Last June it convened a conference at Exeter attended by representatives of the staffs of universities of Germany, Holland, Sweden, Norway, Poland, Italy, Ireland and the United States. Some observations on this conference appear in the October number of the *Universities Review*. The proceedings brought out very clearly a divergence of point of view between universities which, like those of Great Britain, are still dominated by what may be described as liberal ideology and those in which the traditional right of universities to liberty of thought and teaching has given place to a nationalism, narrowly economic, possessive and truculent, prepared to subordinate everything to political ends. Far from being discouraged by the manifestation of such discordant views, the Association, believing that the maintenance of personal contacts with foreign universities is all the more to be desired by reason of such differences, is proposing that the summer meeting of its Council shall, when convenient, be given a definitely international bias by the presence of representatives from foreign universities, and the allotment of some of the time to the discussion of some general academic question calculated to be of interest to them. The same number of the *Universities Review* has an article by C. W. Guillebaud of St. John's College, Cambridge, describing the activities of the International Student Service, an organisation with headquarters at 13 Rue Calvin, Geneva, and a London office at 3 Endsleigh Street, W.C.1. Formed in 1926 to carry on the constructive work initiated by "European Student Relief" in 1920, this body has of late been busying itself with the relief of distress among Jewish, socialist and pacifist refugee students from Germany.

Calendar of Nature Topics

Harmattan

With the approach of winter in the Sahara, the air cools rapidly, barometric pressure rises, and the north-easterly wind which is normal in northern subtropical latitudes is re-established along the coast of West Africa from French Guinea to the Cameroons. This dry, cool, north-easterly wind, known as the Harmattan, is a great relief after the moist heat of the summer monsoon, and from its healthful effects it is locally termed 'the Doctor'. Originating in the desert, it carries a great amount of impalpable dust, which often forms a thick haze, sufficient to hide the sun and impede navigation on the rivers, and penetrates into houses through every crack. The Harmattan generally begins towards the end of November and continues until about the middle of March, interrupted occasionally by short periods of variable winds.

Autumn Bird Migration at Lighthouses

During autumn and winter, heavy mortality of bird migrants occurs at some lighthouses, and though the fatalities have been considerably lessened at certain British lighthouses through the fitting of special rest-perches by the Royal Society for the Protection of Birds, numerous records are still obtained at this time from birds killed through colliding with the glass of the lantern. In September 1929, 1,237 birds of 55 species, chiefly warblers, were picked up at the Long Point Lighthouse, Ontario, a 1,000 candle power light (*Auk*, Oct. 1930). The first Irish record, and first autumn record for the British Isles, of the sub-alpine warbler, was obtained from the Hook Tower Lighthouse, Co. Wexford, in September 1933 (*British Birds*, Nov. 1933). In fog during November and December, numbers of fieldfares, starlings, redwings and curlews are usually reported from certain British lighthouses, and in 1932, the Skerries reported pied flycatcher and yellow wagtail as rare visitors on the southward passage, while later, on the gallery, were noted such non-perching birds as water-rails, turnstones, lapwings, skylarks and whimbrel; snipe and woodcock were seen on two occasions. At the Spurn lighthouse on October 12–13, 1931, the perches were packed with thousands of starlings. The erection of perches at the British lighthouses costs £60–£100, the annual maintenance is £15–£20, and the perches are usually left in position from the autumn until the following June.

Autumn and Winter Movements of Moose

At the end of the summer season, the elk or moose (*Alces americana*), the largest living representative of the deer family (Cervidæ), move away from the neighbourhood of swamps, rivers and lakes in North America for their winter quarters in the higher grounds. This is necessitated by the dense, rank grass growth of summer no longer affording full protection, and they seek the forests, where small parties may take up quarters in what is termed a 'moose-yard'.

The destruction of the elk is almost as tragic a story as that of the bison, but herds numbering about 17,000 find sanctuary in Yellowstone National Park; and a few miles south, at Jackson Hole, as many as 20,000 have been counted in winter. The

Izaak Walton League purchased Jackson Hole as an elk sanctuary in 1925, but later the Elk Commission was organised to save the species. More recently, the U.S. Biological Survey, Park Service and Forest Service have studied the Yellowstone herds for food habits, migrations, disease and natural enemies, and in order to obtain more accurate data of the autumn and winter migrations, 150 young elk were captured and marked.

In North America, the range of the elk appears to have extended originally from about the 43rd to the 70th parallel of latitude (Lydekker), having been reported so far south as Ohio and so far north as the Mackenzie River.

Rabbits and Heather

While rabbits prefer grass to heather (*Calluna vulgaris*) as food, the search for food where the rabbit population is large, or persistent harrying on lower ground, frequently induces migration to the edges of the moor. As a result, there is generally a noticeable degeneration of *Calluna*-heath along the moor-edge and grass-heath eventually takes its place. With new burrows and increase of population in the zone of attack, the degenerating edge tends to move backwards with increasing rapidity.

The formation of established rabbit paths between the *Calluna* bushes, and the eating down of these to a characteristic low rounded form, is the first step. "The result of this attack is that the once closed *Calluna* association becomes more open in character, and various grasses (chiefly *Agrostis vulgaris* and *Festuca ovina*)—the forerunners of the grass-heath association—appear in the rabbit tracks along with various other plants. At the same time *Cladonia coccifera*, *C. cervicornis*, etc., *Leucobryum glaucum*, *Hypnum schreberi*, *Dicranum scoparium*, etc., which previously formed a subordinate layer of vegetation under and around the once luxuriant *Calluna* bushes, take on a new and enlarged lease of life" (Farrow, *J. Ecol.*, 4, 1916). Wet weather during autumn and winter favours the smothering of the reduced heather bushes by *Cladonia* spp., under which decay begins. Any fresh young *Calluna* stems are nibbled off by the rabbits and ultimately the heather is killed. Disintegration follows, and finally the remains of the heather plants, together with the associated *Cladonia*, become dispersed and a short close turf is formed with a richer flora than previously existed.

Societies and Academies

London

Royal Society, November 16. J. W. Cook, E. C. Dodds, C. L. Hewett and W. Lawson: The œstrogenic activity of some condensed-ring compounds in relation to their other biological activities. In all experiments 100 mgm. of substance was administered to ovariectomised rats, and the doses were afterwards decreased if positive results were obtained. Certain di-alkyl derivatives of 1 : 2 : 5 : 6-dibenz-9 : 10-dihydroanthraquinol, 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene, neo-ergosterol, calciferol, ergosterol, 5 : 6-*cyclo*penteno-1 : 2-benzanthracene, 1 : 2-benzpyrene and 1 : 9-dimethylphenanthrene were found to be active. Two interesting features of the results are (*a*) the remarkable fact that the œstrus phenomena may be produced by compounds which differ relatively widely in molecular structure from the natural product, and (*b*) that it is possible to have apparently unconnected biological activities associated with the same molecular structure, for two of the substances now shown to be œstrogenic have powerful cancer-producing activity, and another one is the antirachitic vitamin, calciferol. Some degree of unsaturation seems necessary for œstrus-producing activity, as was shown by an examination of several compounds related to the sterols, some saturated, some ethylenic, and some aromatic in type. J. W. Cook, E. C. Dodds and A. Greenwood: Sex change in the plumage of brown Leghorn capons following the injection of certain synthetic œstrus-producing compounds. Intramuscular injection of 1-keto, 1 : 2 : 3 : 4-tetrahydrophenanthrene, and 9 : 10-dihydroxy-9 : 10-di-*n*-butyl-9 : 10 dihydro-1 : 2 : 5 : 6-dibenzanthracene was followed by a definite appearance of isolated patches of red pigment on the feathers. Later this developed into a definite band across the feather, producing unmistakable demonstration of change from male to female characteristics, as is seen after administration of œstrin. W. E. le G. Clark and G. G. Penman: The projection of the retina in the lateral geniculate body. The localisation of the retina in the lateral geniculate body of monkeys has been studied by reference to the cellular atrophy which occurs in the nucleus after retinal lesions. Atrophy in the geniculate body is always found to be quite localised and sharply defined after small peripheral lesions. The termination of crossed and uncrossed optic fibres in different cell laminæ is confirmed. The macular area of the geniculate body is more restricted than previous observations have suggested, and is represented by a median sector which is definitely limited to the caudal two-thirds of the nucleus. It involves all the cell laminæ. Fibres from the nasal half of the macula undergo complete decussation in the chiasma, while those from the temporal half remain uncrossed. The whole width of the cell laminæ in the rostral third of the nucleus is concerned with peripheral vision.

Paris

Academy of Sciences, October 9 (*C.R.*, 197, 721–800). Ch. Maurain and C. E. Brazier: The earthquake of October 3, 1933. This earthquake was felt in Paris, the origin being about 120 kilometres away. C. Camichel, L. Escande, and P. Dupin: Remarks on certain phenomena of lateral contractions in barrages. Lucien Daniel. The curious variations of the descendants of *Helianthus Dangeardi* to the sixth generation. S. Iyanaga: A lemma of elementary arithmetic in the demonstration of the general law of reciprocity. P. J. Myrberg: A new representation of automorph functions. B. Hostinsky: A functional equation which occurs in the theory of linear partial differential equations of the hyperbolic type. A. D. Michal and A. H. Clifford: Analytical functions which are implicit in abstract vectorial spaces. J. Schreier and S. Ulam: The group of permutations of the series of natural numbers. V. Vâlcovici: The equilibrium of a solid supported on an elastic surface. A. Gay: The plane movement of the incompressible perfect fluid. Jacques Valensi: The measurement of the instantaneous velocities above a helix. P. Jolivet: An auto-exciting electrostatic generator. G. Grenet: The theory of ferromagnetic powders and the magnetic susceptibility of

rocks. G. FOËX : The susceptibility of paramagnetic solutions. Experimental evidence in support of the view of the author and also of Fahlenbrach, according to which the law of Weiss is rigorous and the moment, independent of the temperature, can be calculated starting from the Curie constant. ANDRÉ LÉAUTÉ : The ageing of road coatings with a tar base. Study of the effects of various fillers : finely powdered coal with about 33 per cent of volatile matter proved to be the best filler. J. E. VERSCHAFFELT : The law of displacement of chemical equilibrium. W. GRAFF : The thermal analysis of the system hydrochloric acid, boron trichloride. Thermal analyses of mixtures of boron trichloride and hydrochloric acid do not indicate the existence of any compound. MLLE. SUZANNE VEIL : Discontinuous diffusions in gelatine. HENRI MURAOUR : The causes of the progressive disappearance of diphenylamine in colloidal powders (explosives). G. SCHUSTER : Contribution to the detection of adulterations of coco-butter. The determination of the index of azelaic acidity. FR. HAHN : A very sensitive reaction for boric acid studied in reference to a biochemical problem. The most sensitive reaction examined was formation of the boric acid complex acid with mannitol, using bromothymol blue as indicator. The method was applied to the examination of a fluid secreted by the pistil of a flower containing a trace of boric acid, the presence of the latter being necessary for the germination of the pollen grain. A. PERRET and R. PERROT : The catalysis and transformation of the alkaline earth cyanides into cyanamides. Study of the effect of the nature of the catalyst on the reaction $CaCl_2 + 2NaCN = CaN(CN) + C + 2NaCl$. Iron, cobalt and nickel are the most active catalysts, platinum and manganese rather less active, whilst twelve other elements were devoid of catalytic activity. JACQUES MAROGER and GEORGES MOURIER-MALOUF : New remarks on the reconstitution of the paint technique of Jean van Eyck. R. RAMBAUD : Study of the α-chloro-vinylacetic compounds. J. HOCH : General method for the preparation of the di- and triarylacetonitriles, (Ar) (Ar′).CH.CN and (Ar) (Ar′) (Ar″) C.CN. GEORGES LÉVY : The preparation of a new ethylnaphthol. This naphthol is the first known naphthol derived from α-ethylnaphthalene. J. ORCEL and MLLE. S. CAILLÈRE : The differential thermal analysis of the montmorillonite clays (bentonites). This method can detect three per cent of kaolinite in montmorillonite clay. F. VLÈS and MLLE. M. GEX : A physicochemical reaction changing after electrical connexion with the earth. A. DAUVILLIER : The continuous photo-electric recording of the aurora polaris. The apparatus described shows clearly the daily variation and allows an exact comparison of the auroral and magnetic curves. LOUIS BESSON : The influence of the smoke of Paris on the transparency of the air on the outer border and suburbs of the city. An analysis of daily observations of the visibility, taken between November and February for the five years 1928–32. PAUL BECQUEREL : The growth of mosses in an atmosphere of their own making. Five species of moss were placed in a nutritive solution and the tubes evacuated and sealed. The mosses grew under these conditions, giving off oxygen and nitrogen. P. MARTENS : The origin and function of the superficial folds on the epidermis of flower petals. GEORGES TRUFFAUT and M. LEFOUIN : The influence of the microflora of the soil on the growth of wheat. AUGUSTE CHEVALIER : Adanson, mutationist and evolutionist. J. COSTANTIN : Critical remarks on the preceding communication. GEORGES BOURGUIGNON : The interpretation of the sensibility to heat and pain with the aid of normal sensitive cutaneous chronaxy and their variations in syringomyely. HENRI VIGNES and MAX LÉVY : The acid-base equilibrium and pregnancy. J. BASSET, M. MACHEBŒUF, and G. SANDOR : The study of the biological effects of ultra-pressures. The action of very high pressures on proteins. C. LEVADITI, G. HORNUS, A. VAISMAN, and R. SCHOEN : The presence of the syphilitic virus in the ovary of mice syphilised subcutaneously.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 19, 759–801, Aug. 15). J. O. HALFORD and LEIGH C. ANDERSON : The photochemical production of triphenylmethyl. Triphenylbromomethane in solution in cyclohexane exposed to light from the near ultra-violet and in contact with air or oxygen gives, after several hours' exposure, triphenylmethyl peroxide. The first action is probably photochemical, giving free triphenylmethyl, which reacts with oxygen to give the peroxide. CHESTER STOCK : An amynodont skull from the Sespe deposits, California. EDWIN B. WILSON : On the invariance of general intelligence. A mathematical discussion of conditions under which Spearman's g remains invariant. MARGARET FLOY WASHBURN : Retinal rivalry as a neglected factor in stereoscopic vision. A stereoscope slide coloured red on one half and blue on the other appears purple for part of the time, red for part of the time and blue for part of the time. On looking at the far edge of the illuminated whitened side of a cube standing edgeways in a dark room, the side appears to be thrust out and drawn back alternately. These and other experiments suggest that, when the visual fields of the right and left eye are equal in attention value, the stereoscopic effect is due to automatic alternation of the retinal fields. H. E. FARNSWORTH and B. A. ROSE : Contact potential differences between different faces of copper single crystals. The (111) face is positive with respect to the (100) after outgassing at a high temperature. The potential difference is increased by outgassing, and decreased by evaporation, which causes etching. The observations point to an intrinsic potential difference between the uncontaminated crystal faces. Hence a polycrystalline surface would give only an average contact potential difference. G. A. MILLER : Number of operators of prime power orders contained in a group. C. B. DAVENPORT : Evidences of man's ancestral history in the later development of the child. The proportions of the child's body and limbs differ considerably from those of the adult. Cross-section of chest, upper and lower segments of legs and length of foot in the pre-adolescent stage correspond with those of adult lower forms ; development of the latter has stopped, whereas in man it goes on, until in the adult his position as a non-aboreal biped is established. HARRY H. LAUGHLIN : The general formula of heredity. The formula developed is $K = f(M, R)$, where K is the probability that the pre-indicated or random-selected offspring with a given M or prediction basis will fall within the selected R or class-range of offspring. It is represented by a space-surface called a 'manerkon' and generally takes the form of a skew-saddle. The data used have been obtained largely from thoroughbred horses.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 27

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—W. Harris: A Film of the Mount Everest Expedition of 1933.

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION, at 5.30.—Dr. E. G. Malherbe (Officer in charge of the National Bureau of Education at Pretoria): "Some Aspects of South African Education" (Joseph Payne Lectures) (succeeding lectures on November 29 and December 4).*

Tuesday, November 28

BRITISH RADIO INSTITUTION, at 7.30—(at King's College, Strand, London, W.C.2).—T. M. C. Lance: "Photo-electric Cell Applications".*

ROYAL ANTHROPOLOGICAL INSTITUTE—(in the lecture room of the Royal Society, Burlington House, London, W.1).—Prof. J. L. Myres: Huxley Lecture.

Thursday, November 30

KING'S COLLEGE, LONDON, at 3.—Sidney Smith: "Babylonian Mathematics".*

Friday, December 1

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. R. Ricardo: "High-Speed Diesel Engines for Marine Service" (Thomas Lowe Gray Lecture).

Official Publications Received

GREAT BRITAIN AND IRELAND

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1932. Part 2. Pp. iv+142+10 plates. (London: H.M. Stationery Office.) 3*s*. net.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 14: The Petrography of the Lower Carboniferous Rocks of North-East Ireland. By J. H. Adamson and G. F. Wilson. Pp. 179–190. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Three Lectures embodying "A Survey of Modern Inorganic Chemistry". By Dr. Gilbert Thomas Morgan. Pp. 106. (London: Institute of Chemistry.)

Medical Research Council. Special Report Series, No. 186: Medical Uses of Radium; Summary of Reports from Research Centres for 1932. Pp. 36+2 plates. (London: H.M. Stationery Office.) 1*s*. net.

Proceedings of the University of Durham Philosophical Society. Vol. 9, Part 2, June. Pp. iv+47–116+x. (Newcastle-upon-Tyne: Armstrong College.) 5*s*.

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 3, No. 21: Geology and Petrology of the Dolerites of Spitsbergen. By Dr. G. W. Tyrrell and Dr. K. S. Sandford. Pp. 284–321. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3*s*. 6*d*.

Proceedings of the Cambridge Philosophical Society. Vol. 29, Part 4, October 30. Pp. 441–547. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 44, Part 3, October 25th. Pp. 227–378. (London: Edward Stanford, Ltd.) 5*s*.

Mathematical Notes. Edited by Dr. A. C. Aitken. No. 28, September. Pp. xxiii. (Edinburgh: Edinburgh Mathematical Society.)

Survey of Thunderstorms in the British Islands, 1925–1936. Summer Thunderstorms: Second Annual Report, 1932. Pp. 28+4 plates. (Huddersfield: Thunderstorm Census Organisation.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1543 (T. 3400): Wind Tunnel Tests on Aerofoils R.A.F. 38 and 48. By K. W. Clark and W. E. Wood. Pp. 6+6 plates. 6*d*. net. No. 1544 (T. 3394): Interference of a Wind Tunnel on a Symmetrical Body. By H. Glauert. Pp. 8+3 plates. 6*d*. net. No. 1548 (S. and C. 502): Influence of Wing Elasticity upon Longitudinal Stability. By A. G. Pugsley. Pp. 11+1 plate. 9*d*. net. No. 1549 (I.C.E. 918): Fuel Volatility and Carburettor Freezing. By W. C. Clothier. Pp. 14+7 plates. 9*d*. net. No. 1550: Reports and Memoranda published between 1st April 1932 and 1st September 1933. Pp. 7. 6*d*. net. No. 1555 (T. 3405): Effect of Ailerons on Spinning of Bristol Fighter. By A. V. Stephens. Pp. 7+5 plates. 6*d*. net. (London: H.M. Stationery Office.)

Journal of the Chemical Society. October. Pp. iii+1289–1423+vi. (London: Chemical Society.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 9, September. Abstracts Nos. 1450–1653. Pp. 285–324. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

OTHER COUNTRIES

Cornell University Agricultural Experiment Station. Bulletin 558: Ventilation of Poultry Houses for Laying and Breeding Hens. By John C. Huttar, F. L. Fairbanks and H. E. Botsford. Pp. 48. Bulletin 560: The Income, Savings and Work of Boys and Girls on Farms in New York, 1930. By Howard W. Beers. Pp. 36. Bulletin 569: Insect and other Injuries to Potato Tubers. By G. F. MacLeod and W. A. Rawlins. Pp. 14. Bulletin 570: Soil and Field-Crop Management for St. Lawrence County, New York. Part 1: Soils and Field-Crops, by A. F. Gustafson; Part 2: Pasture Improvement and Management, by D. B. Johnstone-Wallace; Part 3: Soil Map and Soil-Type Descriptions, by F. S. Howe and A. F. Gustafson. Pp. 52. Bulletin 576: The Cornell University Dairy Herd, 1889 to 1928. By Henry H. Wing. Pp. 64. (Ithaca, N.Y.)

Agricultural Experiment Station of the Rhode Island State College. Bulletin 238: The Efficacy of Pigeon Pox Vaccine in the Vaccination of Chickens against Fowl Pox. By John P. Delaplane and H. O. Stuart. Pp. 8. (Kingston, R.I.)

Colony and Protectorate of Nigeria. Annual Report on the Geological Survey Department for the Year 1932. Pp. ii+36+5 maps. (Lagos: C.M.S. Bookshop; London: Crown Agents for the Colonies.) 3*s*. net.

Antigua: Colonial Development Fund: Sugar-Cane Moth Borer (*Diatræa*) Investigations. Outline of Work done in Antigua during the Year 1931. By Harold E. Box. Pp. 10. Outline of Work done in Antigua and St. Kitts during the Year 1932: Report upon the Introduction and Establishment of the Cuban Parasite (*Dixophaga diatrææ* Townsend. By Harold E. Box. Pp. ii+40. (St. John's, Antigua.)

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 5, No. 9, Mathematics No. 6. Pp. 369–394. (Taihoku.)

Contributions to Embryology. Vol. 24, Nos. 139–143. (Publication No. 443.) Pp. iii+203+31 plates. (Washington, D.C.: Carnegie Institution.)

Proceedings of the American Philosophical Society. Vol. 72, No. 5. Pp. 285–369+25 plates. (Philadelphia.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Research Paper 582: Continuous Measurements of the Virtual Heights of the Ionosphere. By T. R. Gilliland. Pp. 141–146+8 plates. (Washington, D.C.: Government Printing Office.) 5 cents.

Minist re de l'Éducation Nationale. Enquêtes et documents relatifs à l'enseignement supérieur, 127: Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe, année 1931. Pp. 132. (Paris: Imprimerie Nationale.)

Studies in West Indian Soils. 6: Some Soil Types of Jamaica; their Origin, Formation and Agricultural Fellowships. By F. Hardy and H. H. Croucher. Pp. 44. (Trinidad: Government Printing Office.) 2*s*.

U.S. Department of the Interior: Geological Survey. Bulletin 845: Guidebook of the Western United States. Part F: The Southern Pacific Lines, New Orleans to Los Angeles. By N. H. Darton. Pp. vii+304+49 plates+29 maps. (Washington, D.C.: Government Printing Office.) 1 dollar.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 45: Australian Export Apple Cases. By W. M. Carne and R. F. Turnbull. (Division of Forest Products, Technical Paper No. 10.) Pp. 48. (Melbourne: Government Printer.)

The Forest Research Institute, Dehra Dun, U.P. Pp. ii+12+2 plates. (Delhi: Manager of Publications.) 3 annas; 4*d*.

The Indian Forest Records. Vol. 18, Part 5: Entomological Investigations on the Spike Disease of Sandal, (8): Carabidæ (Col.). By H. E. Andrewes. Pp. iii+21+3 plates. 7 annas; 9*d*. Vol. 18, Part 8: Entomological Investigations on the Spike Disease of Sandal, (11): The Life-History and Morphology of *Sarima nirocylpeata*, Mel.; Fulgoridæ (Homopt.). By N. C. Chatterjee. Pp. iv+26+2 plates. 12 annas; 1*s*. 3*d*. Delhi: Manager of Publications.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 120: Preliminary Notes on some Entomogenous Fungi in Egypt. By Dr. R. M. Nattrass. Pp. ii+9+6 plates. 5 P.T. Bulletin No. 129: Fowl-Plague in Egypt; Fowl-Disease or Fowl-Plague of New-castle, Egyptian Pseudo Fowl-Plague. By Prof. Dr. M. Carpano. Translated from the Italian by E. Talarewitch. Pp. 22+6 plates. 5 P.T. Bulletin No. 133: Règles relatives à la tuberculinisation des animaux domestiques en Egypte. Par Prof. Dr. M. Carpano. Pp. 16. 2 P.T. (Cairo: Government Press.)

Journal of the Indian Institute of Science. Vol. 16A, Part 6: i. Dilatometric Studies in Enzyme Action, Part 3: Contraction Constants of Enzyme-Substrate Reactions, by H. B. Sreerangachar and M. Sreenivasaya; ii. Physiological Products of the Lac Insect, Part 1: A Preliminary Investigation, by N. K. Ranga Rao and M. Sreenivasaya. Pp. 69–83. 1 rupee. Vol. 16A, Part 7: i. Studies in the Proteins of Indian Foodstuffs, Part 5: The Alcohol Soluble Protein of Fenugreek (*Trigonella Fœnum Græcum*), by Y. V. Sreenivasa Rao, B. N. Sastri and M. Narayana; ii. The Mucilage of Fenugreek (*Trigonella Fœnum Græcum*), by C. R. Harihara Iyer and B. N. Sastri. Pp. 85–90. 8 annas. Vol. 16A, Part 8: i. Contributions to the Study of the Spike-Disease of Sandal (*Santalum Album*, Linn.), Part 13: Investigation of the Hexone Bases, by Y. V. Sreenivasa Rao; ii. Contributions to the Study of the Spike-Disease of Sandal (*Santalum Album*, Linn.), Part 14: Study of Mosaics associated with Spiked Areas, by Y. V. Sreenivasa Rao. Pp. 91–95. 8 annas. (Bangalore.)

CATALOGUES

Cambridge Index Thermometers and Thermographs. Pp. 6. (London: Cambridge Instrument Co., Ltd.)

A Catalogue for the General Reader: History and Biography (English and Foreign), Art and Literature, and other Books of Interest. (No. 468.) Pp. 36. (Cambridge: Bowes and Bowes.)

Book Bargains. Pp. 80. (London: W. J. Bryce, Ltd.)