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Human Biology and Politics

AT the beginning of his Norman Lockyer lecture to the British Science Guild on November 28, Prof. J. B. S. Haldane remarked that Sir Norman was fortunate in that "His work on the chemistry and physics of the sun, revolutionary as it was from the point of view of pure science, did not bring him into conflict with established interests either in religion or politics". In this respect, he and other astronomers are to be envied, for they are immune from many of the dangers and difficulties that beset anyone who serves a science which deals with living things.

The number of the editions of several recent popular books on astronomy can be taken as a measure of the layman's interest in this subject. The books themselves possess great intrinsic value, being models of what such books should be, but this is not the reason why they have become 'best sellers'. We may assume that it is because the layman eagerly seeks information that he does not possess, and because the magnificence of the heavens would seem to proclaim the glories of the Creator, that these books are so much in demand.

With biology, however, things are very different. Popular books on biology, though equally well written, have not the same appeal. They cannot have, for it is rare to meet a layman who, though readily acknowledging his complete ignorance of the chemistry and physics of the sun, has not very definite ideas about the application of biology to human affairs. The specialist is commonly neither required nor welcomed. Almost every year sees the publication of a new book on sex written by someone who disregards completely everything that biological science has to say on this subject. The germ theory of disease is regarded as mere foolishness by thousands, who look upon orthodox medicine as being sadly mistaken. Apparently the only people who tend to preserve an open mind on such matters as birth control, eugenic sterilisation or euthanasia, are to be found in the ranks of biology and medicine. The trained biologist, speaking or writing on the biology of man, inevitably encounters fierce antagonism.

It is obvious that a science of social biology must exist and must develop. Biology concerns itself with the individual and the group in relation to the habitat, with the conditions of the habitat in relation to the vital processes of the individual and the group, and with the distribution of biological types within a varying environment.

This has long been recognised by the medical profession, for, so far, the application of biology to human affairs has been almost entirely the affair of the medical sciences. That this is so is not surprising, for medicine deals largely with the sick, and with illness comes fear, and with fear a willingness to receive help. There is more research now being carried out in the name of medicine than in almost any other cause; the thought of cancer evokes the greatest terror. The only other organised body which is concerned with the application of biology is the eugenic group, but the weakness of eugenics lies in the fact that it addresses its appeal to the strong, to idealism rather than to fear. Moreover, many of its policies are as yet in conflict with public opinion.

Prof. Haldane's lecture, which has now been published*, deals with certain aspects of the results of this contact between human biology and politics. He argues that, as our knowledge of human biology increases, the need for experts—experts on human genetics, population, nutrition, housing, reproduction, for example—will become more and more acute, and expresses the view that it is undesirable that these shall be included in the ranks of medicine. The medical man should be concerned with healing and not with killing, and, in any event, any large increase in the personnel and duties of medicine must lead to an undesirable hypertrophy that must end in disaster. It is true to say that the expert on human biology need not be a medical man, but surely it is eminently desirable that the medical man shall regard himself as an applied biologist, for in dealing with the individual he must necessarily be dealing also with the group, the family, and with problems of nutrition, housing and reproduction. Even though there be non-medical experts for the construction of policies, the execution of these must surely be performed by the medical services. But one's opinions on a matter such as this are largely decided by the possession or otherwise of a medical degree.

Dealing with the problems of human reproduction and population, Prof. Haldane points out that the population of England is likely to diminish very greatly in the near future. The net reproduction rate for England is 0·75; and wherever this rate is less than unity, the population is bound to fall.

"The net rate is below unity throughout North-Western Europe, including France and Germany. It is near unity in central Europe, and rapidly dropping towards that figure in Italy and the Balkans. For example, the net reproduction rate in Bulgaria fell from 1·9 in 1903 to 1·3 in 1929, and is probably now very little above unity. In the United States it probably fell below unity in 1927. In the British self-governing dominions it is still slightly above unity, but approaching that figure. The position in the U.S.S.R. and Japan is entirely different. In 1926–7 the net reproduction rate of the former country was 1·7; that of Japan is also very high, though really adequate figures are lacking. It is of course probable that in both these countries industrialization will ultimately lower fertility, but there are as yet no clear signs of this tendency."

Prof. Haldane discusses the political consequences of a falling birthrate, and concludes that any catastrophic fall is undesirable and should be prevented. He suggests as a means to this end the institution of a system of family allowances and the establishment of a recognised minimum dietary. On the question of the quality of population, he deals with three policies that are commonly presented: the elimination of certain relatively rare and undesirable types, the encouragement of a differential fertility on the part of the various social groups, and the control of immigration. He shows that, in most cases, elimination through enforced non-propagation would only have a slight effect upon the incidence of the undesirable in the population, and concludes that the scope of negative eugenics as applied to physical defects is severely limited. He is opposed to the policy of wholesale sterilisation, which to him seems to be the policy of those who consider sterilisation to be a cheaper alternative to segregation. As a biologist, he is prepared to advocate the voluntary sterilisation of the possessors of a harmful dominant gene.

Prof. Haldane's lecture is remarkable not only for the variety and cogency of the argument, but also for the reason that, recognising his responsibilities, he deliberately suppresses many views that he is known to hold. Rather than parade his own preferences, he stresses those opinions, not necessarily his own, which enjoy a sufficiently general support to render them worthy of consideration not only by biologists but also by politicians of all shades of opinion. The lecture admirably represents a biological expression of the objects of the British Science Guild: "To promote the application of scientific methods and results to social problems and public affairs".

* Human Biology and Politics. (The Norman Lockyer Lecture, 1934.) By Prof. J. B. S. Haldane. Pp. 23. (British Science Guild, 6 John St., Adelphi, London, W.C.2, 1934.) 1*s*.

Clinical Medicine and Science

IN the anniversary address delivered before the Royal Society on November 30, the president, Sir Frederick Gowland Hopkins, devoted particular attention to the relation between clinical medicine and science.

After alluding to the extraordinary progress which atomic physics continues to make and the remarkable response of atoms to various forms of treatment, he pointed out that the subject he had chosen is of special interest to the Royal Society inasmuch as it has received large bequests to support original research in medicine devoted to improvement in the treatment of disease and the relief of human suffering. He illustrated the close relationship between practice in the wards and activity in the laboratory by two recent advances which, taken together, served in a sense as a text for the rest of his address.

The first of these was the investigation carried out by means of the oscillograph method by the Foulerton research professor, Prof. E. D. Adrian, with his colleague, Mr. Brian Mathews, on the electrical changes which take place in the brain, with the object of relating the potential changes in the brain with the changes in individual nerve cells. The rhythmic activities of the human brain recorded as a series of waves after passing through the skull were shown by this method to be temporarily abolished by concentrated thought such as that involved in mental arithmetic. Sir Frederick suggested that further development of the technique might serve the clinical investigator of the brain as the cardiograph has served those concerned with the heart.

The second example of the assistance given to clinical medicine by the laboratory is furnished by the study of the virus of influenza, in which Mr. Laidlaw, in collaboration with Drs. Andrewes and Wilson Smith, who had previously shown that influenza can be transmitted to the ferret, proved that the mouse can also be infected, and thereby made the approach to various aspects of the problem much easier. Such progressive research, due entirely to the laboratory, is of prime importance alike to clinical and laboratory medicine, and being inspired by clinical experience illustrates the now generally recognised interdependence of the ward and the laboratory.

Sir Frederick next dealt with the uneasiness apparently felt by some physicians with regard to the introduction of multitudinous laboratory methods into the domain of diagnosis. While it is an open question as to whether reliance on laboratory reports destroys the clinical sense, as some are inclined to believe, he instanced the objections raised to the use of the stethoscope when it was first introduced by Laennec, on the ground that it was fatal to the dignity of the physician and brought only discomfort to the patient. Although a few may still be inclined to regard each diagnostic aid from the laboratory with a similar distrust, it is to be hoped that the practitioner will be ready to avail himself of every diagnostic assistance without impairment of his clinical sense.

Sir Frederick then proceeded to give a historical sketch of clinical science based on the classification of Sir Thomas Lewis, who grouped its activities in three categories. The first was the discovery of disease, or a clear description of specific diseases or states, which has been the aim of enlightened clinicians ever since the escape of medicine from Galenic authority in the seventeenth century. The second was experimental work on clinical cases, and the third the application of physiological discoveries to human material. The ignorance of the medical profession as to the nature of disease when experimental study of it began and the Royal Society was founded was illustrated by the appalling treatment of its founder, Charles II, in his last illness, when Galenic teaching was still predominant. How William Harvey, the indisputable father of clinical science, who had a thorough contempt for the Galenic teaching of his contemporaries, would have regarded such treatment, is best left to the imagination.

It is noteworthy that of the 146 original fellows of the Royal Society in 1663, 24, or nearly one sixth of the whole, were medical practitioners, while only one outstanding physician, Thomas Sydenham, did not join it, doubtless owing to his hatred of theory and any kind of deductive speculation. Sydenham, who was a pioneer in the discovery of disease in Sir Thomas Lewis's sense, held that each disease was an entity apart from the particular patient, and taught that the clinician's task was to reduce diseases to certain definite species, as botanists were doing in the classification of plants.

Continuing his historical sketch, Sir Frederick pointed out that there was no outstanding advance in the theory or practice of medicine in the eighteenth century, and that it was not until the rise of the great French school in the early years of the nineteenth century that real medical progress took place. With the notable exception of Broussais, who vehemently opposed the doctrine of specificity, the principal physicians in Paris shared Sydenham's belief in specific diseases as entities, and classified them accordingly, but they added something to mere observation of symptoms

as a basis for their classification. Thus Bichat, who was a profound student of morbid anatomy, emphasised the importance of relating the specificity of each disease to the nature of the fundamental tissues attacked rather than to the disturbances in individual organs.

The views of Broussais, who rejected the conception of diseases as entities and insisted that disorders of function should receive more attention, were supported by the contemporary school of Vienna, which maintained that the task of the physician was to identify in the patient the various individual lesions of morbid anatomy.

Meanwhile, the leading English-speaking physicians, such as Addison, Bright and Hodgkin in London, and Graves, Stokes, Cheyne and Adams in Dublin, were bringing about real advances in clinical medicine by the clear demonstration of diseases and clinical states with which their names are associated.

The great movement in German medical thought which culminated in the middle of the nineteenth century was associated with a strong reaction against all claims of specificity based on the mere assembling of associated symptoms. Virchow in particular maintained that French and British ontology had impeded real progress in scientific medicine, and believed that with its destruction the use of a treatment falsely called specific would also disappear.

On the other hand, the doctrines of Sydenham and the leading representatives of the French school, among whom Sir Frederick omits to mention Bretonneau, to whom Trousseau was indebted for his views on specificity, were later confirmed by the discoveries of Pasteur, whose laboratory work did more to clarify medical thought than most of the doctrines emanating from the medical schools, inasmuch as he replaced a mysterious something by the highly objective micro-organism as the cause of certain infectious diseases. Sir Frederick, however, pointed out that the presence of bacillus or virus, though an efficient cause, is not necessarily a sufficient cause of a disease, and that the constitutional factor, on which much emphasis has been laid in recent years, must also be considered in the causation, especially in the case of non-infectious diseases, and is doubtless susceptible of analysis by modern methods.

In forecasting the activities of clinical science, Sir Frederick expressed his conviction that the scope for really controlled experiments applicable to the intact human body is limited. He suggested that there are relatively few experimental fields for clinical science besides those of cardiology and related subjects in which Sir Thomas Lewis is engaged, and the studies of Prof. Edward Mellanby on nutrition in relation to disease (see NATURE of December 1, p. 830). On the other hand, there are many wide fields in laboratory science, and particularly those of biophysics and biochemistry, the cultivation of which will continue to benefit medicine.

Sir Frederick deprecated the growing tendency in Great Britain and elsewhere to distribute the funds provided for medical research in the endowment of the clinic at the expense of fundamental biological science, as he is convinced that such a policy will sterilise advance. In support of this conviction, he quoted Charcot's dictum that the clinic "without scientific renovation soon becomes a belated routine and, as it were, stereotyped".

In conclusion, Sir Frederick expressed the hope that the Royal Society, though its special duty is the encouragement of pure science, will continue to endow whatever fields of research might at any moment promise to offer most help towards progress, whether in the narrow region of clinical science or in the wider regions of pure science.

Maison de la Chimie, Paris

THE inauguration of the Maison de la Chimie by the President of the French Republic, which had been postponed for a month owing to the assassination of the King of Yugoslavia at Marseilles, took place on December 1. An international gathering of unusual brilliance witnessed this important step towards the co-ordination of scientific endeavour. Twenty-four countries were represented, and among the delegates from Great Britain were Prof. H. E. Armstrong (Royal Society and Federal Council of Chemistry), Mr. W. A. S. Calder (Institution of Chemical Engineers), Prof. C. S. Gibson (Royal Society), Dr. T. A. Henry (Wellcome Research Institution), Mr. Emile Mond (Federal Council of Chemistry and Chemical Society), Sir Robert Robertson (British Government), Mr. Richard Smith, Mr. Edwin Thompson and Prof. J. F. Thorpe (Institute of Chemistry), Mr. Thomas Pearson, of the International Chamber of Commerce and Sir Robert Cahill of the British Embassy. An excellent copy of the painting by Sir Thomas Lawrence of Sir Humphrey Davy was given to the "Maison de la Chimie" by a group of English chemists, whilst Mr. and Mrs. Emile Mond presented a replica of the bust of Faraday, the original of which is at the Royal Institution.

In the large and imposing hall, which will serve as meeting hall for future congresses, speeches

were delivered by the French Minister of Education, by M. Behal of the Academy of Sciences, by Prof. E. Biilmann of Denmark and by Sir Robert Mond, emphasising the importance of the event and the debt which chemistry owes to Marcelin Berthelot, to whose memory the Maison de la Chimie is dedicated. It was, in fact, in 1927, on the occasion of the Berthelot centenary, that an international appeal was made for funds for the erection of a centre for chemistry in Paris. To this fund sixty-five countries contributed, the total amounting to 25 million francs ; £12,000 was contributed from Great Britain, of which £9,000 came from Sir Robert Mond. The French Government gave to the Centre the historic building of La Rochefoucauld d'Estissac, rue St. Dominique, just behind the Chamber of Deputies (Fig. 1). Since 1931, extensive alterations have been made to this building, and two new wings added (Fig. 2) so that it is now admirably fitted for its new functions, which are to provide a meeting place for scientific societies and congresses and to supply information which it hopes to place at the disposal of those engaged in every branch of chemistry.

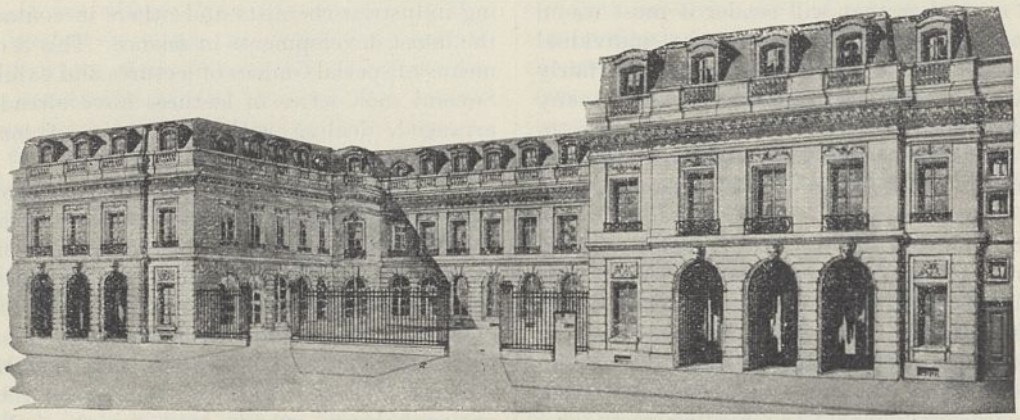

FIG. 1. Drawing of the front of the Maison de la Chimie.

Its organisation covers three spheres of action :

(1) The "Centre Marcelin Berthelot", which supplies facilities for meetings and offices for scientific societies ;

(2) A Centre of Chemical Documentation ;

(3) A Section of Technical Improvement.

With regard to the first, it is possible for a chemical society to have its own separate office within the building, or simply to have there a postal address and to share office facilities. Such affiliated bodies bring to the Centre their libraries. While remaining technically their property, the books are assembled and catalogued so that they are generally available. Each affiliated society pays about one shilling a year for each member for the facilities afforded to its members (*adherents*).

The services offered by the Centre as a meeting place are very extensive. There are reception rooms, committee rooms (for 20–50 people), conference rooms (for 35–100 people), banquet rooms where up to 500 people can be entertained, and a large congress hall which accommodates about one thousand. The amphitheatre with some two hundred individual seats has extensive facilities for chemical experiments, and several projection screens that can be used simultaneously. Microscopic, cinematographic and direct projection of

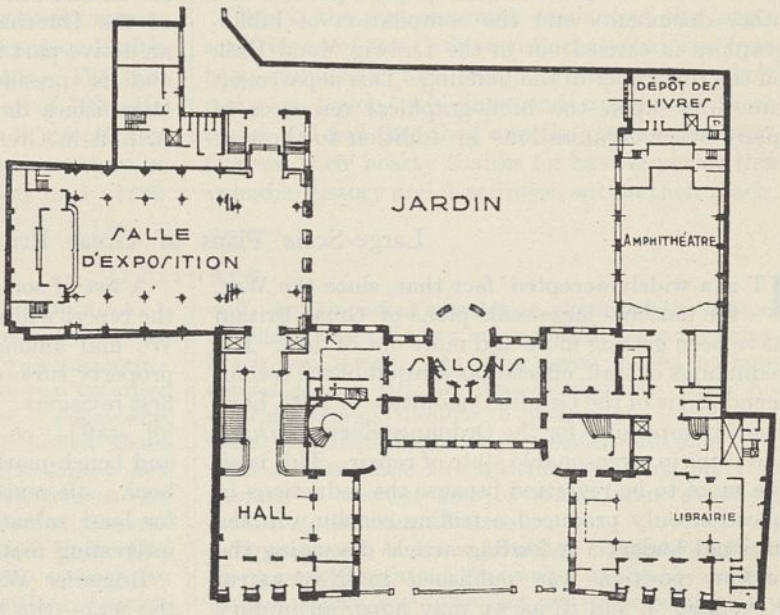

FIG. 2. Plan of the Maison de la Chimie.

experiments are all provided for. Individual microphones for the use of deaf persons can be connected to thirty seats, apart from the usual microphones used by the lecturer.

The Centre of Documentation aims not only at being a depository of all chemical knowledge, but also hopes to select, extract and arrange such knowledge in a manner that will render it most useful and most readily available to the individual investigator. It should be able to prepare fairly complete bibliographic information upon any chemical subject referred to it, supply photographic copies of the less easily available material, and translate matter from one language into another when necessary. It follows that the members of its staff will have to be highly trained, and many of them will need that particular flair that enables one to pick up from a large amount of material the essential facts that are likely to be useful in a given problem—by no means an easy undertaking, yet one which must be faced.

As regards equipment, the reading room provides at present for thirty readers, and is equipped with special optical and acoustical apparatus, since the library includes not only printed material but also films, gramophone records, etc. A glass partition separates the reading room from a smaller 'conversation' room, also provided with telephones.

The abstracting of scientific papers, patents and other documents and the compilation of bibliographies is carried out in the Ludwig Mond Hall, on the third floor of the building. This department can draw upon the bibliographical resources of many other organisations in addition to those of the Maison de la Chimie. This last is affiliated to the Union française des Organismes de Documentation, the task of which is to co-ordinate the great libraries of Paris.

The third section of the Maison de la Chimie is the Centre of Technical Improvement (Centre de Perfectionnement technique), which aims at keeping industrial chemists and others in contact with the latest developments in science. This it does by means of special courses of lectures and exhibitions. Several such series of lectures have already been arranged, dealing with new types of materials, the organisation of industry, etc.

The success which has attended the centralisation of chemical documentation and facilities in the Maison de la Chimie has opened even wider horizons. A "Cité des Sciences" is now being suggested, which would bring together all branches of science, act as a link between them, co-ordinate their discoveries and render them available to workers in every field, and strengthen the international bonds which bind together all those engaged in scientific work.

Many people have helped to bring about the successful completion of the Maison de la Chimie, but there can be no doubt that credit rests largely with its active *administrateur*, M. Jean Gérard, to whose vision and energy every one of those present at the inauguration paid a well-deserved tribute. M. Gérard has been for many years the secretary of the International Union of Chemistry, takes an active part in the editing of *Chimie et Industrie* and is president of the Union française des Organismes de Documentation (corresponding to ASLIB in Great Britain).

Large-Scale Plans of Great Britain

IT is a widely accepted fact that, since the War, the national large-scale plans of Great Britain have been getting more and more out of date. The reductions of staff, effected as a result of the recommendations of the Geddes Committee of 1922, have made it impossible for the Ordnance Survey to keep the plans in a reasonable state of repair. This is all the more to be regretted because the reductions in question only produced a trifling economy in the national budget. A leading article discussing the present position was published in NATURE of November 3, and if, as we may hope, an inquiry is to be held into this matter, a recent publication by the Director of the Ordnance Survey* will provide a sure foundation of fact upon which it can be based.

* Ordnance Survey. Professional Papers, New Series, No. 16: The National Plans (The Ten-Foot, Five-Foot, Twenty-five-inch, and Six-inch Scales). By Brigadier H. St. J. L. Winterbotham, Director-General of the Ordnance Survey 1934. Pp. 112+27 plates. (London: H.M. Stationery Office, 1934.) 4*s*. 6*d*. net.

A list of some of the headings of the sections of the report will serve to give an idea of its character. We find amongst these headings :—early British property surveys ; foreign analogies ; city scales ; first revisions ; a pre-War stocktaking ; reductions [of staff] ; co-ordinates and sheet lines ; levels and bench marks ; areas ; boundaries ; the name book ; air revision ; plans for registration ; plans for land valuation ; surveys for tithes, and other interesting matters.

Brigadier Winterbotham rightly says that, in the main, the history of the Ordnance Survey in the century before this year, that is, since 1834, remains to be written, and he remarks that the history of our large-scale plans is particularly vital. "The times are difficult. Short cuts and next bests suggest themselves in a variety of ways. It is time to take stock of where we are going."

Two generations ago, a commission of inquiry

gave a list of seventeen purposes which come properly within the scope of a national survey, and to this number we may now add four more at least, namely, town and regional planning, the conveyance of property, land registration and land valuation. Here it is very appropriately pointed out that, chiefly as the result of Colby's foresight in 1825, it has always been the custom on the British large-scale plans to depict the actual physical features of the countryside on which the property boundaries depend, and not the boundaries themselves. "There seems to be no foreign analogy for the use in property questions of a map which shows no property boundaries as such. But then, in England, whether the actual boundary is coincident with the wall, fence or hedge, or not, the owner and his neighbours know at once from his enclosures what land he actually makes use of" . . . "A purchaser going upon the property he is about to buy, with an accurate plan in his hand, can, in nine cases out of ten, identify the thing which he is buying with as much ease and certainty as if he had lived upon it all his life."

A good account is given of the city scales, namely, those of 1 : 500, often called the ten-foot scale, the 1 : 528, which is the true ten-foot scale, and the 1 : 1056 or five feet to the mile. These are beautiful and elaborate plans, executed on these various scales between 1843 and 1894, when they were discontinued by order of the Treasury, except in cases in which the local authority agrees to pay the extra cost involved as compared with the cost of the twenty-five inch plans. The last case of the kind was the Leeds survey of 1909–10, so that the arrangement nowadays is practically obsolete. For land registration, elsewhere than in London, enlargements of the 1 : 2500 to 1 : 1250 are used—not a perfect solution, but inexpensive.

The work contains much well-described technical matter, and will give an idea of the complexity of some of the problems dealt with. It may also serve to show that many of these problems have been discussed and examined at various times during the past century. But of course there are also new methods, and among these we may note the use of air photographs for large-scale revision. Various experiments have been made, chiefly with the view of seeing if economy would thereby result in the revision of the twenty-five inch plans. The question is not being allowed to drop, but it looks as if "town air revision may pay and country work certainly not". But much must depend upon the cost of the air photographs. The matter is not quite so straightforward as it might seem.

The report is well-illustrated. We find comparisons of the plans of twenty years ago and more with those of to-day. Examples are given of maps prepared for the Land Registry and of surveys for tithe redemption ; and there are several interesting graphs which illustrate the amount of time spent on different classes of work. There is a useful chronology extending from 1820 to the present year. Indeed, anyone who desires to be correctly informed as to the many social and technical aspects of the national large-scale plans cannot do better than consult this work.

This is the first thorough account of the large-scale plans of the Ordnance Survey that has ever been published, and many of those—and their name is legion—who use and appreciate these plans, will feel that they owe the present Director-General their hearty thanks for having placed this valuable history and description within their reach.

Obituary

PROF. SANTIAGO RAMON-Y-CAJAL, FOR.MEM.R.S.

THE microscopy of the nervous system had, by the latter half of last century, grown into something of a special study. It relied on its own votaries, not many but distributed world-wide. Fellowship in their somewhat recondite pursuit united them quasi-socially into a sort of family, a family not shrewdly discontent with its own achievement nor indeed gravely perturbed by a slowness of progress which seemed to challenge eternity. Upon this pedestrian tradition, when the century entered its final decade, burst suddenly an astonishing Spanish master. Santiago Ramon-y-Cajal of Valencia was then close on forty years of age. From the Pyrénnean slope, in a mountain village, where his father practised among the peasants, he had, when his parents moved, with their bare savings, to Zaragoza, been little of a success at school. So little in fact as to be twice withdrawn thence, once to assist a barber, and once again for apprenticeship to cobbling. He did cobbling well, but his father's ambition cherished the scalpel for him, though the boy's own pleading was for paint-brush and pencil. In after years indeed he substantiated his gift for draughtsmanship when his drawings became familiar to students the world over. Other recorded likings of the recalcitrant schoolboy were at that time the watching of birds and the reading of travels, and of these latter as prime favourite "Robinson Crusoe".

To anatomy, however, Santiago eventually settled down, under his father, its teacher at the University. Ramon senior was planning an anatomical atlas ; for this, his son made drawings ; but no publisher was found. Following medical study came military service, in Cuba, where he contracted malaria and tubercle. He returned after slow recovery to Zaragoza, this time as anatomical assistant. He secured his doctorate ; in 1884 he gained the chair of anatomy at Valencia. There in his house he installed a microscope and a tiny laboratory. He examined nerve

tissue. Chick, earthworm, mouse and lizard served for material. He worked in isolation, with an urge amounting to a fury of curiosity and enthusiasm. He extended his technique on lines of his own, suggested from photography. Expense hampered him; he would mount on a single slide a dozen different things. He could afford no illustrations save his sketches. But he made his observations with a fidelity and an understanding which as the world now knows were supreme.

Cajal's observations sometimes would not tally with accepted views. The dense thicket of minute fibres in the grey matter of the brain and spinal cord was regarded at that time as a reticulum, a network of unbroken continuity spread homogeneously in its several directions. It was interpreted functionally as being either diffusely conductive or perhaps simply trophic, serving to nourish the cells scattered in it. The more Cajal examined this thicket the more did it seem to him clearly resoluble into discrete many-branched nerve cells linked on a definite plan into perfectly determinate chains. Moreover, the direction of nervous conduction along these chains he found could be read ("ley di polarizacion del cellula nervosa") by noting certain features repeating themselves from cell to cell. He had in fact analysed the brain and the nervous system generally, vertebrate and invertebrate, into branching cell-chains, chains, in electrical parlance, arranged both in series and in parallel. He traced the main paths through the grey matter of the optic lobes (birds), the retina, the cerebrum, the cerebellum and the spinal cord.

The fresh conception thus established and placed on a factual basis by Cajal was presently christened, by one who had no hand in its making, the 'neurone theory', a little unwelcomely to Cajal. Cajal's recognition of the morphological discontinuity between cell and cell in the nervous system, agreeing as it did with observation of the cell limits given by Wallerian degeneration, had repercussions on the sister-study, physiology. It led indirectly to the functional conception summed up under the term 'synapse', a term adopted by Cajal. From Cajal derives therefore more or less directly even that latest phase of nerve study, in the forefront of discussion to-day, which asks whether the mechanism of the synapse, that is, the mode of transmission of excitement from one nerve cell to another, is in nature chemical or physical.

Somewhat similarly, under Cajal's analysis, that hitherto difficult tissue which supports and imbeds the active nerve cells throughout the brain and cord resolved itself into separate cells of clearly distinctive subtypes, and with specific fibres of their own. His study of these cells laid the basis for a classification of them, and so incidentally of the modern classification of tumours of the brain, to which unfortunately this supporting specialised tissue makes large contribution.

In 1894, at invitation of the Royal Society, Cajal delivered in London the Society's Croonian Lecture. This recognition was an early satisfaction to him, and its recollection remained a pleasure with him all his life. His work suffered some disadvantage from being published in Spanish. This disability grieved him, less for himself than as a mark of the scanty scientific intercourse of Spain. The periodicals which contained his early discoveries did not get access to libraries in the British Isles. He felt passionately this relative scientific isolation of his country. He laboured unremittingly for Spain to be better equipped in science and for Spanish contributions to science to be better known internationally. His endeavour in those directions has, as we know, been not without success, but has scarcely met in some directions with due assistance from outside. To judge by the present "World List", those periodicals which published his discoveries first are now, forty-seven years later, still not on the intake-list of any scientific, medical or university library in the British Isles. In our library system, extravagant overlap of foreign intake in some directions is coupled with inadequate foreign intake in others. Such lag in dissemination of discovery, as happened with Cajal—and with Gregor Mendel—will assuredly recur, with all its disabilities for us, until such time as our libraries co-ordinate better their foreign intake by revision and sisterly co-operation.

Promoted to Madrid (1892), Cajal there formed a great school. It sent forth famous pupils; to name but a few: the brilliant Achúcarro, early cut short by death; Rio Hortega, the foremost authority on neuroglia; Tello, now head of the Instituto Cajal itself; Lafora, the accomplished physiologist; and, among later disciples, Wilder Penfield, distinguished director of the new Institute of Neuro-Surgery at Montreal. Cajal founded his *Rivista* in 1896, continued as *Trabajos* in 1901. He produced his extensive "Textura del Sistema Nervioso" (1897–1904). He visited the United States to lecture at Clark University. In 1906 he was awarded the Nobel Prize. His period of productivity was long. His latest large work was an amplified edition (1928) in English of his "Degeneration and Regeneration of the Nervous System". Only last year came his masterly little "Neuronismo o Reticularismo", a summary of conclusions on the question he had so early raised, and settled. He died in mid-October of this year at the ripe age of eighty-three years.

Cajal's position in his own country had for many years been one of universal veneration. His opinion was sought on educational matters by authorities of all parties. He had become a national figure, an object of national pride. He was regarded indeed as a kind of living symbol of the scientific aspirations of a new and renascent Spain. His statue is prominent in the Buen Retiro Garden in Madrid. The celebration of him by the million-fold portrayal of a postal issue was proposed, but 'the Master' deprecated the proposal, and it fell through. We cannot, however, but think that, posthumously revived, such a memento, at once national and democratic, would have touched Don Santiago's heart. Be that as it may, the very proposal shows the position accorded to him in the Spanish world, a position accorded him with the sympathy and applause of the civilised world entire. C. S. S.

SIR VINCENT EVANS, C.H.

WE regret to record the death of Sir Vincent Evans, the well-known authority on Welsh history and antiquities, which took place in his eighty-eighth year at his residence at Chancery Lane, London, on November 14.

Evan Vincent Evans was born at Trawsfynnydd, Merionethshire, and after a period as schoolmaster, entered business. He came to London and eventually was appointed secretary, and later managing director, of the Chancery Lane Land and Safe Deposit Co., a post which he held until within a few months of his death.

Evans was inspired—no other term is fully appropriate—with an intense devotion to Welsh studies, and from the time he came to London was in touch with, and soon became one of the leaders of, Welsh circles in which a keen interest was taken in Welsh language, literature, history and antiquities. In fairness, it must be said that he soon became the main driving force which kept this interest alive and extended and strengthened its influence. He played a large part in the efforts to assure the official recognition of Celtic studies and the care of Welsh antiquities. His early efforts in this direction found expression through the Honourable Society of Cymmrodorion, of which he was secretary and editor of publications, including its periodical, *Y Kymmrodor*, and the National Eisteddfod Association, of which he became secretary and editor in 1881. Both these positions he retained until his death. His activity in administrative and editorial work was prodigious. Through his enthusiasm, and his power to inspire enthusiasm in others, he made the Cymmrodorion the most influential body, and its periodical *Y Kymmrodor*, as well as its other occasional publications, the most authoritative source in the study of Welsh history and antiquities, while through the National Eisteddfod Association he revived and fostered interest in the Welsh national gatherings and made them effective in promoting the development of modern Welsh literature and art.

Sir Vincent Evans's organising ability, his wide knowledge and his acquaintance with everyone interested in his subject, inevitably made his assistance indispensable in all academic and public movements connected with Welsh studies. He was chairman of the Royal Commission on Ancient Monuments in Wales and Monmouthshire, and of the Advisory Board of Ancient Monuments (Wales). He represented Wales on the Royal Commission on Public Records. He was a governor of the University of Wales and of its constituent colleges at Aberystwyth and Bangor. He was also a governor of the National Library and of the National Museum, as well as a member of the Board of Celtic Studies. He was for long active in the administration of the business of the Cambrian Archæological Association. In 1909 he was knighted for his services to Wales, was made a Companion of Honour in 1922, and received the honorary degree of LL.D. from the University of Wales.

WE regret to announce the following deaths :

Prof. Collier Cobb, professor of geology in the University of North Carolina, an authority on moving sands and shore line processes, on November 28, aged seventy-two years.

Sir Horace Lamb, F.R.S., lately professor of mathematics in the University of Manchester, on December 4, aged eighty-five years.

News and Views

Queen Mary College

ON December 12, H.M. the Queen is to present at Buckingham Palace the Royal Charter incorporating the East London College (University of London), and with this incorporation the College changes its name to Queen Mary College. The incorporation of the College has long been planned by the Council of the College and by the late principal, Mr. Hatton. It confers upon the College many powers and privileges which it has not in the past enjoyed. As an incorporated College of the University it becomes entirely independent of the Board of Education, and also acquires unrestricted ownership of the property vested in it, which includes the site of the Queen's Hall and Winter Garden, London, E., previously the property of the People's Palace, with which, and the Drapers' Company, the College has for many years had very friendly relations. The site of these buildings, which suffered from a fire a few years ago, will now be available for building extensions which the College has long required. The Charter also gives the College the power to confer honorary fellowships, and the Queen has graciously consented to be the first honorary fellow of the College which is to assume her name.

THE change of name of East London College has been felt desirable because the territorial designation in no way indicated the true functions of the College, which draws its students from all parts of the country and from abroad. It was desired to preserve the association with the queens of England which was begun by the laying of the foundation stone of the original technical school by Queen Victoria in 1887. The College was admitted as a school of the University of London in 1907, and throughout its career it has acquired a reputation for a high standard of work both in teaching and research. The College has for many years presented students for all degrees of the University covered by its curriculum, and its students have shared the academic honours of the University equally with those of the other colleges. The authorities of Queen Mary College hope that the great opportunity for extension which now presents itself will enable the College to provide more ample scope for teaching and research, and

will inspire further benefactors to give it the means to go forward with the work of placing the higher branches of knowledge within the reach of "persons of the poorer classes".

Portrait of Sir Flinders Petrie, F.R.S.

ON Sir Flinders Petrie's retirement from the Edwards professorship of Egyptology in the University of London, many of his friends and admirers desired to commemorate his long tenure of that chair. It was decided that the memorial should take the form of a portrait of the great pioneer in the science of archæology, to be presented to University College, where he had worked for forty years. An appeal for subscriptions met with a generous response and, on Sir Flinders Petrie's visit to England in the summer, the portrait was painted by Mr. Philip de Laszlo. On November 23, Sir Henry Lyons made the presentation to the College on behalf of the subscribers, of whom a large number were present; Sir John Rose Bradford accepted the gift on behalf of the College. The portrait is an exceptionally fine example of the artist's work and a striking likeness of Sir Flinders Petrie.

IN presenting the portrait to the College, Sir Henry Lyons referred to the debt to Sir Flinders Petrie of archæology in general and Egyptology in particular. He recalled that during the forty years Sir Flinders has been connected with the College, he has combined the duties of teaching with work in the field, at first and for long in Egypt and afterwards in Palestine. He has applied the method of exact measurement and scientific observation, which he employed in the investigation of the ancient monuments of Great Britain, to the study of the monuments of Giza, so that not only have his measurements of the pyramids been the first observations of exact value, but they have been fully confirmed by the measurements made much later under far more favourable conditions by the Survey of Egypt. From both Egypt and Palestine he has brought back a harvest of material objects and recorded observation, of which the prompt publication was his first care. In the application of scientific methods to archæological investigation he has been a pioneer and his methods have been adopted and extended by those whom he himself had trained and by others. Here Sir Henry might well have referred to Sir Flinders' elaboration of the system of sequence dating which has remained the principal means of scientific chronological analysis in archæological investigation ever since he first formulated it, and is largely responsible for the great advances in recent archæological exploration in the near East to which Sir Henry went on to allude. All archæologists will cordially concur in the note on which he concluded, when he spoke of Sir Flinders as an inspiring teacher, who has brought home to a wider public "the interest and importance of Ancient Egypt in human history", and as one who well merits this record in the College in which he has worked.

Dr. C. E. Guillaume

THE degree of doctor *honoris causa* of the University of Paris was conferred on M. C. E. Guillaume, director of the Bureau international des Poids et Mesures at Sèvres, on November 10, in course of the annual meeting held at the reopening of the University, with M. Charlety, the rector, presiding. The inauguration address was read by the dean of the faculty of sciences, Prof. Maurain. M. Guillaume, a Swiss citizen, has been doing work in France for nearly fifty years at the Bureau international, first as assistant, and for twenty years as director. A fervent metrologist, M. Guillaume has fostered every improvement likely to increase the accuracy of the measurements. His painstaking investigations in thermometry and in the measurement of length made him look for possibilities of diminishing the effects of temperature. Hence followed a laborious research on special alloys, which led to the discovery of his famous 'invar', a nickel alloy of which the coefficient of expansion is practically negligible. But metrology did not monopolise M. Guillaume's thoughts. A good many people have enjoyed reading his "Initiation à la mécanique", a pleasant booklet reflecting the leading ideas in physics at the beginning of the twentieth century. Besides purely scientific work, M. Guillaume has done much to further the use of the metric system, as a means to ensure international collaboration. As the Director of the Bureau international, created in 1875, M. Guillaume has had the satisfaction of seeing the system adopted even in oriental countries such as the U.S.S.R., Japan, Turkey, Persia, Afghanistan, Siam, Iraq and China. His report to the International Conference of Weights and Measures in 1933 dealt with the "Recent Progress of the Metric System" and raises the hope of the early and universal adoption of this system.

Broadcast of the Royal Wedding Service

THE broadcasting of the wedding service of H.R.H. The Duke of Kent and Princess Marina from Westminster Abbey on November 29 was described by the *Times* wireless correspondent as an unparalleled technical feat of the B.B.C. engineers. All who listened on this occasion will agree completely with this opinion; while those whom circumstances compelled to wait for the re-broadcast of the ceremony in the evening programme will have been equally impressed by the very high quality of the recording and reproducing technique. A brief description of the technical arrangements adopted for this occasion was given in *World Radio* of November 23, from which it is quite clear that the wireless listener was in a much better position, so far as hearing was concerned, than were probably most of those who attended the wedding service in the Abbey itself.

FOURTEEN microphone circuits were installed in suitable locations in and near the Abbey, and were connected to a control room installed in the crypt.

The microphones used were of the moving coil type and, with one exception, they were carefully hidden. The engineer responsible for the arrangements sat in the crypt operating the controls for the various microphones required for the different portions of the ceremony, ranging from the running commentary outside the Abbey to the actual service at the altar steps. The various circuits were faded in and out so smoothly that the impression conveyed to the listener was that only one microphone was being used, and that it was being transferred from point to point as required. Four special telephone circuits were established between the control room and Broadcasting House, and from the latter centre the programme was distributed through all the home and Empire broadcasting stations. The developments of broadcasting and communications technique during recent years were utilised in the above manner to make this wedding ceremony an outstanding event in history; for, as the Archbishop of Canterbury remarked in his address, never before has a marriage been attended by so vast a company of witnesses.

An Experimental Railway Journey at High Speed

ON November 30, the London and North Eastern Railway made an experimental run with a train from London to Leeds and back, to demonstrate what the possibilities were with steam as compared with oil. For the outward journey, the train was made up of locomotive No. 4472, a 'Flying Scotsman' engine, with a dynamometer car, a first-class corridor coach, a dining car and a brake van, while for the homeward journey two other corridor coaches were added, increasing the weight behind the engine from 145 tons to 205 tons. The train left King's Cross at 9.8 a.m. and arrived at Leeds at 11.39 a.m., the distance being 185·7 miles and the average speed being 73·4 miles per hour. The return journey was begun at 2.0 p.m. and ended at 4.37 p.m. During the return run, between Grantham and Peterborough, a maximum speed of 100 miles an hour was recorded, while during the climb from Tallington to Corby the speed was never less than 80 miles per hour. The experimental run was intended as a test of the steam locomotive burning coal on a service similar to that now run in foreign countries by trains with Diesel-engined locomotives. The most notable of these trains at the present moment is the *Flying Hamburger*, which covers the distance between Berlin and Hamburg daily at an average speed of 77 miles an hour. The line over which the *Flying Hamburger* travels is level and without curves, while the line between King's Cross and Leeds has gradients up to 1 in 100, and several speed restrictions. Such a passage as that made on November 30, of course, could not be made without a certain amount of dislocation to other traffic and it was expensive; but it showed that the potentialities of the steam locomotive for high-speed work have not been exhausted. It is noteworthy that the engine used is stated to have run some 44,000 miles since its last overhaul.

Launching of Long-Range Aeroplanes

INVESTIGATION into the possibilities of a new method of overcoming the difficulties of taking off with fuel sufficient for a long flight together with a reasonable amount of useful load, will shortly be carried out under the auspices of the Air Ministry and Imperial Airways by the use of a 'composite seaplane' now being built by Messrs. Short Brothers of Rochester. The machine is a flying boat, with sufficient initial climb to be able to take off the water easily with an exceptionally heavy load. The major portion of this load is a high-speed float seaplane, the design characteristics of which are those required for economical long-distance flight. It is carried practically on the wings of the flying boat, from which it can be released when sufficient speed and height are attained. The power of both of the machines is used for taking off. For this experiment a small single-engined seaplane will be used, which will probably not be seaworthy enough to weather rough water on the open seas if compelled to alight. It is, however, capable of flying to the Azores under normal conditions, and in the rarely favourable case of a continuous following wind, even to fly the whole of the direct crossing to America. The problem of securing exceptional range has hitherto been dealt with by refuelling in the air immediately after starting. The operating aircraft takes off with a small fuel load and is then filled from a 'tanker' machine, by means of a trailing hose picked up and connected while in flight. This system has been developed successfully by the R.A.F., but has never been used extensively for either military or commercial purposes.

Airship Developments in the United States

ACCORDING to Science Service, of Washington, D.C., one of the older U.S. naval Zeppelin airships, the *Los Angeles*, has been reconditioned and made fully airworthy for a series of experiments upon mooring. It will be maintained in ordinary flying condition and moored out of doors, in the usual way, for at least a complete year. Experience thus gained will help to settle a number of questions upon which it is impossible to theorise. These include estimation of the velocity and extent of winds and gusts, the behaviour of the airship when under the effects of these and other meteorological conditions, the best handling of the ship to counteract the adverse effects of such, taking on supplies, fuel, etc., development of the ideal mooring system, and methods of docking into a hangar. Such information should be obtained with greater expedition and safety, using a trained experimental staff in this way, than endeavouring to gain similar experience during the normal using of the airship in service.

Development of Cargo Vessels

The seventh Thomas Lowe Gray lecture to the Institution of Mechanical Engineers was delivered on November 30 by Mr. L. St. L. Pendred, who took for the title of his lecture "A Survey of Ships and Engines". Although, in the first part of his lecture,

Mr. Pendred recalled some of the historic vessels and a few of the notable inventions connected with marine propulsion in the early days of steam navigation, he avoided the well-trodden path which leads to the epoch-making ships connected with ocean travel or with fighting fleets, and turned aside to consider the development of ships designed especially for cargo carrying. These he said are "the lesser vessels which do the come-day go-day work of the world; the tramps and freighters slogging their patient way across the Bay, facing typhoons in the China Sea, picking their courses 'twixt Scylla and Charybdis, nosing themselves into little ports looking for cargoes; never certain where next their lawful occasions may take them". By means of curves of tonnage, horse-power, speed, steam pressures and the like, he endeavoured to show how, in these as in all ships, economy has been attained. In 1887 a typical tramp had a displacement of 4,840 tons; in 1896, 7,075 tons; in 1911, 10,000 tons and in 1928, 12,380 tons; and during this time the coal consumption per knot per ton dead weight carrying capacity had fallen 40 per cent. To those who would call a halt to invention he said, "not the wills of all the anti-mechanization people in the whole world will check for a fraction of a second the wheel that began to spin a hundred and forty years ago when James Watt produced the rotative steam engine". Further economy in cargo ships must be and will be sought.

The Waitaki Hydro-electric Installation, New Zealand

THE opening on October 26 by Lord Bledisloe, Governor-General of the Dominion of New Zealand, of the hydro-electric power station near Kurow, on the Waitaki River in the South Island, was the occasion of an imposing ceremony attended by the Prime Minister (the Right Hon. G. W. Forbes) and other ministers and public men. It was a noteworthy event in the annals of the country, being the inauguration of the largest installation of water-power so far developed there. The following brief details of the undertaking are extracted from the *Wellington Evening Post*. The total length of the impounding dam is 1,800 ft., with a spillway 1,200 ft. long. The structure, which contains half a million tons of concrete, has a maximum height of 120 ft. and a base width of 145 ft. The power house, 350 ft. long, 150 ft. wide and 130 ft. high, is an integral part of the dam and provides for the reception of five turbo-generators, each of 23,000 horse-power, of which only two, as yet, have been installed. Lord Bledisloe in his address said that electric supply is available to no less than 94 per cent of the total population (a percentage probably not exceeded in any other country in the world) with an average consumption per capita of about 500 units per annum. The total capital invested in electrical supply undertakings in New Zealand is £32,000,000, of which £28,000,000 has been expended during the last eleven years. During the same period, Government expenditure has amounted to £10,500,000. The average cost of current for ordinary domestic purposes is 1·31*d.* per unit as compared with 1·30*d.* in Great Britain and 1·39*d.* in the United States. Lord Bledisloe urged a fuller recognition of the complementary possibilities of user on the part of urban and rural consumers, and the extent to which one could assist the other.

Mangarevan Expedition of the Bernice P. Bishop Museum

ON October 28, Bernice P. Bishop Museum welcomed the natural history party of the Mangarevan Expedition returning to Honolulu aboard the specially designed sampan *Islander* from six months' field work in south-eastern Polynesia. The Mangarevan Expedition was organised for the exploration of little-known islands and atolls in extreme south-eastern Polynesia. Of the thirty-one islands and many atolls and reefs on which the party landed, particular attention was given to Anaa, Napuka, Tatakoto, Hao, Mangareva, Timoe, Pitcairn, Henderson, Oeno, Rapa, Raivavae, Rurutu and Rimatara. Surveys supplementing those made by Bishop Museum in previous years were conducted at Tubuai, Tahiti, Raiatea, Huahine and Borabora. To gain access to atolls and cliff-bound volcanic islands, a ship of high power and shallow draught was designed, and to permit the party to divide its forces for particular kinds of work, a transfer ship and power launches were provided. The expedition was made possible by generous grants from the Rockefeller Foundation and from institutions and individuals in Hawaii. Regarding the expedition, Prof. Herbert E. Gregory, director of Bernice P. Bishop Museum, remarks: "Under the experienced leadership of Dr. D. Montague Cooke, ably supported by Captain William Anderson of the *Islander*, the program of the expedition was carried out with marked success. The collections, which include some 15,000 sheets of plants, 40,000 insects, 160,000 land shells, and representative series of other animals, is sufficient to give a fairly complete picture of the land fauna and flora of the southeastern Pacific, and to indicate the relation of the oceanic islands to South America. The expedition practically completed the general survey of the ethnology and natural history of Polynesia which has been the chief interest of the Museum since 1920."

Third International Locust Conference

IT is not unusual for proceedings of international scientific congresses to be published some months, or even years later, but this cannot be said with regard to the Third International Locust Conference held in London in September (see NATURE, **134**, 484, Sept. 29, 1934). The volume of its proceedings was issued by H.M. Stationery Office two months after the Conference. It is a very compact publication which contains in its 184 pages a mass of first-hand and thoroughly up-to-date information on the locust problem. The official part of the proceedings occupies only a relatively small portion of the volume, while the bulk of it consists of papers presented by various experts. The papers deal with all sides of the locust problem in a very brief and concise manner, discussing the most important points to be investigated

and the methods of doing it. The set of resolutions adopted by the Conference, and printed in English and French, presents a mass of very detailed and valuable recommendations for future research. Although the Conference was concerned only with the locust problem in Africa and western Asia, the resolutions should be of great assistance in all countries where the locust problem is studied, because many of the recommendations with regard to the organisation and methods of research are applicable to any country. In view of the recent disastrous developments in the locust situation in South and North America, Australia and China, the work of the London Conference will undoubtedly have a world-wide appeal. It has laid a firm foundation for the international scientific attack on the locust problem and the main task of the next Conference, to be held in 1936 in Cairo, will be to extend the existing anti-locust front to all the countries suffering from these pests.

Imperial Agricultural Research

THE fourth annual report of the Executive Council of the Imperial Agricultural Bureaux, recently issued, continues the story of the smooth and successful working of an Imperially controlled and financed organisation (Imperial Agricultural Bureaux. Fourth Annual Report of the Executive Council, 1932–1933. Pp. 23. (London: H.M. Stationery Office, 1934.) 1*s*. net). The period under review marks the end of the two years' term of office of Mr. F. L. McDougall, the representative of Australia, as chairman of the Council; and for the next two years Sir Charles J. Howell Thomas, the United Kingdom representative, has been elected chairman, with Mr. Nevill L. Wright, New Zealand, as vice-chairman. The most important event in the year was the inquiry made into the work and organisation of the Bureaux, in common with that of other inter-Imperial organisations, by the Imperial Committee on Economic Consultation and Co-operation, appointed as a result of one of the resolutions of the Ottawa Conference. That committee of inquiry not only recommended the continuance of the work but also accepted the organisation as a general model for inter-Imperial organisations and proposed that additional duties be placed on the Council. The main functions of the Bureaux are the collecting, sifting and distributing of information on research in eight branches of agricultural science; and the nine abstract journals already started have now become well established. In addition, a number of reviews with bibliographies on special subjects have been published, and the issue from Weybridge of the "Index Veterinarius"—a compete index of all papers and publications on veterinary science—has been sanctioned.

Physical Investigation of 'Immaterial' Bodies

THERE has recently been published by the Dr. William Bernard Johnston Foundation for Psychological Research, Reno, Nevada, a pamphlet by R. A. Watters entitled "The Intra-Atomic Quantity". Mr. Watters describes a series of experiments in which grasshoppers, frogs and mice were killed in a Wilson expansion chamber, a cloud produced at the moment of death, and the resulting 'tracks' photographed. It is alleged that these photographs reveal forms corresponding in shape to the dead bodies, and it is claimed that this result demonstrates the existence of an "intra-atomic Quantity" which is an "immaterial body" and an "exact counterpart of the physical body to which it belongs". It is further claimed that when the subjects of the experiments were removed from the Wilson chamber and gave any signs of life, the photographs never showed anything unexpected; but that when the photographs showed 'intra-atomic' tracks, the subjects were unquestionably dead. Unfortunately, the few photographs reproduced in the bulletin before us reveal the alleged markings only to the eye of faith; for the rest, the essential experimental details are almost wholly wanting. If Mr. Watters wishes his work to receive attention, he should publish a more adequate and a more fully illustrated report.

Calculating Machine for Simultaneous Equations

THE calculating machine for the solution of differential equations constructed by Dr. V. Bush, of the Massachusetts Institute of Technology, has attracted a great deal of attention, and a similar machine is being built in Great Britain by Prof. D. R. Hartree of Manchester. Dr. Bush has now, in collaboration with Dr. J. B. Wilbur, constructed another machine, the purpose of which is to give the solution of a number of simultaneous algebraic equations of the first degree. A larger model, containing nearly 1,000 pulleys and more than 500 feet of steel tape, has been designed, but is not yet constructed. This will deal with ten variables connected by ten equations, and will be of great use in the solution of problems such as the determination of stresses in buildings and the adjustment of triangular networks in surveying, which, treated by ordinary methods, require long and tedious calculations.

Toads Save Sugar Crop

Biological control seldom extends to the importation of Amphibia, but great success has followed the establishment of the large toad *Bufo marinus* in Puerto Rico. From two lots of this species brought to Puerto Rico from Barbadoes and Jamaica, millions of descendants have sprung, and the food of this host has consisted largely of the May-beetle (Science Service, Washington, D.C.). The sugar crop, which is the staple product of the island, was threatened by great numbers of the 'white-grubs' of May-beetles, which swarmed everywhere in the soil, devouring the roots of the cane and of other plants as well, so that the planters were reduced to picking the grubs by hand. The introduction of the toad has reduced the May-beetles to scarcity, and the Porto Rican sugar crop has been freed from its worst enemy.

The 200-inch Mirror

ACCORDING to a message from its New York correspondent which appeared in the *Times* of December

4, the 200-inch mirror has been cast, this time successfully, so far as can be judged, at the Corning glass works. It will be remembered that the pouring which took place last March was unsuccessful, as part of the mould became detached and floated to the top of the molten glass. The recent pouring has been uneventful, and the mirror, which weighs twenty tons, and is made of borosilicate glass, has been set aside to anneal. It will be ten months before the mirror has cooled sufficiently to be inspected critically. Mount Palomar, in southern California, has been selected for the site of the 200-inch telescope when completed.

Unity History School, 1935

DURING Easter of next year (April 13–27) a Unity History School will be held at Rome under the direction of Mr. F. S. Marvin, in co-operation with the Institute of the History of Science, Rome. The subject will be "Science in the Modern World" and it will be dealt with from various aspects by speakers of authority in their different spheres, some from England and some arranged by the heads of the Institute of the History of Science—Profs. Enriques and Santillana. The speakers from England will include Mr. F. S. Marvin on "Science and the Unity of Mankind", Dr. C. H. Desch on "Science and the Amelioration of Life", and Prof. H. Dingle on "Modern Developments of the Physical Conceptions of the Universe". Further particulars may be obtained from the Hon. Sec., Mrs. K. E. Innes, 29 High Oaks Road, Welwyn Garden City, Herts.

Announcements

WE have received the following cable from Brisbane dated December 3: "My experiments have proved human enamel permeable to carbonic acid, product of fermentation sugars, hence caries. This explains why prevention caries secured by citrates. Livingston, University, Brisbane."

THE Gold Medal for 1934 of the Royal Agricultural Society of England has been awarded to Sir Arnold Theiler, formerly director of veterinary research in South Africa, for his work in veterinary pathology, which over a period of more than thirty years "has been of tremendous benefit to mankind in the Union of South Africa and to the Empire as a whole".

PROF. CARL J. WIMAN, professor of palæontology in the University of Uppsala, and Prof. František Slavik, professor of mineralogy in the University of Prague, have been elected foreign members of the Geological Society of London. Prof. Pentti E. Eskala, professor of geology and mineralogy in the University of Helsingfors, Prof. Giuseppe Stefanini of Pisa and Prof. Frédéric Roman, professor of geology in the University of Lyons, have been elected foreign correspondents.

IT is announced in *Science* that the Perkin Medal for 1935 has been awarded by the American Section of the Society of Chemical Industry to Dr. George O. Curme, Jr., vice-president of the Carbide and Carbon Chemicals Corporation, for his "distinguished research in the field of organic synthesis which has led to the founding of a new industry".

THE fourth award of the Joseph Leidy Medal of the Academy of Natural Sciences of Philadelphia "for the best publication, exploration, discovery or research in the natural sciences" has been made to Gerrit Smith Miller, Jr., curator of mammals in the United States National Museum at Washington. Mr. Miller was selected for his extensive and fundamental studies on the structure, classification, distribution and evolution of the Mammalia, particularly of the Chiroptera (bats), the mammal faunas of North America, western Europe, south-eastern Asia and the East Indies, and the Pleistocene and sub-fossil West Indian members of the group, as well as his comprehensive classification of the voles and lemmings of the entire world.

THE Adolf Fick prize, which consists of 1,000 marks with a silver portrait medal of the physiologist Adolf Fick (1829–1901), was founded by his sons in 1929 in commemoration of the centenary of his birth. It is awarded to any member of a German-speaking country for the most important publication on a physiological subject during the last five years, with the proviso that "the competitor has not shown any anti-German activity or committed any un-German action". The prize has recently been awarded to Hans Spemann, of Freiburg im Breisgau, by the Physico-Medical Society of Würzburg, before which he delivered an address on November 16 on experimental investigations on a theory of development.

MR. J. R. MOFFATT has been appointed farm manager at the Rothamsted Experimental Station in succession to the late Mr. H. G. Miller. Mr. Moffatt is a native of Cheshire and received his education at Beckenham County School and the Wye Agricultural College. He graduated B.Sc. in agriculture of the London University, and in addition gained the National Diploma in Agriculture and the Wye College Diploma. For the past two years he had been working on the Rothamsted farm, first as recorder and assistant manager, then as temporary manager during the illness of Mr. Miller.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A technical adviser and inspector in connexion with optical instruments—The Director-General, India Store Department, Belvedere Road, London, S.E.1 (Dec. 12). An assistant lecturer in chemistry at the Robert Gordon's Technical College, Aberdeen—The Secretary (Dec. 15). A deputy director of civil aviation in India.—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Dec. 21). A William Gibbins fellow in metallurgy at the University of Birmingham—The Secretary (Dec. 31). A University professor of physiology at St. Mary's Hospital Medical School—The Academic Registrar, University of London, S.W.7 (Feb. 15).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 901.]

Elimination of Water from the Human Body

SHORTLY after the first application of radioactive isotopes as indicators, the late H. J. G. Moseley and one of the present writers discussed the prospect opened by the introduction of this method, when indulging in a cup of tea at the Manchester Physics Laboratory. The latter then expressed the wish that an indicator might be found which would allow one to determine the fate of the individual water molecules contained in the cup of tea consumed. Even a man of the vision and outlook of the late H. J. G. Moseley considered this hope to be a highly Utopian one.

The recent work of Urey and his collaborators brought, however, the above-mentioned wish within the range of realisation. Although diplogen and hydrogen, unlike the atoms of radioactive isotopes, are not practically inseparable by chemical means, yet if we add to a cup of tea a slight amount of heavy water and then find, for example, one per cent of the latter in the water which has left the body, we can assume that about one per cent of the 'normal' water molecules taken in with the cup of tea has shared the same fate.

TABLE 1.

Density of water prepared from urine after the intake of diluted heavy water.

Time elapsed since the intake of water started in hours	Urine (volume passed in c.c.)	Density difference between water prepared from urine and 'normal' (distilled) water
0·5	130	6×10^{-6}
0·8	190	10
1	230	15
1·2	210	21
1·5	230	23
1·8	290	25
2	160	21
2·5	80	20
4	120	18
8	130	20
10	290	18
17	320	20
23	140	19
24·5	210	18
42	820	19
67	1120	17
92	2100	17
244	—	10
340	—	8

That heavy water present in high dilution in the organism behaves like light water is borne out by the fact that the heavy water content of urine and other excreta is the same as that of ordinary tap water, within a limit of 1 : 100,000 as found by us and other experimenters[1]. If we slightly increase the heavy water content of the normal water we can assume that, with an accuracy sufficient for our purposes, the heavy water will show the same behaviour as the normal one. As a further argument in favour of this view, we may quote the results obtained when investigating the behaviour of highly diluted heavy water in the body of fishes[2].

Our first step was to investigate if water prepared from urine has the same density as the tap water drunk. The result was within $1 : 10^6$ in the affirmative. The preparation of water from urine was carried out by combined adsorption and distillation processes. 55 samples of urine and other excreta were investigated and more than 1000 distillation processes carried out. One of us took then in one experiment 150 c.c. and in another 250 c.c. water containing 0·46 per cent heavy water showing a density difference against normal water of 480×10^{-6}. As the increase in density of the urine obtained after the intake of these quantities was only a few units in a million, an experiment was made in which 2000 c.c. were taken. The increase in the density of the water obtained was then up to $25 : 10^6$. Some of the results are seen from Table 1.

From the above figures it follows that, after half an hour from the beginning of the intake of water, some of the water drunk is found in the urine, though only 0·2 per cent of the amount taken. The bulk of the water leaves the body at a slow rate and it takes 9 ± 1 days before half of the water taken has left the body.

We controlled the water balance during the experiments and found (in hot summer weather) that on an average 60 per cent of the water lost left the body through transpiration and evaporation. In the possession of these data, and as we find that the density of urine water and transpiration water is the same within the limits of our accuracy relevant for these considerations ($\pm$ 5 per cent of the density excess), we can calculate the time which elapses before half of the water taken left the body by an independent method. The result works out again as 9 ± 1 days. By dividing the last figure by $ln\ 2$ we get for the average time a water molecule spends in the body $13 \pm 1{\cdot}5$ days. To explain this comparatively long time, we have to assume that most of the water taken becomes completely mixed with the water content of the body. This assumption can be tested by calculating the water content of the body of the experimenter from the amount of diluted heavy water taken and the density of the water prepared from urine any day except the first one. We arrive at a water content of 43 ± 3 litres, namely, 63 ± 4 per cent in fair accordance with known data.

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[1] H. J. Emeléus, F. W. James, A. King, T. G. Pearson, R. H. Purcell and H. V. A. Briscoe, *J. Chem. Soc.*, August, p. 1207, 1934.

[2] G. v. Hevesy and E. Hofer, *Hoppe-Seylers Z.*, **225**, 28; 1934. cf. also G. N. Lewis, *Science*, **79**, 151; 1934. H. Erlenmeyer and H. Gärtner, *Helvet. chim. Acta*, **17**, 334; 1934.

Liberation of Neutrons from Beryllium by X-Rays: Radioactivity Induced by Means of Electron Tubes

IT has been recently reported[1] that neutrons are liberated from beryllium by γ-rays of radium and that these are able to induce radioactivity in iodine. Following up this work, we have attempted to liberate neutrons from beryllium by means of hard X-rays, produced by high-voltage electron tubes. An electron tube, which could conveniently be operated by a high-voltage impulse generator at several million volts[2], is at present in use in the High Tension Laboratory of the A.E.G. in Berlin, and has served in the present experiment for the production of X-rays.

X-rays from a tungsten anticathode generated at a voltage above $1{\cdot}5 \times 10^6$ v. were allowed to fall on beryllium. An organic bromine compound (bromoform) was exposed to the radiation of the beryllium and this compound was then sent by air from Berlin to London. Here, at St. Bartholomew's Hospital, after an isotopic separation[3] of the radio-bromine from the ordinary bromine, a weak activity decaying with the six-hour period of radio-bromine was observed.

Afterwards, at a higher voltage, but still below 2×10^6 v., very much stronger activities were induced in bromine and were observed both in Berlin and London. Strong activities were observed in Berlin both in bromine and iodine (30 minutes half-life period) in co-operation with K. Philipp and O. Erbacher of the Kaiser Wilhelm Institute for Chemistry, the activity and its decay being easily measured by means of an electroscope. Recently, Fermi, Amaldi, Pontecorvo, Rasetti and Segrè discovered[4] that by surrounding the irradiated material with substances containing hydrogen the efficiency of activation of certain elements by neutron bombardment is greatly increased. Use was made of this effect in these experiments.

A very sharp increase of the induced activity with increasing voltage is to be expected if there is a more or less sharply defined upper limit of the wave-length at which the liberation of neutrons from beryllium begins. If there is such a critical wave-length, and if the voltage applied to the tube only slightly exceeds the corresponding critical voltage, a small fraction only of the total X-ray energy will be present in the form of radiation of sufficiently short wave-length; this fraction will then increase sharply with the excess voltage.

We wish to thank Prof. L. Meitner for her kind assistance in the Berlin experiments.

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Nov. 26.
T. E. BANKS.
T. A. CHALMERS.
LEO SZILARD.
F. L. HOPWOOD.

[1] Szilard and Chalmers, NATURE, **134**, 494, Sept. 29, 1934.
[2] Brasch and Lange, *Z. Phy.*, **70**, H. 1/2.
[3] Szilard and Chalmers, NATURE, **134**, 462, Sept. 22, 1934.
[4] Fermi, Amaldi, Pontecorvo, Rasetti and Segrè, *La Ricerca Scientifica*, **2**, Nos. 7–8.

Nature of Atmospherics

THE purpose of this note is to clear up some confusion which appears to exist concerning the average duration of atmospherics. Appleton, Watson Watt and Herd[1], and also Cairns[2] give times of the order of milliseconds for the duration of the atmospherics which they observed. On the other hand, observations which have been made in Australia using an ordinary tuned receiving set, and recording the motion of the string of an Einthoven galvanometer on moving photographic paper, have given durations ranging, in most cases, from 0·2 sec. to 0·5 sec., and occasionally longer. This is also the order of magnitude of duration which is deduced from listening to an ordinary broadcast receiver.

The difficulty is resolved if one examines the waveform of the atmospheric with a cathode ray oscillograph provided with a time-base of considerably slower period (say 0·1 sec.) than was used by the above-mentioned investigators. Experiments made at Laverton (near Melbourne) and Toowoomba (south-east Queensland), using an aperiodic receiver of somewhat similar type to that used by these investigators indicated that the 'atmospheric' really consists of a number of discrete pulses, separated by clear intervals. The sizes and separations of the component pulses vary in an irregular manner, this giving rise to the rough noise produced in a broadcast receiver.

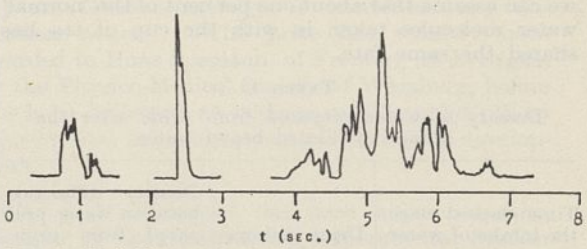

FIG. 1. Typical atmospherics. Einthoven galvanometer records, using tuned circuit of decrement about 10 sec.$^{-1}$.

This result is confirmed by the photographs of lightning flashes (the source of atmospherics) taken by Schonland and Collens[3], Boys[4], Halliday[5] and Walther[6], with moving lens cameras. Schonland and Collens, for example, obtained photographs of flashes with a camera in which a pair of lenses revolved at about 25 rev. per sec., and simultaneously with an ordinary camera. The moving-lens camera usually showed several flashes where the fixed lens showed only one (sometimes branched). The actual temporal separation cannot be obtained from the photographs since, as the authors point out, several revolutions of the lens system probably occurred between the flashes. The photographs show a relatively small number of constituent flashes (not more than ten), whereas our observations showed up to fifty constituent pulses. It is possible that a multitude of small flashes occur within the cloud, which the photographs do not reveal. In this connexion it may be noted that the first in the succession of pulses is by no means necessarily the largest. (This has been noted also in observations with the cathode ray direction-finder.)

The observations of Appleton, Watson Watt and Herd were evidently made with such rapid time-bases that only one of the constituent pulses was

(*Continued on p.* 897.)

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Reviews

Sir Ambrose Fleming's Reminiscences

Memories of a Scientific Life. By Sir Ambrose Fleming. Pp. xii+244+3 plates. (London and Edinburgh: Marshall, Morgan and Scott, Ltd., 1934.) 5*s*.

WE think that everyone will derive pleasure from reading the reminiscences of Sir Ambrose Fleming. Beginning with an adventure in the nursery when he was less than three years old, it is interesting to read the events which left a strong impression on the mind of the budding man of science. When he was nine he saw Donati's comet (1858)—with its tail stretching a quarter of the way across the sky. Although secretly alarmed he was greatly interested, and if a suitable opportunity had occurred he might have become an astronomer. A few years later we find him sailing a large model yacht, which he had carved out and rigged himself, on the Hampstead ponds, and he was taken to see 'Pepper's ghost' at the Regent Street Polytechnic. 'Dissolving views' were shown with a pair of oxyhydrogen light magic lanterns and he remembers the thrilling pictures of the Indian Sepoy mutiny. Lectures on chemistry were also given, and one of his favourite books was "The Play-Book of Science" by Prof. Pepper. At sixteen years of age he entered University College, and on completing his course was placed in the first division in the B.Sc. examination. His father's friend, afterwards Sir Edward Frankland, helped him to get a science mastership at Rossall School, where he proved himself a most capable teacher. But he hankered after research work, and so we find him a year and a half later studying under Dr. Frankland in the Science Schools at South Kensington. One of his fellow students was Sir Oliver Lodge, who in a 'foreword' to this book points out the many similarities in their two careers.

Fleming then became a research assistant to Dr. Frankland, and one of his colleagues was R. Meldola, the great chemist, and he met there Prof. Guthrie, the founder of the Physical Society. At the first meeting of this Society (March 21, 1874), Fleming had the honour of reading the first paper. He was then appointed to a science mastership on the military side of Cheltenham College and for three years proved an excellent teacher who could interest the boys and yet maintain discipline, but although receiving £400 a year and with a good prospect of a house mastership, he thought it a 'blind alley' occupation and in 1877, at the age of twenty-seven, went to Cambridge to study under Clerk Maxwell. Although his classical knowledge had become rusty he passed the 'Little-go' and entered St. John's College. Fleming says that as a teacher Maxwell was difficult to follow and his classes were small—on one occasion Fleming was the only student. But he says that everything Maxwell did or said bore the stamp of genius. In 1880 Fleming took a first class in the Natural Science Tripos, his subjects being chemistry and physics. He next did research work at the Cavendish Laboratory and began to improve the methods of making electrical measurements, a branch of the subject on which he did much excellent work later. He next became demonstrator in mechanism at Cambridge under Prof. James Stuart, the predecessor of Sir Alfred Ewing.

In 1881 Fleming went to Nottingham University College as the first professor of mathematics and physics. From 1885 until 1926 he was a professor in University College, London, and did much valuable work in research and as a consulting engineer. At the Deptford Power Station his researches led to great improvements; the results were afterwards communicated to the Institution of Electrical Engineers. In 1885 he read a paper to this Institution advocating the establishment of a National Laboratory for testing and certifying the accuracy of electrical instruments. His researches in conjunction with Sir James Dewar on the properties of matter at low temperatures led to very interesting and novel results.

As a teacher Fleming stands in the front rank; he has a wonderful knack of making things clear and of imparting his knowledge very rapidly. When the writer first heard him, many years ago, give a lecture, he was strongly reminded of the lecturing method used by Dr. E. J. Routh, the famous Cambridge mathematical coach. Another characteristic in his experimental lectures was the kind way in which he co-operated with his assistants to their mutual advantage.

As Fleming has written nearly a hundred

important scientific papers and also twenty books, some of which have gone through several editions, it is impossible to discuss them here. He was the first to explain the importance of the rectifying action in the devices commonly used in the early days of radio telegraphy, namely, the crystal detector, the electrolytic detector and the magnetic detector. His explanations enabled one to picture the actions taking place, and the phenomena ceased to be mysterious. The Wehnelt tube had rectified current, but no one thought of utilising this property for radio telegraphy. Fleming's great discovery was that, in order to obtain a receiving action, it was only necessary to rectify the high frequency alternations. The Fleming valve, which is a two element rectifier, was no more sensitive than a good crystal detector, but it had the inestimable property of permanence of adjustment. In this volume Fleming tells the story of his help in the arrangements made by means of which R. N. Vyvyan and others sent the first message across the Atlantic.

In conclusion, Fleming gives a sketch of many enjoyable holidays he has spent abroad and tells vividly what a relief they were after lecture-rooms, laboratories and libraries. He revels in the beauties of Nature as shown in mountain, sea, lake and forest. He has climbed Mont Blanc and several lofty peaks in Switzerland. He gives good advice also. "In all Alpine ascents the weather is the uncertain factor, and it is never wise to attempt a high mountain except in perfect weather." We hope that he will write a further book of memories.

A. R.

The Autobiography of H. G. Wells

Experiment in Autobiography: Discoveries and Conclusions of a Very Ordinary Brain (since 1866). By H. G. Wells. Vol. 2. Pp. viii+417–840+11 plates. (London: Victor Gollancz, Ltd., and The Cresset Press, Ltd., 1934.) 10*s.* 6*d.* net.

THIS is an attempt on the part of the author to trace the development of his own mind, and, as he sees them now, the social forces and personal characteristics conditioning the changes that ensued. Thus we are presented with a slab of social space-time, and the world-line H. G. Wells has traced out in it. We see the ineffectual draper's assistant blossoming forth as a serious-minded science student, the student as a competent journalist, and the journalist, through external stress and struggle and internal strife, into a literary innovator and a social force. The drudgery and degradation of 'living in', sow the seeds of rebellion and social discontent. A fleeting and not too academically successful passage through the Royal College of Science provides the quickening. The chrysalis unfolds and the grown Wells emerges, the literary and moral iconoclast, the pioneer of science for the common man, the dreamer of a World State. The autobiography is like a swelling orchestra; as each new instrument adds its part it gradually assumes the appearance of a fugue working up to its climax—the Modern Utopia, the New Republic, the League of Free Nations, the World State.

For two generations the author has striven with consummate journalistic skill and tireless energy, by educating his public, to get them to appreciate his theme and to desire its realisation. In particular he has succeeded: in general he has failed.

It began as a struggle against the prudery, inhibitions, and falsehoods of the Victorian era, a fight to the success of which he contributed more than any living man. Few of us who read our modern novels and listen to our problem plays realise how much we owe to the author of "Ann Veronica". When the storm of abuse aroused by that novel had subsided, and the social ostracism meted out to the author had passed, it was evident that a long-awaited release had occurred; a new mood had entered into literature and with it into social life.

This, however, was one only of the fronts on which Wells waged his war. The inspiration of T. H. Huxley at the Royal College of Science had aroused him to the significance of the theory of evolution for mankind, and the possibilities for the future that lay in the fullest use of the findings of science. To him it meant a levelling of political frontiers and a new scale of life. The ideas can be seen germinating in his early scientific stories, and blossoming forth later in the scientific passages in his socially propagandist books. Finally it takes concrete shape in his "Modern Utopia", that marvellous *tour de force* the "Outline of History", his "Work, Wealth and Happiness of Mankind", his "Science of Life", "The Shape of Things to Come", "After Democracy" and numerous other volumes. It is an amazing performance, this steady and rapid output showing the gradual experimental groping towards precision in an idea at first faintly perceived and finally forcing itself more and more into definition with the logic of events.

In particular, Wells succeeded. He jerked the youth of last generation out of their complacent acceptance of established tradition in politics, morals and religion. In letters he smashed the classical tradition that science and literature are necessarily inimical. To the man in the street he brought an understanding of his history, and of the scientific make-up of himself and his environment. In all this, and more, he succeeded, and he

succeeded because he was supersensitive to the mood of his times.

For the 'seventies and 'eighties were a critical phase in the development of Great Britain. Industries had flourished steadily as England poured her manufactured goods into the Colonies and Dependencies ; Free Trade and Liberalism had provided the theoretical justification for our entry into all and every market of the world. They were principles that seemed to accord simultaneously with enlightenment and self-interest. Germany emerging now as a new united State from the Franco-Prussian war consciously threw herself into the industrial struggle and turned to organise scientific knowledge and scientific research to assist her. In the face of this, Britain turned in the same direction, but not before a temporary stagnation had given warning of troubles ahead. Science was in the air, and the windows of schools and colleges were slowly being prised open to allow the new enlightenment and the new knowledge to penetrate. Trade schools and evening classes, colleges of science and scientific laboratories, began to spring up, and for those who, like the young Wells, had noses to sniff, a new and stimulating atmosphere began to make itself felt. Huxley spread the gospel of Darwinism and fought the Bishops ; the Trade Union movement strengthened, became militant and neo-Marxist, seeking its own special representation in Parliament as a special working class movement ; and Wells and his associated intellectuals swept into the Fabian Society to impregnate this movement on the political side with the policy of gradualness and planning for their new social order. The names that stand out boldly in this period are Wells, the upstart scientific groper and visionary ; Shaw, the sharp incisive critic and mental gymnast ; and Sidney and Beatrice Webb, the embodiment of the British Museum. These were the currents that swept Wells on his way, and through which he swam on his distinctive route.

What of the outcome of it all? What of the ideal to which Wells devoted so much of his life? In the last few pages of this extraordinary story he sums up his final conclusion :

"The truth remains that to-day nothing stands in the way to the attainment of universal freedom and abundance but mental tangles, egocentric preoccupations, obsessions, misconceived phrases and bad habits of thought, subconscious fears and dreads and plain dishonesty in people's minds—and especially in the minds of those in key positions." And then apropos of the latter : "I can talk to them and unsettle them but I cannot compel their brains to see."

Now of one thing Wells may be quite certain : most of these individuals in key positions have brains. Then why, he must ask himself, do they not see? Perhaps after all it is not simply intellectual assent only that is needed, but also emotional harmony. To desire a new social order implies a valuation, and a valuation of a type that does not come into scientific or mathematical propositions. Why should he expect that the people in key positions would want the kind of world that Wells himself desires? They may see that in the long run it is inevitable, but why should he expect them to raise a finger to shorten the run? The answer is not to be found in the intellectual sphere. It must be expressed in terms of the physical circumstances that arouse the desire to which he is appealing. He is in fact addressing an intellectual and emotional argument to a group of individuals from whom he need not expect to receive an emotional response.

The same weakness in the methodology of Wells's propaganda can be seen in another way. After almost half a century of energetic striving for his ideal, is his plaint not rather like the old statement that, if only everyone had goodwill, everything would be for the best? Surely the first question to ask is what are the material conditions requisite for goodwill? What are the material conditions for eliminating the egocentric preoccupations? Is it within the power of Mr. Wells to produce these conditions, or is it the case that those who control the conditions are also those who possess the stubborn traits to which he objects? If this is so, is it not evident that Wells has not faced his problem squarely until he has faced the problem of how to acquire power?

The lack of a clear analysis of this issue shows itself over and over again, but particularly when he bitterly laments his failure to get Stalin to see that Russia and the United States are in fact treading the same path. The suggestion (apart from the trivial interpretation that we are everywhere treading the same path) is fantastic. The emotional motifs and the whole working structure of the two countries are poles asunder. The dislike of Roosevelt for the Russian system is probably equalled only by the repugnance of Stalin for the American, and in any objective handling of propaganda for a World State these are facts to reckon with. In social science, unlike physical science, the changing likes and dislikes of the human material play a significant rôle.

He who desires to forecast the future behaviour of social groups and to play his part in that development, as Wells does, must evolve a science of social dynamics. He has to study society as a material phenomenon, and deduce its laws of change. He has at the same time to recognise that these laws are brought into existence by human

beings in the teeth of opposition by others, each striving to carry out his desires. Only those desires that are consistent with material possibilities are therefore capable of reaching fruition. To bring them into being, either those who have the desires that can be realised must acquire power, or those who possess the power must acquire the realisable desires. Wells's complaint concerning the obtuseness of those in key positions is in effect an admission that those who have the power cannot acquire the desire. One can only conclude that either he must become a full-fledged active revolutionary or he is seeking to bring the wrong type of World State into being.

It is for these reasons, a false methodology in his propaganda or the pursuit of a false ideal, that the reviewer holds that while Wells has succeeded in particular he has failed in general. One of the particulars, however, in which he has undoubtedly succeeded is in the creation of a new form to suit the content of autobiography. Throughout the whole of the work, in striking contrast to the babbling inconsequences and fatuous anecdotes of social nonentities invariably found in the compendious volumes that pass for autobiography, he has examined his own developing mind with relentless objectivity. With this and the preceding volume he has smashed a staid and formal tradition and raised autobiography to a new level.

H. Levy.

Annals of the Arctic

Northern Conquest: the Story of Arctic Exploration from Earliest Times to the Present. By Jeannette Mirsky. Pp. xx+386+16 plates. (London: Hamish Hamilton, Ltd., 1934.) 15*s.* net.

The Conquest of the North Pole: Recent Arctic Exploration. By J. Gordon Hayes. Pp. 317+16 plates. (London: Thornton Butterworth, Ltd., 1934.) 18*s.* net.

THE word "Conquest" with regard either to exploration or research seems to postulate an antagonism between man and Nature, and it is perhaps a mistake to allow such an 'evil dream' to colour one's view. Although the pioneers of polar travel had to meet great difficulties and to undergo hardships which it required heroism to face, the knowledge they acquired should have taught those who followed that success awaited the men who took advantage of existing conditions rather than those who fought against forces they could not control. The belief that a fighting rather than a conciliatory spirit best suited an explorer is no longer justified; but writers and publishers of works on exploration apparently find the warlike phrase agreeable to public taste.

Even those who deprecate fancy titles for serious works must allow that both the books named above are serious contributions to the history of exploration. They are sufficiently non-technical to appeal to the general reader, but careful enough to serve the student for permanent reference, especially as they have admirably full indexes. Their value is enhanced also by the supervision during compilation of experienced arctic travellers who were themselves men of science. The critical adviser of the English author prefers to remain anonymous, that of the American reveals himself as Dr. V. Stefansson, who contributes an introduction to Miss Mirsky's book. Mr. Gordon Hayes writes his own introduction, and both lay stress on the importance of impartiality and open-mindedness on the part of the writers of history. Both deplore the shortcomings in this respect of earlier works of similar scope. The English writer commends General Greely's "Polar Regions in the Twentieth Century", but only as "a species of intellectual pemmican", and after referring slightingly to certain unnamed works of popular travel he comes to the satisfactory conclusion that "uncritical works are now intellectually obsolete".

Dr. Stefansson's introduction makes something like a berserk attack on Sir Clements Markham's "Lands of Silence", many of the flaws in which might be put down to the failings of extreme old age. The author of "The Friendly Arctic", however, while insisting on the duty of taking up an unprejudiced point of view, naïvely expresses pleasure at the gradual approach of Miss Mirsky to his own set opinions. This hint at a comedy of prejudices is by the way. My main purpose is to welcome two very fine books, neither of them perfect it is true, but each in its own way deserving of warm commendation to the student and to the lover of adventure.

Miss Mirsky traverses 22½ centuries, Mr. Hayes only the first third of the present century, so the scales necessarily differ; but as the long-period record has a sliding scale growing larger as the date approaches the present, there is overlap enough to afford interesting comparisons. Divergent views are expressed on controversial matters. Both handle the Peary-Cook controversy with wisdom and restraint. Mr. Hayes obviously controls his feelings in showing quietly the impossibility of Peary's alleged long daily journeys to the Pole and back, and as obviously restrains his warm sympathy with Cook, whose amazing narrative he finds perfectly credible. Miss Mirsky, on the other hand, states the pros and cons for each explorer with an obvious, though not an obtrusive, leaning towards Peary and a distinct aversion from Cook. Again Miss Mirsky is, of course, very friendly in her judgment of Stefansson's revolu-

tionary method of 'living off the country', for it was in his unique Arctic library that she spent three years in compiling her record, while Mr. Hayes brings the whole force of his critical powers to show that Stefansson's methods are unsuited for the use of men of less Herculean mould. But both writers set out the facts fairly, and no one need be misled by the flickering of personal predilections which light up a depressing subject.

(1) "Northern Conquest" is a brilliant book. To turn over its pages of history from the most distant ages is like turning one's eyes to the starry sky on a moonless frosty night. Against the Milky Way of early tradition the stars of great explorers shine out sharp and sparkling each in its appointed place, each of its proper magnitude. The author, of Russian race, trained by American education and using the English language as the natural medium of her thought, has achieved a detachment from prejudice and a wide sympathy with divergent methods and motives denied to most historical writers. By means of a series of appendices she clears the text of confusing repetitions and distracting footnotes. One appendix gives a full list of the leaders of the Franklin search parties and their ships with the dates and districts explored. Another a skeleton chronology of Arctic exploration—date, explorer, region visited—from Pytheas c. B.C. 330 to Wilkins in his unlucky submarine of A.D. 1932. A third appendix gives references to the main sources relied upon for the compilation of each chapter. By this means Miss Mirsky is able to deal in the text with the motives, the character and the achievements of each explorer in a well proportioned narrative, and she succeeds in preserving the atmosphere of the time and the place by discriminating quotation. This is how she touches an early wintering in Hudson Bay:

"In 1631 Captain James wintered unhappily and to little purpose in the extreme south eastern dip of the bay, and the account of his voyage is verily a 'book of lamentation and weeping and great mourning'. That same year Luke Foxe, the self-styled Northwest Foxe, explored the waters to the west and east of Southampton Island. He poked into Sir Thomas Roe's Welcome, mistook it for a bay, and then sailed a little way up Foxe Channel, pompously calling his turning-point 'North-West Foxe his Furthest'. A shrewd, gay man, he named a cape Wolstenholme's Ultimum Vale, for the reason 'that I do believe Sir John Wolstenholme will not lay out any more monies in search of this bay'. He was right."

"Northern Conquest" is certainly not intellectual pemmican; it rather resembles a tasty and nourishing Christmas pudding full of choice fruit, carefully stoned, and flavoured with the spirit of youth and the spice of humour. Now and then one comes on a hidden charm in the form of some quaint American locution.

(2) Mr. Gordon Hayes is well known as an enthusiastic student and an iconoclastic critic of Antarctic exploration and of some Arctic explorers. He has modelled his "Conquest of the North Pole" on the lines of his recent "Conquest of the South Pole". It is a detailed, critical and conscientious statement of all the Arctic expeditions since 1905. With his usual love of accuracy in detail he has secured the revision of the relative portions of his manuscript by many, if not most, of the explorers he deals with who are still alive. He excels in the precision with which he sets down the length of daily journeys, the nature and quality of the means of transport and the extent to which the purpose of each expedition was fulfilled. His book is not a transcript of published matter or a commentary on journeys familiar to most English readers of polar books, but includes the records of Russian and Scandinavian travellers whose work has not hitherto appeared in English. Mr. Hayes is an earnest worker, concentrating on essential facts, seldom led away in lighter mood from his stern critical scrutiny of the explorer with whom he is for the moment concerned. His method does not require fine language for its expression, and even if the wheels of his literary chariot sometimes seem to cry out for lubrication, they carry him straight to his goal.

The reader who goes through this book will be thoroughly posted in the work of Peary, Cook, Mylius-Erichsen, Mikkelsen, Rasmussen, the two Kochs, de Quervain, Vilkitski and the other Soviet polar investigators, Bernier, MacMillan, the North West Mounted Police on their dismounted Arctic patrols, Stefansson and his comrades on the ill-fated *Karluk*, Wegener, the Oxford and Cambridge University expeditions under Binney, Wordie, Watkins, and a host of others. Finally, the airmen Amundsen, Nobile, Ellsworth, Byrd and Wilkins have their turn. All had great adventures and most of them collected scientific data which have still to be worked up. Over all the author like Burns's Justice "high wields her balance and her rod" and there is little indeed in the way of shortcomings which escapes him. The eagle eye of his learning scarcely goes so far as to "seek Science in her coy abode" though he speaks very respectfully of her. He is strongly in sympathy with the new trend in exploration which is contemporaneous with, and has been effectively furthered by, the Scott Polar Research Institute at Cambridge. After pointing out the limitations of expeditions sent out under orders by Governments or learned societies, and of those in which a leader initiated and directed his own work, while depending on Press support for funds, he says:

"Both these methods, especially the former, now seem relatively unsuitable for Arctic exploration and a great change was made by Rasmussen and Stefansson . . . another new type of expedition was introduced on the founding of the Oxford and Cambridge Schools of Explorers. While not unadventurous, this type is academic in character, benevolently monarchical in government and desirous of avoiding heroics."

The work of Mr. Hayes in his detailed account of the recent expeditions is well-planned, sound and solid. A few slips in proof-reading leave some erroneous initials in the names on p. 305. The publishers and place of publication of the books cited on that and the following page might well have been given in order to facilitate reference.

I conclude with two morals which may be drawn from the records in both of the books under review: the supreme importance of careful note-taking and log-keeping by every member of an expedition; and the equal duty of every society which rewards success to insist on seeing and testing the original data before awarding its medal.

HUGH ROBERT MILL.

Problems of Longevity and Eugenics

(1) *The Ancestry of the Long-Lived.* By Raymond Pearl and Ruth DeWitt Pearl. Pp. xiii+168. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1934.) 13*s.* 6*d.* net.

(2) *Human Sterilization To-day: a Survey of the Present Position.* By Cora B. S. Hodson. (The Forum Series, No. 19.) Pp. vii+56. (London: Watts and Co., 1934.) Cloth, 1*s.* net; paper, 7*d.* net.

(1) THE authors confess, with regret, that this book cannot be looked upon as easy reading, and they are probably right. On the other hand, they seem to be fully justified in saying that anyone who is really interested can follow the reasoning and understand the results. It is to be hoped that many people, other than specialists in the subject, will read it.

The results are, briefly, that your chances of living to more than ninety years of age are much greater if all your parents and grandparents lived to be more than seventy than if only some or none of them did. Yet your chances cannot be completely forecast on that basis since, in 13 per cent of the nonagenarians and centenarians studied, and in about 10 per cent of their parents, neither parent lived to be more than seventy. It is impossible to say to what extent that fact depends on failure to realise potential longevity because of environmental 'accidents' such as death in childbirth or from acute infections.

Further, the brothers and sisters of these nonagenarians and centenarians showed an average duration of life well above the standard expected mean duration at birth. The families were, on the average, larger than those of the series used for comparison, and the mortality, especially during infancy and childhood, much below the rates for the general population. This indicates that longevity is associated with a high general vitality, which is not an attribute only of one particular individual in a family, but of the family as a whole.

In this lies the chief practical interest of the study. For, although it is doubtful whether longevity in itself would be regarded, generally and without qualification, as a desirable characteristic, there can be no doubt that superior healthfulness of a whole family would be so regarded.

It is a relief that no attempt is made, at this stage, to analyse the data from the point of view of the mechanism of inheritance. In the present welter of eugenics, theoretical and practical, this study might be taken as a model of what is required as a foundation for rational judgments, and certainly the following quotation should be noted by all enthusiastic eugenists: ". . . the case of modern genetics and particularly human genetics is being seriously harmed by wildly uncritical extension of the gene theory, for which the observed evidence is either wholly lacking or is absurdly inadequate".

(2) Mrs. Hodson's book is in part a catalogue of information regarding the laws at present in existence relating to sterilisation, and, as such, it quite adequately fulfils its purpose. The information appears to be reliable, is concisely put down, and may be recommended to anyone desiring a rapid survey of the position.

On the other hand, in as far as the book offers, without any attempt to state the laws of heredity involved, to explain and justify the aims of the campaign for sterilisation, it is inadequate and may be misleading. The idea of eugenic sterilisation is based, we are told, on evolution, in the Darwinian sense of natural selection. But it is, in fact, based on the evidence, from actual human pedigrees, of Mendelian segregation of undesirable characteristics, which is a very different matter.

On the practical side there are two points, in particular, that require consideration. The first is the statement that preventive medicine "is actually promoting the increase of constitutional diseases" since, previously, "the tainted stock was kept down to very small numbers" by the ravages of (germ) disease. If this statement is to have any meaning, it must imply a higher death rate from acute infections amongst persons affected with these constitutional diseases than amongst

the non-affected. But is there any evidence that the bearers of the diseases in question are abnormally susceptible to infectious disease ? If this were so to any significant degree, it would certainly be apparent, even without such infections as cholera and smallpox, in a high death rate, and it is unlikely that the proportion of affected persons in the general population would be increasing, as is claimed.

The second point is the clearly stated attitude to inherited but curable disease. "It is as much against philanthropic ideals as against sound sense to cure the results of a bad constitution" if reproduction is allowed. Assuming that this book represents a certain class of opinion, there appears here to be serious ground for debate. Apart from the probability that the same or other defects would arise *de novo*, it seems reasonable to think that the problem of such diseases must be decided in human society, which is not merely a herd, on considerations other than that of the disease itself. In the evident absence of ideal individuals who can be guaranteed to breed ideal progeny indefinitely, there is as much to be said, on the present evidence, for using the triumphs of medical research to preserve the germ plasm we have, as for using them as an excuse for its destruction.

The Eternal Village

Hooton Pagnell : the Agricultural Evolution of a Yorkshire Village. By Dr. Arthur G. Ruston and Denis Witney. Pp. viii+459+12 plates. (London : Edward Arnold and Co., 1934.) 25*s.* net.

A SURPRISING number of English towns and villages bear Saxon names, and it is remarkable how little the expanding population of the eighteenth and nineteenth centuries affected the number of settlements : old villages grew into towns, and adjacent villages gradually touched each other and became large cities, but there were not the new settlements that one sees in America. This persistence of the English village is one of its characteristic features, and in recent years there have been numbers of historical studies tracing particular villages back to their earliest times.

The village dealt with in the present volume, Hooton Pagnell in Yorkshire, has a special interest to the agriculturist because it was the residence in the early part of the fourteenth century of Sir Geoffrey Loutrell, who arranged for the making of the wonderful Psalter that bears his name and that gives us better pictures of agricultural operations than any other document of its time. The implements are so well shown that they could be reconstructed by a village smith without difficulty ; the men and animals are drawn with rare skill and vigour, and are obviously taken from life. Dr. Ruston and Mr. Witney have followed the history of the village from Domesday Book, where it is called "Hotone", right up to the present time, searching every old document they could find with the painstaking conscientious labour associated with all Dr. Ruston's work. Even apart from its intrinsic interest, the book is useful as showing the range and extent of sources of information about the village life of the past ; while the long quotations from the various documents serve to show the kind of use to which they may be put.

There have been no revolutions and no wars to speak of in the British countryside, and consequently the old records stored in church and manor house still survive in many places, furnishing material of considerable interest to present-day economists, geographers and agriculturists. In the English countryside, more perhaps than anywhere else in the world, the key to the present lies in the past : the things we now see have their roots deep down in the village history, and no one can understand the present position without a knowledge of how it came about. If, as sometimes happens with would-be social reformers, the story is quite unknown, or worse still, if it has been warped and twisted to suit a political theory, the vision will be wrong and the suggested reform is foredoomed to failure ; only if the story is apprehended without prejudice and with a single eye to truth can any good emerge.

This book should be studied by all students of agricultural history, whether their interest be technical or social. It is well illustrated with maps showing the enclosures and the changes at the various times which have finally resulted in the village as it now stands. After perusing this book, the student will understand how it comes about that problems of tithe, of tenure and of tenant right, are so complex. E. J. RUSSELL.

An Unorthodox Chemistry

An Introduction to Chemistry. By Prof. Frank B. Kenrick. Pp. viii+434. (Toronto : University of Toronto Press, 1933.) 3 dollars.

PROF. KENRICK disarms criticism of this remarkable book by his statement in the preface that it "will not be found to be a 'teachable' book", but immediately throws down the gauntlet by continuing : "a teachable book must be a learnable book, and that is a most dangerous educational weapon". Such provocation in the preface whets our curiosity as to the text, but before we reach the latter we are 'brought up short' again by the table of contents. Chap. i begins with the manufacture of salt, and, after a

chapter on 'composition', two chapters are devoted to the refining of crude sugar and various chemical phenomena that the process involves. Chap. xii is entitled "Wood", chap. xiii "The Mass Law, Esterification, Synthesis of Ammonia, Dissociation, Electrolytes", chap. xiv "Air" and chap. xv "Rocks". We are led to murmur, like Alice, "Curiouser and curiouser", and to turn with now thoroughly stimulated eagerness to the body of the book. After the shocks we have already experienced, it is no surprise to find that Prof. Kenrick has certainly elaborated a unique method of approach to the study of chemistry. His first fifty pages are, in the main, devoted to a consideration of what chemists mean by the 'composition' of a substance ; in the end, after what seems to be a needlessly involved and verbose discussion, he arrives at the merely commonplace conclusion that the "composition of a material states a set of substances and their proportions which could be changed quantitatively into the material on the assumption that any actual transformation can be reversed".

Prof. Kenrick's treatment of further conceptions is on similar lines, his anxiety to frame definitions in strict accordance with fact leading him to disquisitions that must inevitably befog even the most earnest and conscientious of his readers. Thus the idea of a 'pure substance', which does not normally present any great difficulty to a student, is scarcely made clearer by a definition which describes a pure substance as one that "is not an intermediate member of any continuous series of non-mixtures". The explanation of symbols, formulæ and equations is equally long-winded and confusing, and is also inaccurate inasmuch as, for example, "H" does not stand for "1·008 of hydrogen" but for one atom of hydrogen—a very different thing.

It is, however, unnecessary to describe any further details of the book, except to remark that when Prof. Kenrick says (p. 352) that "equations such as . . . $CaCO_3 + 2HCl = CaCl_2 + CO_2$ seldom state the facts accurately", we find ourselves in complete agreement. No one would deny that the common methods of teaching chemistry are far from perfect, or that students frequently have far too hazy an idea of the precise meanings of terms that trip lightly from their tongues. In so far as Prof. Kenrick has realised this, and has tried to improve matters, he deserves commendation. But we fear that his book will do little to clarify confusion or to correct looseness of thought, and our sympathies are with the "Reverend professor of medieval history", who "read critically and patiently every sentence" of the book, but protested that he did not understand a word of it.

E. J. Holmyard.

The Structure of Solids

The Chemistry of Solids. By Cecil H. Desch. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 13.) Pp. ix+213. (Ithaca, Ill. : Cornell University Press ; London : Oxford University Press, 1934.) 11*s.* 6*d.* net.

TWENTY-FIVE years ago, the title of Dr. Desch's book might have been challenged as a contradiction in terms by those who maintained that in the solid state chemical change did not take place. Even to-day, there will be found many to argue that his subject matter is really physics—thus starting a profitless discussion, since the boundary-lines dividing the sciences are as arbitrary as any political frontier. But the fact is that Dr. Desch deals with many things which—being equally important to physicist and chemist—are usually admitted to the curriculum of neither. He has indeed made his volume all the more valuable to chemists by surveying researches originally published in physical, crystallographic or metallurgical journals, which they rarely find time to study. These he discusses in an interesting manner—not unsuited for arm-chair reading. The treatment is in the main elementary, calling for little previous knowledge ; but, although the complete exclusion of mathematics often makes it impossible to set forth the arguments leading up to the opinions indicated, the author does succeed in presenting, in concise form, an accurate picture of the views generally held at the moment.

The volume contains the substance of the lectures delivered by the author at Cornell University in 1931–32, as George Fisher Baker non-resident lecturer in chemistry. In an interesting introductory lecture, which will appeal to many whose tastes lie neither in chemistry nor solids, Dr. Desch examines in turn the thesis that "scientific research carried out for the satisfaction of intellectual curiosity is antisocial", the present tendency to substitute for individual workers "the organized labour of skilled teams", and the moral responsibility of the scientific worker for the misuse of his discoveries both in peace and war. He then passes to modern views on crystal growth and crystal structure, rightly pointing out that the block-units postulated by Smekal are much smaller than the units indicated by etch-figures or slip-bands. Next follows an interesting chapter on surface films and passivity ; here it may be right to suggest that the thicknesses ascribed to the "temper-colour films"—quoted from a paper published in 1924—appear to be too low ; Constable, whose optical determinations accord fairly well with the values reached by other experi-

menters using different methods, obtained nearly ten times the thickness assigned to the film on 'straw yellow' steel.

After a discussion of abrasion and solid diffusion, two useful chapters are devoted to the Widmanstätten and martensitic structures, which, it is shown, are closely interconnected. Next Dr. Desch approaches the age-hardening of alloys, intermetallic compounds and the production of a vitreous phase; "the hypothesis of Beilby," he writes, "is out of favour at present with many, perhaps most, physical chemists, but it corresponds so closely with the facts with which the metallurgist is familiar as still to deserve serious consideration". After a chapter devoted to "Chemical Changes in Solids", a discussion of layered lattices and fibre structure closes this exceptionally interesting survey.

The book assembles a wide range of subjects in a limited space, but the reader escapes that sense of congestion which often makes the reading of contemporary chemical literature a penance, in these days when certain publication authorities seem to regard the virtue of a contribution as inversely proportional to its length. The Cornell University Press has contributed to success by clear printing, and the excellent photomicrographs, largely due to the skill of Mr. G. A. de Belin, add greatly to the attraction of the volume. U. R. E.

Science and Everyday Life

(1) *The Laboratory: its Place in the Modern World.* By D. Stark Murray. (The Fen Series, No. 8.) Pp. 117. (London: The Fenland Press, 1934.) Paper, 2*s*. net; cloth, 3*s*. net.

(2) *Science in an Irrational Society: delivered at Conway Hall, Red Lion Square, W.C.1, on April 25, 1934.* By Prof. H. Levy. (Conway Memorial Lecture.) Pp. viii+82. (London: Watts and Co., 1934.) 2*s*. net.

IN the establishment of right relations between science and the community to-day there are two primary tasks: on one hand the education of the community as to the meaning of science and its methods and the bearing of scientific work on everyday problems, and on the other hand, the stimulation of a true appreciation on the part of the scientific worker himself of the social aspects of science. Valuable contributions to both of these tasks are made by the two little books under review.

(1) Mr. Stark Murray gives a popular but well-balanced exposition of the functions of the laboratory in the modern world and the services it renders to industry and to the State alike. It is one of the merits of his book that he endeavours to rend the veil of mystery with which the laboratory worker is frequently surrounded in the public mind and to set forth his achievements in ways capable of general appreciation.

On the whole, Mr. Murray has done his work well. Without burdening the book with unnecessary details he indicates the romance with which scientific work is often surrounded, and its great possibilities in the service of the community. He succeeds in relating it to the everyday life of the ordinary citizen and in indicating, too, the human or personal problems of the scientific worker himself. Much of the material of the book is drawn from pathological work, and in this respect alone the book would afford a useful example of the way in which relations can be established between the scientific worker and the public, based not on a sense of mystery but on a respect springing from mutual appreciation and understanding.

(2) Prof. Levy addresses himself to the rather more difficult task of formulating an adequate philosophy of the place of science in society. He delivers a frontal attack on the traditional abstraction of the laboratory worker from the ordinary affairs of life. Man is at once a piece of matter, an individual and a social being, and the method of science to search for useful isolates may easily lead the scientific worker to overlook the reactions of his social environment on his own scientific work. Scientific workers too readily forget that they themselves are an element of society. Although science is essentially an objective examination of material processes, it is none the less a human activity and there must be a subjective aspect to the objective operation. Prof. Levy exposes the weakness of the distinction which many are so ready to draw between 'pure' and 'applied' science. Science involves ordered and systematic knowledge, not the indiscriminate compilation of observed data. The data must be arranged in a logically cogent form and this continuous interplay of thinking and acting is bound to be affected by human needs and human desires. Even the choice of the problems to which the man of science devotes himself is frequently restricted—almost determined—by social forces of the existence of which he is scarcely conscious.

The appreciation of this aspect of the mutual influence of science and society is important when we come to consider science as a factor in the solution of social problems. In discussing the scope of human laws, Prof. Levy points out the insufficient data on which many of the deductions of eugenists are based, and suggests that scientific deductions in this field are scarcely possible until a new order of society has been created in which a standardised social environment is a possibility.

Inevitably, Prof. Levy's argument leads him into a controversial field. He raises issues, however, which must be fairly faced by those who are concerned with the social consequences of scientific discoveries and wish to assist man to regain control over events. As he points out, to experiment with society involves changing the *status quo*—it means making social history. To the extent to which the application of scientific discoveries has opened up new vistas of social possibilities and intellectual interest, science is a part of society's system of production.

Even those who find themselves reluctant to accept Prof. Levy's conclusions as to the breakdown of the capitalist system and the incompatibility with progress of a wage system coupled with production for profit, should be grateful for his exposition of the real issues. The isolation of the man of science is a thing of the past. Science has both essential and environmental properties. There is not and cannot be a standardised, unchanging static environment, and this stimulating lecture should assist many scientific workers to think out their own position in relation to the changes which are being produced by the mutual reactions of science and society.

R. BRIGHTMAN.

A Crystallographic "Arrowsmith"

The Search. By C. P. Snow. Pp. 429. (London : Victor Gollancz, Ltd., 1934.) 8*s*. 6*d*. net.

IT is curious that in spite of the overwhelming influence exercised by science on our civilisation, there have been so few attempts to express its ethos in literature, especially in the field of imaginative romance. Many causes have probably contributed to this, not the least of which has been the fact that most writers are not in any sense within the boundaries of science, and have to take those essential structural details on which the whole complex of human relations must depend, at second or third hand. For this reason a book such as John Masefield's "Multitude and Solitude", which deals with medical research in Africa, gives always a shadowy impression, failing to inspire confidence in the probability of its main theme. The "Martin Arrowsmith" of Sinclair Lewis, in contrast, is a much more powerful book, and most of those who buy "The Search" will probably place the two novels side by side on their shelves.

It may be said at once that these purchasers will be many, and that "The Search" will rightly receive the general applause due to an almost unqualified success. It is to be noted, moreover, that the achievement is in more than meets the eye, for by the selection of crystal physics as his protagonist's subject, Mr. Snow abandons the popular appeal of the struggle against death and disease. The novel is in autobiographical form, and after a perhaps too Wellsian introductory childhood, describes the life of a student at the University of London and his first researches both there and in Cambridge. This is all excellent, becoming at times intensely exciting, with only traces of over-dramatisation. It leads on to an account of the proceedings of a committee appointed to set up a research institute, which is one of the most brilliant studies in character we have read for a long time. In the midst of this, the protagonist, who hopes for the post of director, becomes involved, somewhat to his detriment, in an unfortunate polemic, which destroys his chances. After some years of further work he leaves science altogether and takes up social and political writing.

The parallels with "Martin Arrowsmith" are striking, though until we have finished the book, we are not at all conscious of them. Like Martin Arrowsmith, Arthur Miles struggles in the realms of methodological imperfection, and as the former failed to maintain his controls during the island plague, so the latter puts unjustifiable trust in some data obtained by his assistant, with depressing results. The women, too, arrange themselves similarly, for though Leora and Audrey are admirably and sympathetically drawn, Joyce and Ruth are but flat characters.

Of criticism, perhaps the most serious that might be made is that Mr. Snow does not sufficiently make clear the nature of Arthur Miles's second enthusiasm. What is this for which an on the whole so successful scientific worker lays down his overall and slide-rule ? We are given to understand that the psychological and political education of mankind comes to seem more important to him than the search for detailed scientific truth. But the outlines of this need greater clarity. Had he turned to propagate a robuster political faith, this would not have been so necessary as it is when his aims seem so mild and moderate, so Lowes-Dickensonian, so L. N. U.

In sum, we have in "The Search" a really important study of human life as it is lived in the world of science. If Mr. Snow can push on along this line, we are not willing to suggest bounds for his possible achievement. But it will need a more definite socio-political outlook, and all the understanding that the closest and most sympathetic observation of human behaviour can give, whether it be of shop-assistant, railwayman, biologist, or parish priest. The results of such a life work are certainly no less valuable than a hundred papers in Proceedings and Transactions.

J. N and D. N.

Short Notices

Folklore and Archæology

Virgil the Necromancer : Studies in Virgilian Legends. By J. W. Spargo. (Harvard Studies in Comparative Literature, Vol. 10.) Pp. xii+502+27 plates. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1934.) 21*s.* net.

It is unlikely that Comparetti's study of the legends which grew up around the name of Virgil in the Middle Ages will be superseded ; but since its first publication towards the end of last century, the science of folklore has made considerable advances, and there are certain aspects of the legends which Comparetti did not consider.

It was very generally held that Virgil had prophesied the coming of the Messiah ; but this scarcely accounts for the fact that in popular belief he was credited with magical powers. Then it was believed, or rather story had it, that he constructed a fly of bronze which kept the flies out of Naples ; he built a market in which the Neapolitan food-supply would keep fresh for five hundred years ; and he is supposed to have fashioned human figures of metal which had magical powers of varied kind. This is only a small fraction of his achievement. Comparetti regarded these stories of Virgil's wonder-working as a folklore version of his literary reputation as an inspired *vates* ; but in so doing he overlooked the fact that these legends do not appear until late (twelfth century), and had they originated in the way he suggests, some earlier version would have survived. Dr. Spargo has investigated the source of these tales and shows that they belong to the common stock of medieval legend. Specific variants can be traced, on one side to India, on the other to Germany, and he argues that they were attached to Virgil in Italy as a local celebrity, just as they might have been attached to any other semi-legendary, semi-heroic character of local fame.

While Dr. Spargo does not present an irrefutable case, folklorists will agree that his view of the origin and growth of the legends as an attribute of Virgil has not only a strong element of probability, but also is in accordance with the manner in which popular traditions gather around the names of great men elsewhere and in other times. His account of the Virgilian legend and of its distribution and later history makes an entertaining volume, of which the illustrations from contemporary prints are not the least interesting feature.

The Mystic Mandrake. By C. J. S. Thompson. Pp. 253+8 plates. (London : Rider and Co., 1934.) 15*s.* net.

Mandragora (*Mandragora officinarum*, Linn. var. *vernalis Bertolini*) is one of the most ancient of medicaments. Its qualities as an agent of narcosis and anæsthesia were known to the Greek and Latin writers, and knowledge of its use for this purpose in connexion with surgical operations had reached the Chinese. In the poets and imaginative writers, especially of the Elizabethan period, it is coupled with the poppy as a producer of sleep and forgetfulness.

Mandragora, however, is best known under the name of the mandrake, for its magical properties. It was supposed to be an aphrodisiac and to ensure fertility in women. For this purpose not only was it used in the form of a drug, but also its supposedly human root was a powerful amulet. In form it was either male or female ; and when it was pulled from the ground, its shrieks caused the death of its hearers. The sound was, therefore, drowned by a trumpet as the root was pulled from the ground by a dog, which immediately fell dead. Representations of the operation are frequent in medical manuscripts and herbals of the Middle Ages. Mr. Thompson reproduces several of these. In England, owing to the scarcity of the mandrake, its magical properties came to be attached to the root of briony, and the belief still survives in attenuated form.

Mr. Thompson has followed the history of the mandrake superstition from the earliest times and among various peoples, Hebrews, Arabs, Greeks, Romans, Chinese and medieval Europeans. An interesting development was the artificial mandrake, which had a ready sale for magical purposes, especially in Germany, in the Middle Ages. This suggests a connexion with magic and witchcraft rather than a belief in a tree-spirit, to which Mr. Thompson inclines.

Historical Studies

The Renaissance of Medicine in Italy. By Prof. Arturo Castiglioni. (The Hideyo Noguchi Lectures.) (Publications of the Institute of the History of Medicine, the Johns Hopkins University, Third Series, Vol. 1.) Pp. xiv+91. (Baltimore, Md. : The Johns Hopkins Press ; London : Oxford University Press, 1934.) 7*s.* net.

This series of three lectures is preceded by an intimate picture of Prof. Castiglioni by his brother historian Prof. Henry E. Sigerist of Johns Hopkins University, where the lectures were delivered in 1933 at the Institute of the History of Medicine.

In the first lecture, which deals with the dawn of the Renaissance in the life, art and science of Italy, Prof. Castiglioni maintains that the three characteristic features of the Italian Renaissance were the individualistic conception of man as the centre of the cosmos, the passion for study and research independently of religious faith and scholastic doctrine, and the return to the Greek understanding of beauty, considered as harmony of shape and function. All these characteristics were admirably represented in Leonardo da Vinci, who was the complete type of the universal man as well as the initiator of physiological anatomy.

The second lecture contains a description of

medical studies in Italian universities at the time of the Renaissance, with special reference to the work of Alessandri Achillini (1463–1512) of Bologna, whose text on anatomy showed the first attempt to correct Galen's errors, Berengario da Carpi (1470–1530), the first to study the anatomy of the brain, to describe the position of valves and to examine carefully the vocal organs, Gian Battista Canano of Ferrara (1515–79), the third forerunner of Vesalius, whose work is then described, and Andrea Cesalpino, another universal man and the first to affirm that the organ of sanguification was not the liver but the heart.

In the third lecture, Prof. Castiglioni emphasises the importance of the work of Fracastor in relation to contagious diseases in general and syphilis, typhus and phthisis in particular, and concludes with a study of Galileo's work, which is described as not only creative in the field of astronomy but also as a renewal of all scientific thought from its foundations.

Jöns Jacob Berzelius. Autobiographical Notes published by the Royal Swedish Academy of Sciences through H. G. Söderbaum. Translated from the Swedish by Prof. Olof Larsell. (History of Science Society Publications, New Series 6.) Pp. xi+194. (Baltimore, Md.: The Williams and Wilkins Co., 1934.) 2.50 dollars.

THIS translation of the "Autobiographical Notes" Berzelius gave to the Swedish Academy of Sciences in 1823 and 1842 provides an interesting background to the state of science at the beginning of last century. At that time the rules of the Swedish Academy prescribed that each member should present his *Curriculum Vitæ* as soon as elected, and should contribute additions after every decade.

Berzelius fulfilled these obligations, setting out in great detail the story of his early struggles and frustrations, his travels and ultimate successes. Only brief mention is made of his actual discoveries, and nothing is said of his influence on the development of chemistry beyond the inclusion of a list of his students who attained eminence. He does, however, give valuable details concerning his meetings with English, French and German contemporaries, and sometimes expresses an opinion upon their work and character.

The Swedish version was published in 1901 under the editorship of Prof. Söderbaum, and is the basis of this English edition by Prof. Olof Larsell.

Combustion from Heracleitos to Lavoisier. By Joshua C. Gregory. Pp. vii+231. (London: Edward Arnold and Co., 1934.) 10*s.* 6*d.* net.

THIS is a dramatic book and should be read as such, for though it does not deal with the journeyings of men and women, of their love affairs and battles, yet it has relation to a subject old as man himself, that of fire. As long as there has been human thought, it must have struggled to understand fire; many civilisations got no further than worshipping it, until at long last there came a man, Lavoisier, who raised the curtain of ignorance and disclosed the rôle of oxygen in the kindling. In fact, it was not until systematic experiment took the place of dogma—and this did not happen until the seventeenth century—that the real facts of combustion could be elucidated and the phlogiston theory laid to rest. To-day we still concern ourselves with the mechanism of combustion and the order of events, but the points of issue are but minnows compared with the tritons of old.

The modern chemical student, alas, has no leisure and seeks only to acquire facts, but there are still some who wish to acquire taste maybe in literature or in the other good things of this life. To such we recommend Mr. Gregory's book for edification and profit. Many have mused before a brightly burning fire of this and that and written out their thoughts for posterity to enjoy; not a tithe of the musers have been curious as to what is happening in the fire. So it is still: curiosity is a character which dies very young and scarcely anyone asks why. Fortunately, there is a sufficiency of those who do so to carry the world forward at an ever increasing rate as science spreads but, as the subject of combustion illustrates, this was not always so. The book makes close reading, but the philosophically minded will not regret the labour, or close it without a debt of gratitude to its author, who surely must have enjoyed writing it. E. F. A.

Nature Study

Scolt Head Island: the Story of its Origin, the Plant and Animal Life of the Dunes and Marshes. Edited by J. A. Steers. (Published for the Norfolk and Norwich Naturalists' Society.) Pp. xvi+234+34 plates. (Cambridge: W. Heffer and Son, Ltd., 1934.) 15*s.* net.

SCOLT HEAD ISLAND, a narrow strip of land some four miles long off the coast of north Norfolk, between the harbours of Brancaster and Burnham—now the property of the National Trust—is likely to become famous. At any rate it will serve as a model station for the study of ecology, that is to say of the interrelations between wild plants and animals, and their relation, in turn, to their physical environment. Much that has been written on this theme makes somewhat tiresome reading. But in this small volume every page is of absorbing interest. The idea of securing this small stretch of the Norfolk coastline as a Nature reserve originated with Prof. F. W. Oliver, and was eventually brought to achievement by the enthusiasm of Dr. Sidney Long, one of the foremost of living Norfolk naturalists.

It would require a very long review to do justice to this remarkable volume, which has set a standard of what such a survey should be. Here we have set down for us, in most lucid fashion, the effects of shifting sand and scour of the tides in moulding and changing the form of the island, and their effects on the vegetation of the island. These variable factors form, so to speak, the basis of the book. In the following chapters, botanists and zoologists whose names inspire confidence give the results of their researches, which others are invited to carry on,

comfortable quarters being provided on the island, enabling students to make the prolonged stay necessary for sound observation work.

The history of the plant life, by Mr. V. J. Chapman, is extraordinarily interesting; and no less so is Miss E. L. Turner's account of the breeding birds. The treatment of the less familiar mosses and lichens and the marine invertebrates displays a knowledge as intimate and a skill in presentation as certain as that of the more familiar and more popular themes just referred to.

Our Garden Birds: their Food, Habits and Appearances. By H. Mortimer Batten. Pp. 192+39 plates. (London and Edinburgh: Thomas Nelson and Sons, Ltd.; T. C. and E. C. Jack, Ltd., n.d.) 5*s*. net.

THIS book will make an irresistible appeal to those who have an affection for the birds which add so much to the joy of our gardens. For the author writes of them evidently with an intimate, first-hand knowledge, and with a directness and simplicity of style which one rarely finds in books on this well-worn theme. An added charm is given by the unusually good coloured plates. These, apart from their unquestionable artistic merits, will prove of the greatest help to many of those readers whose knowledge, even of our common birds, is limited.

There is one statement made by the author concerning the lapwing which will cause no little surprise among ornithologists of experience. This statement is to the effect that it is getting too numerous in certain localities, and farmers are complaining of its change of food and habits. Surely the author should either not have made this charge, or he should have supported it by some show of evidence. We venture to think these charges are quite unfounded.

The author's description of the habits of the various species, forty in all, makes delightful reading, and they are all, obviously, from his own observations. His very beautiful coloured plate of the tree-sparrow, one of the best we have ever seen, should be welcome. For few people recognise this bird even when they see it. But the author does not tell his readers that one of the most characteristic features of the tree-sparrow, next to the conspicuous cheek-spot, is the chestnut-red crown, and that male, female and young all wear the same livery, whereas in the house-sparrow the female differs markedly from the male, while the young have a livery of their own, though very like that of the female. But for all this, it is an excellent book and should find a place on the shelves of every bird-lover.

The Life of the Rook. By G. K. Yeates. Pp. 96+16 plates. (London: Philip Allan and Co., Ltd., 1934.) 10*s*. 6*d*. net.

THE best first-hand account we have read of the daily habits of the rook in rookery and roost. The author is sometimes inclined to speculate hazardously, as when he suggests that the female rook visualises in courtship the stages of the life-history (although in her first breeding season she can have no experience of these stages), and he deliberately avoids discussion of the economic side of the rooks' behaviour. However, his observations are careful, his explanations of conduct on the whole reasonable and illuminating, and his photographs as near perfection as may be. He also tells how to construct a hide in the tree-tops.

Highways and By-ways

The Place-Names of Surrey. By J. E. B. Gover, A. Mawer and F. M. Stenton, in collaboration with Arthur Bonner. (English Place-Name Society, Vol. 11.) Pp. xlvi+445. (Cambridge: At the University Press, 1934.) 21*s*. net.

WITH a few exceptions, Surrey place-names are entirely English. The Celtic element, which to the English place-name hunter is in the nature of a plum in the pudding, here survives only rarely, although curiously enough, in the south-west, names indicating a connexion with pagan centres of worship are more numerous than in any other area of equal size in England. One example, to which attention is directed, is Tiusley near Godalming, which probably refers to a sacred grove of the god Tiw. Another name, which has now disappeared, but is recorded in an early document, is Cusan *weoh*, which is taken to mean the temple of (belonging to) Cusa. This is remarkable in view of the fact that while the element *weoh* is of fairly frequent occurrence in the midlands and south, the only known similar conjunction with a proper name is Patchway in Sussex. These survivals of Saxon paganism suggest a late, or more possibly a difficult, conversion to Christianity.

The significance of the name Surrey is by no means clear. The obvious explanation that it is the 'southern province' does not accord with the fact that no dynasty of the Middle Saxons is recorded. The authors suggest that a loose association of two peoples, of whom one was on the south side of the river, may have existed before the northern came under the Mercians and the southern was in turn acquired by the kings of Kent, Mercia and Wessex.

Admiration for the excellent work which is being done by the English Place-Name Society grows with the publication of each volume of its survey. The attention now given to field names, which appeared for the first time in the previous volume covering Northamptonshire, much assists the student. Of the appendices which close this volume, one by Mr. Arthur Bonner deals with the much discussed Cold-harbour and another by Prof. Bruce Dickins discusses head-names of the type of Shepshed, Swineshead and the like—survivals of much interest to the student of pagan beliefs in Britain.

From Track to By-Pass: a History of the English Road. By T. W. Wilkinson. Pp. xvi+240+39 plates. (London: Methuen and Co., Ltd., 1934.) 10*s*. 6*d*. net.

THE preparation and maintenance of roads has become an important industry into which science is beginning to penetrate. Although their present is definitely more important than their past, there will

be many who have a very real interest for the roads of rural England regarded as something more than speed tracks, and to these a history of the development of the English road from a track to the latest speedway or by-pass will appeal. Mr. Wilkinson knows his subject and, what is as important, has real affection for it, so that he has produced a book which is as entertaining as it is educative.

It is remarkable that only twice before in our long history have we built roads in England, once when the Romans did so to conquer and to hold it, and again, after a long period of neglect, during the coaching era in the early part of the nineteenth century before the advent of what Macadam dolefully called "the calamity of railways".

Mr. Wilkinson tells us the lore of the roads, including the technical work of Telford and Macadam, and it is perhaps worth emphasising how scientific road-making has now become. There is a Road Building and Materials Section of the Society of Chemical Industry and a Road Tar Association, as well as sundry specifications for road materials from the British Standards Institution: much research is going on to make the most permanent non-skid, dustless roads requiring a minimum of upkeep.

Gone Rustic. By Cecil Roberts. Pp. 318+4 plates. (London: Hodder and Stoughton, Ltd., 1934.) 7*s.* 6*d.* net.

In sending a copy of "Gone Rustic" to Nature for review, the publisher was not so greatly daring as might seem at first sight. For though there is nothing in this book which, even by a stretch of imagination, could be called 'scientific', yet there can be few readers of Nature who will not revel in its delightful pages. Here, when one is feeling jaded, will be found refreshment as delicious as a draught of sparkling wine. It has a bouquet all its own. The joy of a garden, and the restfulness of the country, many of us know well, but it has been left to Mr. Cecil Roberts to give these joys a language which glows and sparkles in continual effervescence. Our mistakes, our trials and our triumphs as gardeners are delightfully recalled to us. They are, indeed, *our* experiences, but we have had to wait for him to show us that even our failures should not mortify us, and to express that quiet satisfaction with a life in the country which refuses to be caught, and set down, by any other pen than his.

So vivid are his scenes, so life-like the people he portrays, that one feels that whether this is wholly a work of fiction, or wholly a work of fact, it is, in either case, supremely good.

Local Colour: a Landscape Analysis for Sightseers. By Edmund Vale. Pp. xvi+275. (London and Toronto: J. M. Dent and Sons, Ltd., 1934.) 5*s.* net.

This little book is full of that type of information coming under the head of general knowledge which we all should know though in reality so few of us do. But it has the further advantage of inspiring those who dip into it to take a greater interest in all that is around them. Though much of the population nowadays is only concerned to rush around seeing nothing and taking no interest in anything beyond themselves, there is a certain amount of return to the countryside by the hiker, and as the school education takes no note of such a subject, the sightseer must provide his education in landscape analysis for himself. With such a book in the hand, or still better in the head, a day in the country will possess added joys and a field-path will have more significance than being the shortest route between inns. Mr. Vale merits the widest possible public for his effort.

Geography in relation to the Social Sciences. By Isaiah Bowman. (American Historical Association: Report of the Commission on the Social Studies, Part 5.) Pp. xxii+382+17 plates. (New York and London: Charles Scribner's Sons, 1934.) 2.25 dollars.

This work is an attempt to re-write certain portions of modern geography and their bearing on human relationships. It contains excellent photographs, which would have been of greater value had they borne a closer relation to the adjoining text. Emphasis is rightly laid on the importance of a careful consideration of not one but a number of maps of a region before interpreting its significance in human relations. The extended use of italics is unfortunate, and not always conducive to clarity of expression.

In addition to Dr. Bowman's portion of the book, a compendium relating to the teaching of geography in European schools is included, this latter addition being necessarily somewhat cursory. In general, the work falls neither in the category of a textbook nor in that of books suitable for the lay reader.

B. H. K.

Astronomy and Modern Physics

Through Space and Time: based on the Royal Institution Lectures, Christmas 1933. By Sir James Jeans. Pp. xiv+224+53 plates. (Cambridge: At the University Press, 1934.) 8*s.* 6*d.* net.

In this book Sir James Jeans makes available to a wider public the admirable lectures which last Christmas he delivered at the Royal Institution to an audience varying in age from eight to eighty years. As then by the spoken word, so now by the written one, he portrays, in a style and with illustrations that a boy and a professor can alike appreciate, our present picture of the material universe. In the main his subject is astronomy, to which six of the eight lectures or chapters are devoted: they are entitled the sky (chiefly concerned with the astronomy of the ancients), the moon, the planets, the sun, the stars and the nebulæ. The first chapter describes the earth's present constitution, as revealed by earthquake records, and its past history, as disclosed by geology: among the many illustrations (which are a notable feature of the whole book) are several depicting prehistoric animals as 'reconstructed' from their fossil remains. The second

chapter recounts much of our present wide and varied knowledge of the lower and upper atmosphere.

The picture of the universe which is presented is an external one, as seen by supposed travellers making a journey from the earth, through the air, to our neighbours in the solar system and, beyond, to the stars and the nebulæ: the journey is one through time as well as space, for the author ranges over the past and, in some places, the future, as well as the present. Nowhere is the scene "sicklied o'er with the pale cast of thought"; eschewing philosophy and ultimate questions, the wonders of material things are vividly described, with that apt and varied imagery of which Sir James Jeans is a master. The book gives a splendid opportunity both for children and their elders to acquire a really up-to-date acquaintance with the outlines of the knowledge at present afforded by geophysics and astronomy. S. C.

The Mysteries of the Atom. By Prof. H. A. Wilson. Pp. viii+146. (London: Chapman and Hall, Ltd., 1934.) 10*s.* 6*d.* net.

NEW facts and new ideas in physical science are described by Prof. H. A. Wilson in this book on the mysteries of the atom. The author was one of the band of pioneer investigators in the Cavendish Laboratory, Cambridge, when the electron was discovered and its properties measured. Due prominence is given to the important contributions of J. J. Thomson and his fellow workers to the fundamental identification of the negative electron as a constituent of matter. "There is some truth in this, that many things have an epoch, in which they are found at the same time in several places, just as the violets appear on every side in the spring" (Bolyai).

The first chapter of the book contains an outline of the classical view of matter and electricity, and the following chapters describe the new discoveries and show how these have led to new views. "Determinism," says Prof. Wilson, "has definitely gone, for the time being at any rate, so that the idea of free will is no longer untenable". He concludes that "the laws of nature appear to have been designed so as to allow the course of events to be guided from outside without any violation of the laws".

One minor criticism may be made. The reviewer cannot approve the use (defended in Appendix I) of the term 'weight' in this book as equivalent to 'mass', employed in such expressions as 'charge per unit weight of electrons'. It would have been a simple matter to have explained the difference between these terms in the first chapter.

The book as a whole achieves the object of providing a plain and interesting account of modern physics. H. S. A.

The Diffraction of X-Rays and Electrons by Amorphous Solids, Liquids and Gases. By J. T. Randall. Pp. xii+290+31 plates. (London: Chapman and Hall, Ltd., 1934.) 21*s.* net.

THIS is really an excellent book on an interesting topic written in a clear and convincing manner with many suggestive remarks. Whilst the application of X-ray and electron diffraction methods of investigation are now a matter of routine both in the research laboratories and in industry to materials in the form of crystalline solids, it is only recently that the methods have been applied to the elucidation of the structure of gases, liquids and amorphous solids. A general survey of the principles of X-ray crystallography is first given and the method of application of these principles to microcrystalline systems and single molecules is then discussed. Whilst some advance in the application of X-rays to the investigation of liquids has been made, it is interesting to note that but little work has been carried out on the diffraction of electrons by liquids, a field of undoubted importance especially in connexion with the problem of lubrication. Some fifty pages are devoted to the structure of important substances such as glasses, coal and fibres, including an excellent although short account of Astbury's work on the proteins. The last chapter is devoted to the results obtained in investigating the phenomena of melting and liquid crystals.

It is evident from the ample documentation that the author has taken great pains to ensure that no paper of importance should be overlooked, and although as a result in some sections the effects of compression are to be noted, the author is to be congratulated on the results of what must have been a difficult but extremely valuable piece of work. E. K. R.

Miscellany

Sea Fishing. By A. E. Cooper (Editor), the Marquess of Sligo, Eric Parker, Louis Babcock, P. N. R. Bartlett, A. F. Bell, C. Leo Biden, G. Bonnaire de Maupas, Van Campen Heilner, T. E. Donne, O. W. Fenney, A. Fraser-Brunner, "Seangler", F. B. Hannam, J. R. Harris, C. S. Patterson, "Pelican", J. A. Sturch, W. K. Summers, Fred Taylor, etc. (The Lonsdale Library, Vol. 17.) Pp. 352+86 plates. (London: Seeley, Service and Co., Ltd., 1934.) 15*s.* net.

HERE we have a thoroughly up-to-date guide to sea fishing for sport—rod and line—in the format of the Lonsdale Library which has superseded the old Badminton, the delight of our youth. It is essentially a practical manual covering rods, gear and bait, spinning and casting, while the actual handling is indicated under each fish. The fisherman's first thoughts are directed to weather and boat management, the neglect of the theory and practice of which has cost many lives.

The fish are arranged according to modern classification, not habitat, and this is wise, for the likes and dislikes of fish and the mode of application of their strength show classificatory affinities as well, if judged by our text. Twelve sharks and dogfish and fifteen skates and rays are referred to, of which only about a third are regarded as sporting fish. Next follow the bony fishes, but the chapters dealing with fish after fish, considered by different authors, are often of textbook type and hence uninteresting to

the general reader. We fancy that this is due to the editor's necessary pruning, but all fishermen would like to know more of the eel's migrations, and the slip, 16,000 fm. of depth, for the breeding conger must be corrected. The cod and its allies are the commonest of sea fish, while the mackerel and tunny are recommended for enjoyment and the highest form of sport. Then follow chapters dealing with South Africa, New Zealand, the tarpon, the bone fish and fish mounting and modelling.

We suggest that the first appendix treating of "The External Features of Sea Fish" should be inserted before the "Contents" since its understanding is critical to so much of the subsequent text.

The form of the book pleases, its paper and illustrations are attractive and it is a necessary and desirable addition to the bookshelf of every fisherman —and perhaps yachtsman also.

Simple Science. By Prof. E. N. da C. Andrade and Prof. Julian Huxley. Pp. xi+688. (Oxford: Basil Blackwell, n.d.) 8*s.* 6*d.* net.

Profs. Andrade and Huxley offer their readers a "plain tale of the great intellectual adventure that characterises our age". The days are gone when one man could survey the whole realm of science, even to the extent of giving an elementary but balanced account of its fundamentals. The solution would appear to be the collaboration of a physicist and a biologist—with the proviso that both should be skilled interpreters of the story of science. In Profs. Andrade and Huxley we have such a combination; both have distinguished records as men of science and both have a flair for popular exposition. The result of their work is a connected descriptive account which makes a useful basis for a general course in the fundamentals of science. Indeed, the authors state that the material of the book was originally written "for young people", but that the present somewhat bulky edition has been issued with the aim of attracting the general reader.

Part I, entitled "Things Around Us", contains elementary notions on the states of matter, gravity, the atmosphere, water and life; Part II is largely physiological; and Part III, entitled "Forces at Work", has chapters on electricity, magnetism, light and chemistry, in which the everyday and industrial aspects are emphasised. The text contains many useful analogies and descriptions of 'neat' experiments. The only quarrel we have is with the illustrations; in many cases, sketches seem to have been prepared from photographs when reproductions of the photographs themselves would have been more useful.

Fog. By Alexander McAdie. Pp. 23+52 plates. (New York: The Macmillan Co., 1934.) 10*s.* 6*d.* net.

This is an unusual type of work, for it contains only fourteen pages of printed text, the bulk of its contents consisting of the reproduction of fifty-two photographs. Most of these have been taken by the author, but a few are from other sources such as Fontseré's "Atlas de Núvols". The title "Fog" is perhaps a little misleading, for only eight of the fifty-two photographs represent fog in the ordinary meteorological sense, and the preliminary discussion includes subjects not very intimately connected with fog proper, such as Aristophane's satirical play "The Clouds", the question as to the best unit in which to express atmospheric pressure, and the artificial production of rain. It appears that Prof. McAdie in this work uses fog in its widest sense, for he remarks (p. 12) that "Every fog is a cloud, only it is a cloud that rests upon earth. Conversely every cloud is a fog only it is lifted by rising air and shaped by losing energy, chiefly caused by the winds".

The photographs, many of which have appeared in earlier publications by the same author, illustrate some remarkable fog formations such as fog pyramids (Pl. VI), fog cascades (Pl. I) and fog surges (Pl. V), with which most British meteorologists are probably not familiar. In addition to photographs of clouds and fog there are a number illustrating lightning flashes, snow and frost crystals and optical phenomena such as the solar halo and corona, and a very fine one (Pl. XXIV) of a waterspout, taken apparently from an aeroplane. The reproduction does not strike one as quite up to the best standards, for in many cases the whole photograph looks excessively dark and in others the contrasts are so strong as to give the cloud a somewhat unnatural appearance. This last fault is most noticeable with the cirrus clouds.

E. V. N.

The Conquest of Suffering. By Ritchie Calder. Pp. xvi+166. (London: Methuen and Co., Ltd., 1934.) 5*s.* net.

Mr. Calder is avowedly a journalist, using the familiar devices of journalism in his method of presentation, but he writes with the ardour of an earnest social reformer, inspired by deep conviction of the essential justice and rightness of the cause which he pleads. His aim is to stimulate, by enlightened public opinion, State and municipal action to utilise adequately the results of modern scientific investigations which have shown how to prevent and to cure disease. Few will quarrel with this aim in a world where vast hordes of people are receiving less than the amount of nourishment which nutritional science has shown to be essential for the maintenance of health, while large supplies of 'surplus' foodstuffs are being destroyed, and where countless human beings are suffering and dying from preventable diseases. The achievements of medical science, faithfully served by the adjunctive sciences of chemistry and physics, are attractively and accurately presented with a restraint and freedom from exaggeration seldom found in propagandist works.

The scope and purpose of the book are briefly stated in an introduction by Prof. J. B. S. Haldane, and the list of eighteen eminent authorities who have contributed the facts and in many cases the opinions quoted by the author are themselves a guarantee of the essential accuracy of this small volume. It may be commended, not only to the lay reader for whom it is intended, but also to scientific persons who are interested in the development of public health and preventive medicine.

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observed on each occasion. With a tuned receiving set, of relatively low decrement, and recording with a galvanometer which has a relatively long natural period, the constituent parts of the atmospheric are merged together, and hence the duration recorded is that of the whole succession of pulses, that is, the duration as it would appear to a broadcast listener.

Visual observations of lightning flashes made in Toowoomba indicated that these lasted, in many cases, for an appreciable fraction of a second. (This has also been observed by Schonland, Collens and others.) In some cases, multiple flashes were observed by eye in which two or more flashes traversed the same path in relatively rapid succession, but with a definite interval of darkness separating them. In one case four such flashes were observed. Presumably this merely indicates an unusually long interval between successive constituent flashes. This phenomenon is reproduced in observations with the cathode ray direction-finder, in which, in an unexpectedly high percentage of cases, two atmospherics in succession come from the same direction.

It should be pointed out that the flashes observed by us were mostly cloud–cloud flashes, whereas Schonland and Collens appear to have worked mostly on cloud–earth flashes. Schonland and Collens's photographs show a thicker (more intense ?) track close to the *ground*, although the branching is away from the *cloud*. Photographs taken by us show a thinning-out in the direction of branching, indicating a somewhat different mechanism in the propagation of the flash.

The atmospherics dealt with in the above discussion are of the type sometimes known as 'grinders'. Sometimes an atmospheric occurs which consists of a single pulse, this producing a 'click' in a broadcast receiver.

The observations with the Einthoven galvanometer were carried out by Dr. A. L. Green at Liverpool (near Sydney).

G. H. MUNRO.
H. C. WEBSTER.
Commonwealth Radio Research Board,
Melbourne.
Oct. 8.

[1] *Proc. Roy. Soc.*, **111**, 165, 654; 1926.
[2] *Proc. Inst. Rad. Eng.*, **15**, 985; 1927.
[3] *Proc. Roy. Soc.*, A, **143**, 654; 1934.
[4] NATURE, **131**, 765, May 27, 1933.
[5] *Phil. Mag.*, **15**, 409; 1933.
[6] *Ann. Phys. u. Chem.*, **68**, 776; 1899.

Electrical Properties of Materials at High Radio Frequencies

THE accurate determination of the electrical constants of materials becomes progressively more difficult as the frequency at which they are required is increased. The effects of stray capacities and inductances in the measuring apparatus are usually such as to limit the use of ordinary resonant circuits to frequencies below about 10^8 cycles per second. The method described below can be used at much higher frequencies.

If a sinusoidal electromotive force is induced in a parallel wire transmission line immersed in a substance having a dielectric constant K, the distance between two points of the same phase is $1/\sqrt{K}$ times that in a similar line in air. The distance in either case is most readily determined by finding the antinodes of current or potential in the line. When the effect of the conductivity of the material between the wires cannot be neglected, the result is rather more complicated. In this case it can be shown that the distance between two consecutive antinodes of currents or potential in a line immersed in such a medium is not a constant but increases to a limiting value as the distance of propagation in the medium increases. The rate of this increase or the ratio between any two half wave-lengths in the line can be used to determine both the dielectric constant and the conductivity of the medium surrounding the line at the frequency of the inducing E.M.F.

It is usually convenient to have the inducing oscillator and part of the line outside the material under test. The analysis is then much simplified

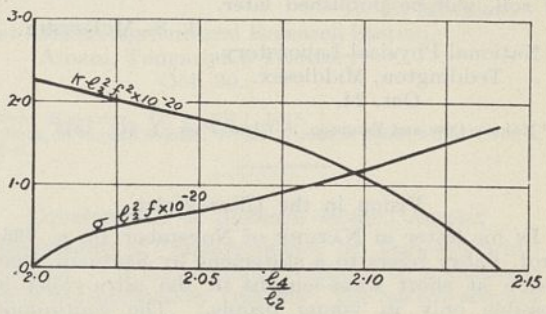

FIG. 1.

if the line is adjusted so that the point of entry to the medium coincides with an antinode of current in the line, as under this condition the effect of the part of the line in air disappears from the analysis. The positions of the antinodes of current in the case of a liquid can be determined by observing those positions of a short-circuiting bridge placed across the wires for which the line is in resonance with the oscillator coupled to it. If the distances between the antinode of current at the entrance to the medium and the positions of the first and second antinodes of current are l_2 and l_4 respectively, the required values of the dielectric constant and the conductivity (in E.S.U.) of the medium for radiation having the

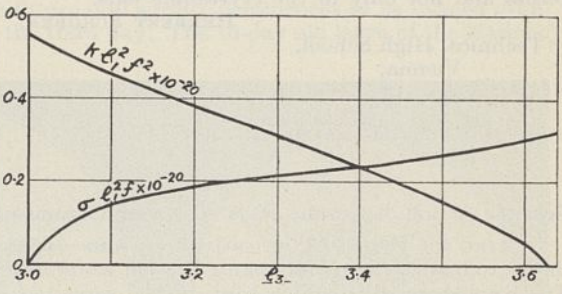

FIG. 2.

frequency f of the induced electromotive force can be obtained directly from the two curves given in Fig. 1. It may be more convenient to find the positions of the antinodes of potential in the line. In this case, if l_1 and l_3 are the distances between the antinode of current at the entrance to the medium and the first and second positions of antinodes of potential, the curves in Fig. 2 may be used. When the material under test is a solid, the method may still be applied by determining those lengths of the medium for which the line enters and leaves the medium at antinodes of current.

The reason that the change in wave-length in a conducting medium has not been observed before is

due probably to the small rate of change in the distances between consecutive antinodes of current or potential. Malone, Case and Ferguson[1] have recently attempted to apply a Lecher wire method to the determination of the dielectric constants of electrolytes. They found apparent inconsistencies in the results when the conductivity was appreciable. They do not give their results in detail, but it is possible that the explanation of them may be found in the change in wave-length with distance of propagation in a conducting medium.

The complete analysis of the method outlined above, together with the results of its experimental application to the study of the electrical properties of soil, will be published later.

J. S. McPETRIE.

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Teddington, Middlesex.
Oct. 24.

[1] Malone, Case and Ferguson, *J. Chem. Phys.*, **1**, 842; 1933.

Vision in the Ultra-Violet

IN his letter in NATURE of November 10, p. 736, Prof. Fabry refers to a statement by Saidman, that vision at short wave-lengths in the ultra-violet is possible only in young people. The continuous retrogression in the limit of visibility is due to progressive absorption with age by the crystalline lens. In his paper, Saidman remarks[1] that the determination of the limit of visibility would give an indication of the age of the crystalline lens.

It is of interest to record that Fr. Exner, who, at the age of nearly seventy years, determined a second time his visibility curve, found a remarkable variation in his own visibility curve from that of the normal eye at the blue and violet wave-lengths[2]. His retina became with increasing age, as he stated, remarkably yellow.

It seems probable that the cause of the limit of visibility at short wave-lengths in the eye of Exner with increasing age was the light absorption in the retina and not only in the crystalline lens.

HERBERT SCHOBER.

Technical High School,
Vienna.
Nov. 13.

[1] *C.R.*, **196**, 1537; 1933.
[2] E. Haschek, *Wr. Berichte*, **136**, 467; 1927.

Possible Action of Cosmic Rays on Living Organisms

DURING the year 1933, we carried out some experiments to test the action of cosmic rays on white mice. The Kongsberg silver mines west of Oslo served as a convenient working place. The station in the mines was surrounded on all sides by at least 350 m. of ore, thus giving a complete shield for the cosmic rays. The ore consists of basic horneblend which is very poor on radioactive substances, giving a correspondingly small amount of α-, β- and γ-rays. The control station outside the mine was in the basement of a wooden building with free passage for the cosmic rays. The ordinary physical conditions were almost identical on both places, with a comparatively good source of fresh air in the mines. The ionisation measurements of the different rays gave for the total intensity outside the mines 8·58 *I.* and 4·63 *I.* in the mine. The excess of 3·95 *I.* outside is mainly due to cosmic rays.

The animal experiments lasted a little more than ten months. 438 individuals were used, belonging to five generations, of which four generations were born during the experiment. As regards their general condition, no difference between the two groups could be found, either by the examination of the living animals, or at the autopsies. X-ray examination was carried out of the great part of the material, without demonstrable changes of the skeleton. The only difference demonstrable by these investigations was that the animals living in the mine had a greater mean weight than the controls. For the most homogeneous part of the material (animals of 2–6 months of age, born either in the mine or at the control station) the difference was about 2 gm. (the mean difference was 3·2–4·1 per cent for these groups).

Full details of the investigation will be published in *Acta Radiologica*.

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The Need for Social Research

ON many occasions during recent years reference has been made in leading articles and elsewhere in NATURE to the need for scientific research in the social sciences with the view of throwing "light on the true causes of many perplexing social phenomena observed both in industry and society"[1]. Several schemes have been proposed, I believe, but nothing apparently has been done. I may be permitted, perhaps, to suggest a line of research which, as it seems to me, would lead to results in the direction named of the highest practical importance; I mean the investigation of the relations which, in a progressive society, should obtain between the State and industry. For many years past, successive Governments have been making laws and regulations of many kinds which have affected our industries in all manner of ways. These laws and regulations must have produced many changes in many directions. What are these changes? Are they beneficial? Are they harmful? Science has not answered these highly important questions; nor does it seem to occur to anyone, not even students of social science, to inquire; and yet it should scarcely be necessary for me to remind men of science generally and sociologists in particular that the industries of society bear the same relation to the body-politic that the alimentary organs bear to the animal-body. When anything goes wrong with our own alimentary organs due to mistakes or ignorant treatment by ourselves, we know what happens; and it surely is not difficult to see that similar disturbances must occur to industry due to any mistakes or ignorant treatment to which they may be subject.

That these disturbances are being produced in industry there is much evidence to show. Many protests have appeared in the public Press from leading business men against this incessant State interference. What is wanted, however, is a collection of the facts upon which the opinions expressed are based, with the view of basing scientific conclusions on them. Facts of the kind indicated are to be had in abundance. I have myself collected them in a small way, and they all point in the same direction—the troubles of industry come from State interference.

Now that the British Association has, as I understand, adopted Sir Norman Lockyer's policy "to promote the application of scientific methods and results to social problems and public affairs", here is a way in which that policy might be put into operation with every hope of reaching conclusions which would be of the utmost practical use.

The world of science would the better realise the condition of industry to-day if its workers could conceive the science research laboratories of the country subjected to regulations, restrictions and increased expenses similar to those under which industry is struggling to-day. As it would be with science under such conditions, so is it now with industry. Both are skilled occupations which have to be conducted in ways known only to those who have the requisite knowledge of them. We must not suppose that the members of either of the Houses of Parliament who legislate for industry, or the Government officials who put their laws into operation, have a sort of super-knowledge and wisdom which fits them to control skilled occupations in such a way as to help forward such work, or enables them to guide social and economic activities to the general advantage. Have they passed examinations, or taken their degrees in these subjects? Or have they in any other way qualified themselves for work of this extreme difficulty and risk? Not at all. We must reluctantly admit that, after all, they are men with no special training either in science or industry, and their particular skill seems to lie in hindering those who have.

Herbert Spencer strongly advocated a research of the nature suggested many years ago: if it was needed in his day, our need is far, far greater to-day.

ALAN BLAIR.

Meir,
Stoke-on-Trent.
Oct. 31.

[1] NATURE, **134**, 393, Sept. 15, 1934.

Breeding Habits of Hornbills

ALTHOUGH the extraordinary breeding habits of hornbills have excited comment for many years, little is actually recorded except that the female is walled up in a natural hole, where she is fed by the male through a slit and undergoes a complete moult. Practically no one who has left notes has resisted the temptation to destroy the nest before the story was complete.

Recently Mr. S. A. Child has made observations at Longido on the small hornbill, *Lophoceros deckeni*, without interfering in any way with the nest. He found that the female was enclosed for not more than 58 days (53 ± 5). Directly she emerged the hole was resealed, and she helped the male to feed the two young for another four weeks. A similar habit was recently established by Hoesch[1] for *Lophoceros flavirostris leucomelas* in South-West Africa, and Schönland[2] had inferred it years ago for *L. melanoleucos*. The habit is, therefore, probably generic.

We have had a nest-hole of the big forest hornbill, *Bycanistes cristatus*, under observation near Amani for two successive seasons. The female did not emerge until the young were ready to accompany her. The dates she began to sit are known only within about four weeks; the dates of emergence are fixed exactly. She was immured for the astonishingly long periods of 159 days ± 16 and 137 ± 14 respectively. During these five months, the male was solely responsible for provisioning his family and, on the average frequency we observed for his visits, he brought food at least three thousand times.

R. E. MOREAU.

East African Agricultural Research Station,
Amani, Tanganyika Territory.
Oct. 20.

[1] *Orn. Monatsber.*, **41**, 97–106; 1933.
[2] Stark, A. C., and Sclater, W. L., "Fauna of South Africa", vol. 3, 1900–6.

Development of *Salmacis bicolor*, Agassiz

MORTENSEN'S "Echinopluteus of Temnopleurid ? species A"[1,2] is undoubtedly referable to a *Salmacis* species as suggested by Tennent[3]. The latter's account of the development of *Salmacis virgulata Alexandri* does not extend to metamorphosis. The present description of this tropical form is the first complete account. The temperature of the aquaria in which the larvæ were reared was maintained at 25°–26° C.

Soon after insemination, a fertilisation membrane is formed. Subsequent development is normal, a blastula being formed in eight hours and a gastrula in twenty-three hours. The first stage of development of the pluteus with the post-oral and antero-lateral arms is completed in three days. The development of the remaining two pairs of arms is complete by the twelfth day. The internal developmental processes have been followed and are essentially the same as those described for species of *Echinus*. It is interesting, however, that the amnion which marks the future oral surface commences to be formed even on the third day. The 10-day old larva of the Madras

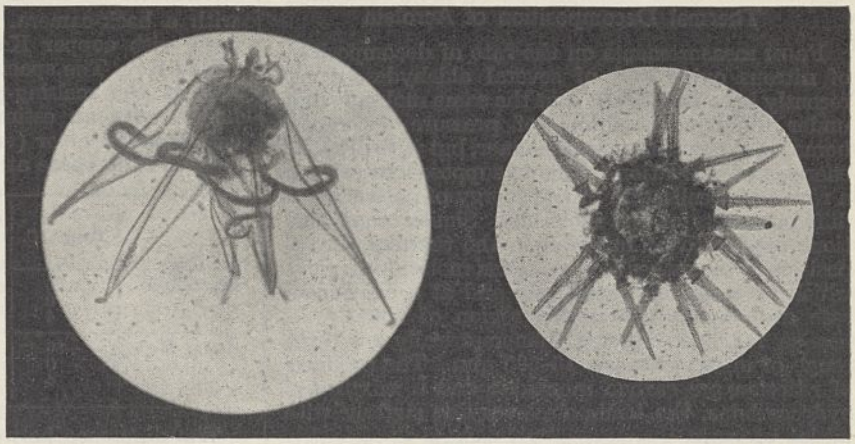

FIG. 1. *Salmacis bicolor*. Left hand, 14-day larva; right hand, urchin immediately after metamorphosis.

form resembles the 55-hour old larva of *S. virgulata Alexandri* described by Tennent. Evidently there is great disparity in the rate of development in spite

of uniformity in regard to temperature conditions, a fact which has already been noticed for other forms by Mortensen. During the twelfth day there is a broadening of the preoral and postero-dorsal arms. The anterior epaulettes are now formed, the posterior ones not being developed at all. The thirteenth day must be said to mark the completion of the development of the skeletal rods of the larva.

A single pedicellaria of the Ophiocephalous type appears on the fourteenth day and is soon followed by two more. A fourth appears very soon on the right side. Ear-shaped postero-lateral processes have developed. The larva sinks to the bottom, and the primary tentacles, pushing themselves into the base of the amniotic floor, soon break through. Metamorphosis is rapid and is usually complete by the twenty-fourth day. Quadrangular spines and ordinary spines, now smooth, have appeared and the young *Salmacis* creeps on the bottom. The adult mouth is a later formation. As yet there is only the first coil of the alimentary canal, soon to be completed by the formation of the second in a fortnight. In three months, when the young *Salmacis* is 4·5 mm. in diameter, the adult anus is formed as a crescentic slit. Six month-old urchins measuring 13 mm. were found to be immature.

The fact that mature individuals could be procured from Madras Harbour throughout the year seems to be in consonance with the view expressed by Semper[4] and Orton[5] that tropical marine animals breed continuously, though there are reasons to believe that *S. bicolor* exhibits an intensive period of reproductive activity during the rainy months.

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[1] Mortensen, Th., "Studies of the Development and Larval Forms of Echinoderms". Copenhagen, 1921.
[2] Mortensen, Th., "Contributions to the study of the Development and Larval Forms of Echinoderms". *Mem. Acad. Roy. Sci.*, Copenhagen, 9, **4**, No. 1.
[3] Tennent, D. H., "Early Development and Larval Forms of three Echinoids of the Torres Straits Region", Tortugas Lab., Carnegie Inst., Wash., **26**; 1931.
[4] Semper, K., "Animal Life". London, 1883.
[5] Orton, J. H., "Sea Temperature, Breeding and Distribution in Marine Animals", *J. Mar. Biol. Assoc.*, **12**; 1922.

Thermal Decomposition of Acrolein

FROM measurements on the rate of decomposition of nitrous oxide and of several aldehydes, it has recently been suggested[1] that the same molecule may under different conditions of pressure decompose homogeneously in the same manner, but with different energies of activation. This is supposed to arise as a result of localisation of the energy of activation in different parts of the molecule. Similar considerations appear to be involved in the thermal decomposition of the rather more complex molecule acrolein, which proceeds homogeneously and at a convenient rate at temperatures in the region of 550° C. It has so far been studied manometrically over the range of initial pressure, 15–600 mm. The products of reaction are carbon monoxide and a mixture of hydrocarbons, the 'end-point' varying slightly with initial pressure.

If the reciprocal of the period of half-change (suitably corrected for the variation in end-point) is plotted against the pressure, a segmented plot is obtained consisting of three straight lines, each giving a positive intercept on the $t_{1/2}$ axis. These three independent 'bimolecular' regions occur over the approximate pressure ranges 15–40 mm., 40–200 mm., and 200–600 mm. It is probable that one or more such regions exists below 15 mm., and the same may be true at pressures higher than one atmosphere. The energy of activation, which is of the order 50,000 cal., is different in the several regions. The measurements are being extended over a wider range of pressure and temperature. The decomposition of propiolic aldehyde is also being studied.

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J. J. FREWING.

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University Museum,
Oxford. Nov. 6.

[1] Hinshelwood, *Proc. Roy. Soc.*, A, **146**, 239, 327, 334, 345; 1934.

Cell Dimensions of Ordinary and 'Heavy' Ice

I HAVE recently made accurate determinations of the cell dimensions of crystals of ordinary and 'heavy' ice (D_2O). Single crystals were used. The apparatus consisted of a small Dewar flask mounted on the arcs of a Bernal photogoniometer, and filled with a mixture of acetone and solid carbon dioxide. A holder of copper wire attached to the bottom of the flask contained a capillary tube of Lindemann glass, into which a drop of water was sealed. The crystal was grown by inserting the glass tube into its holder in contact with the cooling mixture; its growth was observed with a polarising microscope, and it was thawed and grown again until a good single crystal was obtained. The direction of fastest growth was the normal to $(11\bar{2}0)$, so that this direction generally grew along the axis of the tube. There was a steep temperature gradient in the crystal; at the holder it was very nearly at −78° C., while its top, about 3·3 cm. above this, was at the melting point, and was in contact with a layer of liquid. The spacings could thus be determined at different temperatures.

Preliminary photographs showed that the structure of crystalline D_2O is the same as that of ordinary ice. The setting of the crystal was made by means of oscillation photographs. The exact spacings were determined from reflections at nearly 180°, recorded with a back-camera. For *a*, the plane $(50\bar{5}0)$ was used with copper Kα radiation, for *c*, (0008) with cobalt Kα. The spacings were measured at −66° C. and at the melting-point. The results are given below, with an estimate of the probable limits of experimental error (values for D_2O at 0° C. are calculated from those at 4° C. by interpolation).

	Temp. °C.	Ordinary ice (H_2O) (A.)	'Heavy' ice (D_2O) (A.)	Probable limits of error (A.)
Base of cell, *a*	−66	4·5085	4·5055	± 0·002
	0	4·5135	4·5165	± 0·0014
	4	—	4·5175	± 0·0014
Height of cell, *c*	−66	7·338	7·338	± 0·0035
	0	7·3521	7·3537	± 0·0012
	4	—	7·3552	± 0·0012

The difference between the cell dimensions of the two crystals is thus extremely small. There seems to be a real difference between the *a*-dimensions at 0° C., but it is very small, certainly less than 0·1 per cent. It is possible to calculate roughly from the measurements the linear expansion coefficients parallel and perpendicular to the hexad axis. These are found to

be equal, within the limits of experimental error, and there is no significant difference between the coefficients of D_2O and H_2O. The mean value over the temperature range $-66°$ to $0°$ is 29×10^{-6} ($\pm 10 \times 10^{-6}$).

These results have a bearing on the structure of water. The ratio of the molecular volumes of crystalline D_2O and H_2O at 0°, calculated from the spacings, is 1·0014. The density[1] of D_2O at 25° gives a ratio for the molecular volumes at that temperature of 1·0034. Since the radius of the D_2O molecule probably does not increase much more rapidly with temperature than that of the H_2O molecule, the difference in the ratio of molecular volumes must be due to the structure[2] of the two liquids. The smaller volume per molecule indicates that H_2O approximates a little more nearly to an ordinary close-packed liquid; thus its average co-ordination number is a little greater than that of D_2O. In other words, D_2O has a more ice-like structure than H_2O at the same temperature. This conclusion is in agreement with the results of G. W. Stewart from X-ray diffraction measurements[3].

It is hoped to publish elsewhere further details of this work, of which the preliminary results have been reported previously[4]. H. D. MEGAW.

Department of Mineralogy
and Petrology,
Cambridge.
Nov. 1.

[1] H. S. Taylor and P. W. Selwood, *J. Amer. Chem. Soc.*, **56**, 998; 1934.
[2] J. D. Bernal and R. H. Fowler, *J. Chem. Phys.*, **1**, 515; 1933.
[3] G. W. Stewart, *J. Chem. Phys.*, **2**, 558; 1934.
[4] *Proc. Roy. Soc.*, **144**, 24; 1934.

Electrical Changes in the Cerebral Cortex

SOME recent newspaper articles have given sensational accounts of the investigations which we have made in Cambridge on the electrical changes taking place in the cerebral cortex. In these articles we are deeply concerned to find ourselves credited with the discovery of the rhythm which can be detected from the human brain by electrodes applied to the scalp.

This is an important discovery, but it was made six or more years ago by Prof. Hans Berger, director of the Psychiatric and Nerve Clinic at Jena, and has already formed the subject of eight papers by Prof. Berger. We have repeated and confirmed many of Berger's observations; our interpretation of the rhythm differs in some respects from his, but we wish to make it clear that our own work is of recent date and is in the main confirmatory, whereas Berger has already made a detailed study of the cortical rhythm in a very large number of cases and has shown the effect of mental work, external stimuli, sleep, drugs, etc.

We hope that a forthcoming paper by us in *Brain* will remove the impression that we are in any sense the discoverers of the Berger rhythm and of its modification by mental processes.

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BRYAN H. C. MATTHEWS.

Physiological Laboratory,
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Dec. 3.

Points from Foregoing Letters

THE value of heavy hydrogen as an indicator becomes daily more evident. Prof. Hevesy and Mr. E. Hofer, analysing the urine and water of transpiration of one of the experimenters who had drunk water containing excess of the heavy variety, find that a little of the heavy water appears in the urine within half an hour, but the bulk of the heavy water leaves the body slowly, about half being eliminated within nine days. The rate of elimination shows that water which is drunk becomes completely mixed with the whole water-content of the body.

A group of seven investigators in London and Berlin collaborating with several others have succeeded in producing neutrons by means of hard X-rays; the neutrons were then used for the synthesis of radio-bromine and radio-iodine, from compounds containing the corresponding elements. The production of neutrons by means of X-rays is an important step, since neutrons are more efficient than protons in atomic transmutation. Hitherto the only practical source of neutrons was an already existing radioactive element.

'Grinder' atmospherics, so objectionable to radio listeners, consist of a number of disconnected pulses, according to Mr. G. H. Munro and Dr. H. C. Webster, who have analysed the wave form with a cathode ray oscillograph. This composite nature accounts for the divergence in the views expressed by previous investigators concerning the duration of atmospherics.

Dr. J. S. McPetrie describes how the dielectric constant and the conductivity of materials at high frequencies can be determined from the decrease in wave-length in the given material, as compared with that in the air. The method has been used in the study of the electrical properties of soil.

Four generations of mice kept by Prof. R. B. Engelstad and Mr. N. H. Moxnes in a mine 350 m. deep where they were sheltered from cosmic rays, appear to be in no way different from 'control' mice kept at the surface, except that the 'sheltered' mice have a greater mean weight. It has been suggested that cosmic rays may be responsible for 'mutations', sudden changes in the characters of a species. The above experiments leave this question open.

The work of Mr. C. N. Hinshelwood and others indicates that certain substances (nitrous oxide, acetaldehyde) have excess energy differently located in some of their molecules. These molecules behave at different pressures as independent entities from the point of view of the velocity of chemical reaction. Dr. H. W. Thompson and Mr. J. J. Frewing have studied the decomposition of acrolein, the acrid substance formed when glycerine is heated, at various pressures, at 550° C.; it shows a similar behaviour.

Mr. H. D. Megaw reports that the crystalline structure of 'heavy' ice, containing heavy hydrogen, is the same as that of ordinary ice, the difference between the dimensions of the constituent molecular 'cells' being very small. His results further indicate that ordinary water has its molecules more closely packed than 'heavy' water, which has a more ice-like structure.

Research Items

Baptism and the Gypsies. While popular belief in a prophylactive element in religious ritual undoubtedly survived late, it is not always easy to find records of specific instances in which a semi-magical efficacy is attached to any one form of observance. It is, therefore, of interest to find a writer in the *Journal of the Gypsy Lore Society* (Third Series, **13**, pt. 4) directing attention to the excessive addiction to the rite of baptism of the gypsies at various periods of their contact with Christianity. In fact, in Saxony in the seventeenth century, it was found necessary to frame regulations for the institution of inquiry before the ceremony to check this abuse. Some are said to have had their children baptised nine and ten times; but in such cases, the motive appears to have been not superstition but gain, as on each occasion rich presents were obtained from the sponsors, who thought to acquire merit by standing for a pagan child. There is, however, a number of instances quoted, some going back to the end of the fifteenth century, from which it appears that while the gypsies cared nothing for religion, they were always anxious to get their children baptised in the belief that an unbaptised child was in a dangerous state. The Siebenburg gypsies, it is said, kindle a fire before the tent as soon as a child is born to keep evil spirits away, and extinguish it when the ceremony has made it unnecessary; and the Scottish border gypsies considered it unlucky to have an unbaptised child in a house. The magical effects of baptism were not confined to the child, but extended to any ornaments it wore. The Magdeburg church ordinances of 1652 forbade that children at baptism should be bedecked with corals, beads, gold and silver buttons and the like, in order that they too might acquire special power, though this is not attributed to the gypsies specifically, but "as common people say".

Prehistoric Pathology. A survey by Prof. A. V. Vallois of present knowledge relating to the pathology of prehistoric man, communicated to the Institut de Paléontologie humaine at the beginning of the current year, appears in *La Révue scientifique* (No. 20, Oct. 27, 1934). The general conclusion is that it is an error to suppose that our ancestors, living a wild and savage life, had acquired a greater resistance to disease than ourselves. There is, however, a difference in the diseases which were most prevalent, and this distinction is to be observed not only as between modern man and neolithic man, but also as between neolithic man and palæolithic man. Rachitis does not appear to be present in palæolithic man, but there is abundant evidence of rheumatoid arthritis, attacking the vertebræ as well as the limbs. It becomes increasingly common in the neolithic and bronze ages. Traumatic lesions are not very common in the palæolithic period. In the neolithic age they become more frequent and are found in all the bones. Two facts are noticed—the presence of flint arrowheads in the traumata, especially in the dorsal vertebræ, and the high proportion of cases in which the fracture heals with a good join. The observations of tuberculosis and syphilis are subject to the fact that no soft parts are available for examination; but otherwise there is no appearance of tuberculosis in the palæolithic period, while in the neolithic, bronze and iron ages cases are few. To a certain extent, there is uncertainty in the identification of the lesions of syphilis, but it would appear that there is no case of syphilis in palæolithic man, and in the later prehistoric periods only a very few cases from France and one from Russia appear certain. Dental caries is not found in palæolithic man in Europe, but appears in Africa in men of (probably) late palæolithic age. It is found for the first time in Europe in mesolithic man at Aveline's Hole (Somerset) and Teviec (Brittany).

Babylonian Mathematics. In the second edition (1934) of Prof. R. C. Archibald's pamphlet "Outline of the History of Mathematics" (now published by the Mathematical Association of America), there is an account of the discoveries of Otto Neugebauer, an Austrian scholar connected with the Mathematical Institute of the University of Copenhagen, concerning Babylonian mathematics. From about 3500 B.C. until 2000 B.C. the dominant race in Babylonia were the Sumerians. Among their achievements were engineering works, such as the draining of marshes and the construction of canals, and the adoption of cuneiform script. They were familiar with weights and measures, bills, receipts and accounts, and could calculate interest at various rates. Their arithmetic was essentially sexagesimal, and the same symbol may mean 1 or 60 or 3600, which is a source of great uncertainty in reading their tablets. Near the beginning of the Christian era they used a special symbol for zero. They knew a few results in geometry, but, like the Jews, took the circumference of a circle to be three times its diameter. Unlike the Greeks, the Babylonians discussed geometrical problems from what may be called an algebraical point of view; the steps taken seem to lead to simultaneous linear equations or even to quadratics. Cubic and biquadratic equations were dealt with, by means of tables which gave the squares and cubes of all integers from 1 to 60. It is remarkable that they accomplished all this without possessing any algebraical notation, or, as far as we can judge, any general theory underlying their particular problems. Moreover, their work seems to have been unknown, for at least 1800 years, to the Greek pioneers in the same subjects. There are still many cuneiform tablets not yet deciphered, and further discoveries are anticipated.

Hybrid Ducks. Two hybrid ducks, natural crosses between the hooded merganser (*Lophodytes*) and the American golden-eye (*Bucephala*) are fully described by Mr. Stanley C. Ball in Bulletin 3, Peabody Museum, Yale University. One was shot at New Haven in 1920. The only other known record is that of a specimen taken in Maine in 1854, and presented to the Boston Society of Natural History. These two birds show certain differences, the latter being immature. In general, their plumage and other characters are a mosaic of the parental characters, as in number of tail feathers, tarsal scalation, marking of tertials and scapulars. In size, colour of head and form of bill, they are intermediate, while in various other characters which are present only in one parent they appear in modified form in the hybrid. References are made to various other hybrid ducks.

New Congrid Eels. Two new eels belonging to the genera *Arisoma* and *Congrina*, and a new Pleuronectid, *Poecilopsetta albomarginata*, are described by Mr. Earl D. Reid in the reports on the collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep (Johnson Fund, *Smithsonian Misc. Coll.*, **91**, No. 15; 1934). The author points out that tooth characters alone in classification of the congrid eels have very little value, since the variations are so extensive that intergradations are found throughout the group almost without exception. He states that the shape and position of the dental plates, spacing of the groups, and width of the bands of teeth seem to be the most reliable dental characters for purposes of generic distinction, and uses these in classifying the Congridæ discussed, dividing *Arisoma* from *Congrina* and its allies by the upper lip and its bone-like supports; in *Arisoma* the lip being turned upward into a flange, the bones of the facial canal do not send pointed processes into this flange; in *Congrina* the upper lip being without a flange, the bones of the facial canal send pointed processes to the edge of the lip. Examination of the material in the National Museum has revealed the presence of these labial elements, which were specially noted by Bleeker and Schmidt in *Uroconger*, in various degrees of development throughout the entire group of congrids. The pore-like slits in the lip in *Congrina* are shown to be vents of the muciferous channel, and not pocket-like pits for facilitating expansion of the labial membrane.

Life-history and Structure of the 'Cleg'. The common 'cleg', *Hæmatopota pluvialis* (family Tabanidæ), forms the subject of a paper by Dr. A. E. Cameron (*Trans. Roy. Soc. Edinburgh*, **57**, Part 1, 1934). It appears that among 1,400 described species of Tabanidæ, only certain American and Indian species have been traced from the egg through all the larval instars to the adult. In studying the species in question, the author has provided the first complete account of the metamorphosis of a European species. It is noteworthy that the number of larval stadia varies from seven to nine or, in a few cases, to ten, and the species is univoltine or demivoltine. Observations are given on the mating behaviour, feeding and oviposition of the adult fly, and the methods of rearing the insect are described. A general description of the larval anatomy forms a large part of the paper, while the external characters of the pupa are also dealt with. Some account is given of the structure of the problematical organ known as Graber's organ and suggestions made as to its possible function. The paper contains 28 text-figures and a bibliography of the subject.

Respiration in *Ascaris*. Y. Toryu (*Sci. Reports Tôhoku Imp. Univ.*, **9**; 1934) has examined the respiratory exchange of *Ascaris megalocephala*, which is not an obligate but a facultative anærobe. This worm produces carbon dioxide by a fermentative process in the absence of oxygen, but by an oxidative reaction in the presence of oxygen. When the worms are placed in Ringer's solution containing oxygen, they consume the oxygen until the tension in the medium becomes about 0·06. The total amount of carbon dioxide produced in 24 hours at 38° C. per 100 gm. of worms was from 80 c.c. (by females) to 200 c.c. (by males) in the presence of oxygen, and from 20 c.c. (by males) to 80 c.c. (by females) in the absence of oxygen. That little production of carbon dioxide or consumption of oxygen occurred during the first and the last few hours of the experiment suggests to the author that a true fermentation process took place.

Northern and Arctic Tunicata. The attention of workers on northern ascidians is directed to the fourth paper (*K. Svenska Vet. Akad. Handl.*, **3** Ser., **13**, No. 3; 1934) by Augusta Ärnbäck-Christie-Linde, on the northern and arctic Tunicata in the Riksmuseum at Stockholm. The material of the northern Tunicata was obtained for the most part off the Bohuslän coast. The families included in this account are the Cionidæ, Ascidiidæ, Agnesiidæ and Rhodosomatidæ. Synoptic keys of these families and their thirteen genera and twenty-three species are given, and observations added on anatomical features and on the geographical and bathymetrical distribution.

Invert Sugar from the Cashew 'Apple'. In India the cashew, *Anacardium occidentale*, L., is largely cultivated for the nut, and the curious fleshy swelling of the axis beneath the nut is discarded. M. Srinivasan, of the Department of Biochemistry, Indian Institute of Science, has been exploring the possibility of utilising this fleshy 'apple' (*J. Indian Inst. Sci.*, **17A**, Part 7). Alcohol could be obtained from its juice by fermentation, but the costs involved would not warrant large-scale production; on the other hand, the juice contains about 7 per cent invert sugar on the fresh weight of the apple and may easily find a use as a syrup. Pigments present in the juice render more simple its correct neutralisation by lime, and at neutralisation there is complete precipitation of albuminoids and tannins so that filtration is easy. The lime has then to be removed (as carbonate, sulphite or phosphate), before the juice is concentrated, when it yields a clear red syrup for which there may well be considerable demand, as invert sugar is in great use by confectioners. It may also serve as a useful source of lævulose, the sugar to which diabetic patients show so much tolerance.

Mechanism of Disease Resistance in Plants. Prof. W. Brown's presidential address to the British Mycological Society appears in vol. 19, Part 1 of the Society's *Transactions* ("Mechanism of Disease Resistance in Plants", pp. 11–33, Oct. 1934). The address is a valuable and exhaustive review of modern knowledge about the physiology of parasitism. Various types of parasitic attack upon plants are described, and then the mechanism of penetration of the fungus is discussed. Chemotropic theories are reviewed, and shown to be inadequate to explain all the observed facts. Entrance by contact stimulus is also an incomplete hypothesis. It becomes increasingly obvious that mechanical penetration of the host takes place in most plant diseases. Sources of energy for this process, and possible supplies of food, are discussed. Some results obtained by the author show that fungi vary greatly in their penetrative power, and suggest that thickness of cuticle on the host plant may be a factor in disease resistance. Internal mechanisms of resistance are also reviewed, from both mechanical and chemical points of view. Four types of chemical resistance are recognised: (1) The composition of the plant may be unsuited to the growth of a particular fungus; (2) the composition of the plant allows ready growth of the fungus, but not the production of toxic substances; (3) no fungal attack occurs, although chemical composition of the host allows good growth; (4) the active principle of the fungus is unable to affect

the tissues of the host plant. Well-defined examples of each type are given, and suggest wide possibilities for further research.

Meteorology of North-West India. The India Meteorological Department has published a small handbook dealing with the climate of the extreme north-west of India entitled "Meteorological Conditions affecting Aviation over the North-West Frontier" by Flight-Lieut. R. G. Veryard and A. K. Roy. Knowledge of the meteorological condition over the North-West Frontier has been derived largely from the records of the stations at Peshawar and Quetta, of several second- and third-class observatories, and of a number of rainfall stations. The region under review provides a considerable diversity of climates corresponding to the great differences in elevation; there are mountains which reach 26,620 ft. at Nanga Parbat in the Gilgit Agency, and low-lying plains bordering the Indus, that form part of one of the hottest areas in India. At Dera Ismail Khan, with an elevation of 590 ft., the mean daily maximum temperature exceeds 100° F. in the four months May–August and in June reaches 107·8° F., with a mean minimum of above 81° F. from June until August. Even at Fort Sandeman, with an elevation of 4,614 ft., a mean maximum of 100° F. is attained in June and July. Apart from the climatological tables there is a general discussion of all the meteorological elements over the whole frontier region, and detailed discussions of different parts of that region, and in these the year is divided into two main seasons, the hot and the cold, and two transitional periods. In the cold season (December to mid-April), depressions pass directly across the frontier to the plains of north-west India; there are about five or six to each month, and they cause changes in the weather of the kind usually associated with temperate depressions. In the succeeding transitional period that extends to about the end of June, the depressions follow more northerly tracks and generally give rise only to local convectional rains. From July until September there are intermittent incursions of the monsoon, either directly from the Arabian Sea or indirectly across Northern India from the Bay of Bengal, and thereafter the second transitional period corresponding with the reappearance of eastward-moving depressions to the north of the frontier.

Formation of Emulsions. Prof. G. I. Taylor (*Proc. Roy. Soc.*, A., Oct. 1) has investigated the distortion and disruption of drops of fluid suspended in another fluid which has a non-uniform but mathematically definable field of flow. The breaking of the drops results finally in the formation of an emulsion. Drops of an oily mixture were suspended in a tank of golden syrup which was stirred by two parallel bands moving in opposite directions or by four rollers, the latter arrangement giving approximately hyperbolic lines of flow. The distortion of the drop at low speeds of flow was in agreement with a theoretical formula, but at higher speeds the shape of the drop varies with time. The ultimate fate of the drop depends very much on the ratio of the viscosities of the two fluids. When the viscosity of the drop is very small compared with that of the syrup, the drop elongates very greatly but does not burst; for higher viscosities of the drop, the drop elongates to a threadlike form and breaks up into droplets about one hundredth of the size of the original drop. For very viscous drops the parallel field of flow is no longer able to produce disruption.

Nuclear Disintegration Experiments with Pure Isotopes. M. L. Oliphant, E. S. Shire and B. M. Crowther have recently described the separation of the pure lithium isotopes and their nuclear reactions under bombardment with protons and heavy hydrogen ions (*Proc. Roy. Soc.*, A, Oct. 15). The isotopes were separated in a simple mass-spectrograph; ions obtained from a filament coated with a lithium mixture were accelerated into crossed electric and magnetic fields so disposed that the selected ions travelled in a nearly straight path. In one form of the instrument, electrostatic fields were used as 'focusing lenses'. The films of isotope were deposited on metal collectors cooled with liquid air. The quantities separated were of the order of 5×10^{-8} gm., the time of collection being about an hour for the less common Li^6 isotope. The specimens obtained were bombarded with ions of about 160,000 volts. Li^6 yielded with proton bombardment α-particles of 11·5 mm. range, probably obtained by the reaction:

$$_3Li^6 + {}_1H^1 \rightarrow {}_4Be^7 \rightarrow {}_2He^1 + {}_2He^3;$$

the He^3 particles being those observed in the present experiments. With H^2 bombardment, there was a large emission of α-particles of 13·2 cm. range:

$$_3Li^6 + {}_1H^2 \rightarrow {}_4Be^8 \rightarrow {}_2He^4 + {}_2He^4;$$

and of 30 cm. range protons:

$$_3Li^6 + {}_1H^2 \rightarrow {}_4Be^8 \rightarrow {}_3Li^7 + {}_1H^1;$$

Li^7 yielded 8·4 cm. range α-particles with protons:

$$_3Li^7 + {}_1H^1 \rightarrow {}_4Be^8 \rightarrow {}_2He^4 + {}_2He^4;$$

and with diplons a continuous spectrum of α-particles

$$_3Li^7 + {}_1H^2 \rightarrow {}_4Be^9 \rightarrow {}_2He^4 + {}_2He^4 + n_0{}^1;$$

the neutron emission being also observed. The nuclear reaction showed that the contamination of the isotopic specimens with the unwanted isotope was very small and in the worst cases of the order 1 per cent.

Origin of the Craters on the Moon. F. Leitich of Vienna has recently discussed the unsolved problem of the origin of the lunar craters, with particular reference to the outstanding example Copernicus (*Astro. Nach.*, **253**, No. 6065, Oct. 1934). He considers and rejects the explanation, which has been suggested, that they are due to the impact of meteors, and concludes that they result from causes within the moon. In great detail he develops a new hypothesis, that they are due to volcanic action, but of a kind very different from that which, by the emission of lava, has formed craters upon the earth. In his view, the typical lunar crater was made by an outbreak of volcanic gases, slowly accumulating, through thousands of years, between the surface of the moon's crust and an overlying layer, some kilometres thick, of salts (chiefly chlorides of sodium, potassium, calcium, etc.). This outer layer is supposed to be very light, being cellular in structure, owing to the presence of much gas within it when it was formed. This light but strong layer is supposed to have become raised like a (very slightly arched) dome over the growing volume of gas beneath, until finally a collapse occurred. The author explains how this could give rise to the central peak, the mountain-walled plain, and the radial ridges beyond. He suggests that the condition of the disrupted borders of the craters may give an indication of the relative ages of the different craters.

Anniversary Meeting of the Royal Society

THE annual meeting of the Royal Society was held on St. Andrew's Day, November 30, when the president, Sir Frederick Gowland Hopkins, delivered the anniversary address. He referred to the Society's loss by death during the past year of one foreign member and twenty-two fellows. Speaking of the Council's report, he pointed out that the capital value of the Society's research funds now exceeds £600,000, the income from which is £23,700. During the year, a little more than £25,000 was spent in support of research. In spite of this expenditure, Sir Frederick stated that it had proved difficult to meet the many requests for financial support for research in the field, which is now becoming an urgent need in many branches of science. The Treasury was unable to give an additional grant for this purpose, so some of the Society's research funds were utilised. Field research of great scientific and economic importance is inadequately supported at the present time, and the Royal Society is a suitable trustee for any funds which may be provided. Sir Frederick then passed on to a discussion of the parts which the clinician and the laboratory workers play in the development of fundamental medical knowledge.

At the conclusion of his presidential address, Sir Frederick presented the medals for 1934; extracts from his remarks in making the presentations are printed below.

Presentation of Medals

COPLEY MEDAL, awarded to PROF. J. S. HALDANE

Prof. HALDANE is awarded the Copley Medal for discoveries in physiology and their application to a number of important problems, practical and industrial, in which the human factor is evolved. Haldane's researches in physiology centre on that of respiration. His work on the chemical regulation of breathing first made clear the delicacy of correlation on which depends the power of an animal to adapt itself so widely to environment, or to bodily activity. While this work has greatly affected the outlook of physiologists, and has had a fundamental influence on medicine, it has led also to applications of the greatest value, not only in science and medicine but also in everyday life. His investigation of the causes of death in colliery explosions led him to his researches on the union of hæmoglobin with oxygen and carbon monoxide, thence to his discovery of the action of light on the equilibrium between these substances, a discovery which has played a fundamental rôle in the investigation of others. His interest in the influence of high underground temperatures on the working capacity of miners led him to an exhaustive study of the regulation of bodily temperature and of the function of the sweat glands. His 'stage decompression', based on a bold and simple application of gas laws to the human body, gives him a similar claim to the gratitude of divers, or of workers in compressed air, who are liable to caisson disease.

The most striking characteristic of Haldane's work is the way in which his great experimental skill, based always on the simplest methods, and his strong philosophical instincts, have reacted with the broad humanity of his outlook and with the courageous use of his own person, when necessary, for the more drastic observations. Haldane's researches have influenced such diverse activities as mining, diving, flying, muscular work, mountaineering, protection against gas; and his teaching has left a permanent mark on physiological thought.

RUMFORD MEDAL, awarded to PROF. W. J. DE HAAS

One of the main pieces of work that brought fame to de Haas was on the Einstein – de Haas effect, the measurement of which constitutes the first experimental proof of the spin of the electron. In association with a series of collaborators he has made an extended study of the magnetic susceptibilities of various diamagnetic solids in the single-crystalline as well as in the poly-crystalline form. These studies revealed a dependence of the magnetic susceptibilities on the strength of the magnetic fields used and also on the temperatures at which the measurements were made. Similar studies were made by de Haas of the electrical resistance changes undergone by diamagnetic substances under the influences of magnetic fields of various strengths. High diamagnetism and strong resistance changes were found by him to go together. In 1917 he showed that these phenomena could be explained quite readily by the classical theory of light.

In recent years de Haas has done an enormous amount of work on the supra-conducting properties of metals. In particular he has studied exhaustively the effect of magnetic fields on supra-conductors. This is most valuable and the results are likely to lead to very important developments in the theory of electric conduction in metals at low temperatures. Recently de Haas has succeeded in reaching the lowest temperature as yet attained. It was done through the use of a cooling effect obtained by the adiabatic demagnetisation of paramagnetic salts. His latest achievement in this field is to reach a temperature of 0·031° K. in a volume of 56 c.c. of potassium chrome alum through demagnetising the salt when it was thermally insulated.

A ROYAL MEDAL, awarded to PROF. S. CHAPMAN

Prof. Chapman has made contributions of the highest importance to the kinetic theory of gases. In the original researches of Clerk Maxwell, an artificial assumption as to the law of attractive force between the molecules was introduced for the purpose of simplifying the mathematical analysis. Chapman has worked out a generalised theory which assumes no properties for the molecules other than spherical symmetry, and has derived formulæ for the viscosity, diffusivity and conductivity of a gas.

Much of Chapman's work has been concerned with terrestrial magnetism. He has outlined a theory of magnetic storms, and discussed the energy of such storms and the inferences as to the electric and magnetic state of the interior of the earth which can be deduced from terrestrial magnetic variation. He has developed a general theory of the diurnal variations in the earth's magnetism produced by the moon and sun. Somewhat parallel to these investigations have been investigations of the general magnetic field of the sun and of its radial limitations; of solar ultra-violet radiation as a cause of auroræ and magnetic storms, of the influence of solar eclipses on the ionisation of the upper atmosphere and the study of the properties of solar streams of corpuscles. The composition, ionisation and viscosity

of the atmosphere at great heights and a theory of upper atmospheric ozone are some of the other problems to which Chapman has devoted his attention.

A ROYAL MEDAL, awarded to PROF. E. D. ADRIAN

Prof. Adrian is distinguished for his work on the physiology of the nervous system. He has dealt with the activities of the single nerve fibres, single sensory end organs, single muscle fibres, and single nerve cells of which neuro-muscular function is built up, and in each of these he has found one simple quantitative factor in the physiology of sensation or response, namely, the frequency of the rhythmic electrical disturbances which occur in it. Increased intensity of stimulus to a sensory organ means increased frequency of impulses arising from it; increased response from a muscle fibre means increased frequency of stimulation. Recently he has studied the electrical changes of the cortex of the brain, and with Matthews has shown how, even in conscious man, objective graphic records can be made of the rapid electrical accompaniments of various cerebral states. In earlier work he dealt with the complex effect of light on the retina. Equally he has exhibited and made objective factors in the bodily use of the nerve impulse, which Sherrington recognised, but of which he could obtain only indirect evidence.

DAVY MEDAL, awarded to PROF. W. N. HAWORTH

Prof. Haworth is distinguished for his researches on the molecular structure of the carbohydrates. He established, in collaboration with E. L. Hirst, the six-membered oxide ring constitution of the normal simple glycosides, a formulation which is now universally accepted as correct. Following this up, he showed that the more labile so-called γ-glycosides contain a five-membered ring, and he has surveyed the wide field of the saccharides, allotting on experimental grounds a pyranose or a furanose structure to the varied members of the series. Further, he has successfully attacked the problem of the full constitution of disaccharides and even of polysaccharides, and has been able to present a picture of the relations of an entire group of natural products as complete and as satisfying as any in the organic chemist's gallery. His work has a characteristic quality of conclusiveness, due in large measure to a wise insistence on the importance of the use of crystalline reference compounds. In this and other connexions he has made notable advances in the appropriate experimental technique.

DARWIN MEDAL, awarded to PROF. A. C. SEWARD

Prof. Seward has taken a very important part in the great revival of interest in fossil plants which commenced towards the end of last century and has provided such a weight of direct evidence for the doctrine of evolution. Of his larger works, the British Museum catalogues of Jurassic and Wealden plants have been invaluable to subsequent investigators of these floras, while the great textbook on fossil plants, published during a period of twenty-one years, has made the wide fields of palæobotany easily accessible to all botanists. An admirable summary of our knowledge of the past history of vegetation, of its distribution throughout the world and of its bearings on the problems of fossil climates and palæogeography is contained in his book "Plant Life through the Ages". In this the fossils are seen as living plants in a real world and the knowledge of them is applied as the key to the significance of the distribution and composition of the flora of the present.

More than a hundred memoirs dealing with detailed studies of collections and individual plants have appeared from his pen. Among them his studies on the fossil floras of the southern hemisphere and of the old continent of Gondwanaland must be specially mentioned. His botanical and geological contributions to problems of palæoclimatology give not only the fruits of mature thought, but also the mass of data collected is of permanent value for all future investigators. These studies also are of great importance in connexion with the theory of natural selection.

SYLVESTER MEDAL, awarded to EARL RUSSELL

The name of Bertrand, Earl Russell, is proposed for the Sylvester Medal, in recognition of his researches on the foundations of mathematics. His earlier writings, the "Essay on the Foundations of Geometry" (1897) and the "Principles of Mathematics" (1903), in the latter of which the attempt was made to reduce all pure mathematics to symbolic logic, led up to the great undertaking (originally planned as a second volume of the "Principles") of the "Principia Mathematica", the first volume of which (written in collaboration with Prof. A. N. Whitehead) appeared in 1910 and two further volumes later. This, the most important work of the 'logistic' school (as distinguished from the 'axiomatic' school led by Hilbert, and the 'intuitionist' school led by Brouwer), is written in a symbolism originally devised by Peano and greatly extended by Russell. Most of the original researches published since 1914 by members of the logistic school have taken the "Principia" as their point of departure.

HUGHES MEDAL, awarded to PROF. K. M. G. SIEGBAHN

Siegbahn began his research work in the field of electro-magnetic waves and published a series of theoretical papers on the transmission of electrical disturbances along cables, and on related electromagnetic problems. Since 1914 most of his research work has been devoted to X-ray physics, especially to X-ray spectroscopy. With the view of bridging the gap between the X-ray and the optical spectra, the method with ruled gratings at grazing incidence was made the subject of a thorough investigation by him. In connexion therewith, two ruling machines of new design were constructed by Siegbahn at Uppsala. Gratings ruled on these machines have been successfully used by him and his co-workers for exploring the unknown region of X-ray spectra (20–500 A.). He has succeeded in registering and measuring a large number of X-ray series, including the N- and O-series in this region. This work is now in progress and is being pressed forward vigorously. Prof. Siegbahn's gratings, though small, are among the finest ever ruled. In addition to his work on long-wave X-rays, Prof. Siegbahn is also at present laying the foundations for an exploration of the spectral region between short radio waves and infra-red radiation.

One of the most outstanding pieces of work carried out by Prof. Siegbahn and his co-workers includes their beautiful demonstrations of reflection, refraction, interference, and diffraction phenomena with X-rays.

Importance of Grassland in New Zealand

LORD BLEDISLOE'S tenure of office as Governor-General of New Zealand has assuredly had a significance that will come to be regarded as of great historical interest. Because he is himself an expert agriculturist, and a pioneer in the movement which led to the establishment of a co-ordinated system of agricultural research in Great Britain and throughout the Empire, he has been able to take an informed and truly helpful interest in the Dominion's leading industry—agriculture.

From time to time, Lord Bledisloe has delivered a number of addresses—addresses of a practical and technical nature—to the farmers of the Dominion. In all these addresses, the great importance of research has been emphasised and the results of investigations conducted in Great Britain and in all parts of the world brought to the notice of his audiences.

In his most recent address, when opening the Third Conference of the New Zealand Grassland Association at Palmerston North, on October 2, Lord Bledisloe most appropriately has taken grassland as his subject*. New Zealand stands in a unique position relative to her sources of wealth. They are based to an overwhelming extent on her grasslands and on her exports to Great Britain. Grassland products form 94 per cent of her total exports—while 70 per cent of her exports cannot at present be marketed elsewhere than in Great Britain.

In the changing world of to-day, these two facts present very difficult problems for solution at the hands of both the Dominion herself and of Great Britain. New Zealand could easily increase vastly the amount of her grassland products—Lord Bledisloe has no difficulty in making this abundantly clear—but relatively speaking, Great Britain could undoubtedly do the same to an even greater extent. This is epitomatic of the economic tangle in which the whole world is engulfed. Lord Bledisloe in his address is, however, concerned not with world problems, not with the grasslands of the world, but explicitly with the grasslands of New Zealand. He perhaps places the advantages which New Zealand possesses in the matter of a perfect balance between sun and shower rather too high, when he gives it as his opinion that the potential output of meat and milk from the sown pastures of New Zealand would be at an average per acre of 60 per cent above that of Great Britain—always above, emphatically, but not 60 per cent above what the sown pastures of Britain could be made to be.

With great justice, Lord Bledisloe urges the New Zealand farmers to give more attention to the production of supplementary crops—silage and fodder crops for winter feed. He also considers that the Dominion would be well advised to extend the scope of her products for export; and remarks ". . . there is in this Dominion an urgent need for more diversified farming based upon the current requirements, within saturation limits, of overseas markets". He points to the part which the pig may be made to play in connexion with the small dairy farm; and it is certainly remarkable that the New Zealand dairy industry has been built up without any supplementary aid from concomitant swine husbandry.

Lord Bledisloe considers that the dairy farmers should pay a great deal more attention to cheese, and especially to the quality of the cheese produced. In this connexion, he emphasises the important fact that what is a good pasture for other livestock products is not necessarily a good pasture for cheese production, and incidentally directs attention to a matter, the *ad hoc* uses to which pastures are put, which has nowhere been made the subject of sufficiently critical investigation.

Lord Bledisloe concludes his address with an admirable summary of recent grassland research, and emphasises the strides New Zealand is making by means of schemes of certification applied to her grassland seeds. There is not the least doubt that certified New Zealand white clover and Akaroa cocksfoot have a very considerable usefulness in Great Britain. It must not, however, be thought that the Hawke's Bay rye-grass for our purposes can be placed in the same category as seed taken from genuine old Kentish pastures, even if 'somewhat inferior' to our authenticated strains. The Hawke's Bay rye-grass in Britain behaves more like 'commercial' than like 'indigenous' strains. It is, however, more permanent than the commercial and therefore, as Lord Bledisloe remarks, superior to it for long leys—but for such long leys (as equally for permanent pasture) the genuine Kentish rye-grass is in a class to itself.

* Grassland: the Main Source of the Nation's True Wealth. By Lord Bledisloe. Pp. 36. (Auckland, N.Z.: Gordon and Gotch (A'sia), Ltd., 1934.) 9*d*.

Early Science in Oxford

THE appointment of a reader in the history of science at Oxford is a notable event, and the inaugural lecture of Dr. R. T. Gunther, the first holder of the post, contains much interesting information not generally known*. It deserves careful study, and may, it is to be hoped, arouse the interest of the University of Oxford to a consciousness of what has already been done by Oxford towards the promotion of science, and what it might do in the special but philosophical field of the history of science.

Roger Bacon studied in Oxford; the earlier meetings of the Royal Society took place in Oxford, in Wadham College in the time of Wallis; Christopher Wren was a Wadham man and Savilian professor of astronomy; Rigaud, another Savilian professor, was one of the first historians of science, and Oxford has now appointed the first reader in the subject. Dr. Gunther is a Magdalen man, and he tells in his lecture a good deal about the work and collections of Dr. Daubeny, another Magdalen man, made a fellow of the Royal Society in 1822. Considering what Dr. Gunther has done, in pious memory and scientific sequence to Dr. Daubeny, considering too that Dr. Charles Singer, a leading historian of science, is also from Magdalen, that famous and opulent foundation may fairly take its place by the side of Wadham on the rôle of Oxford science.

* Oxford and the History of Science: with an Appendix on Scientific Collections in College Libraries. Dr. R. T. Gunther. Pp. 49. (London: Oxford University Press, 1934.) 2*s*. net.

Dr. Gunther describes in his lecture both the collections of books and geological material left by Daubeny and of which he took charge, and also how for many years he continued the scientific work of Daubeny in measuring the sea- and land-levels all round the Italian coast. Daubeny, though a man of varied scientific interests, had made a special study of volcanic phenomena in Europe, above all in France and Italy. He represented the universities of England at the first meeting of the British Association at York in 1831, and through his influence the second meeting was held in Oxford.

Dr. Gunther has done well to keep Daubeny's memory alive in his old university, and the opportunity now seems to have arrived to give better housing, both for the Daubeny collections and library and also for the Lewis Evans collection of scientific instruments which have been left to Oxford, and are at present exhibited in a portion of the Old Ashmolean building. It is difficult for a non-resident to appreciate all the conditions of building in present-day Oxford. We know that the Bodleian is now embarking on a large scheme of reconstruction. It is known also that the Radcliffe Trustees have recently opened a new and beautiful building. There is also, it seems, additional accommodation available in the Ashmolean for the objects which Dr. Gunther desires to preserve.

The building question is therefore complicated, but every friend of science will heartily support Dr. Gunther in his claim that the history of science should be duly represented in the university which has so many men of science on its rolls. An obvious and indispensable way of doing this is to have a good library of books on this branch of knowledge, available for all serious students. If this can be done in conjunction with a museum of scientific instruments and objects, such as those which Dr. Gunther has in charge, it would, of course, have added value.

Electrical Warming of Large Buildings

IN a lengthy paper read to the Institution of Electrical Engineers on December 6, Mr. R. Grierson and Mr. D. Betts make a critical examination of the present practice relating to electrical warming, air-conditioning and hot water supply to large buildings.

It is often assumed that before electric heating can be justified as compared with a coke-fired boiler and hot water or steam radiators, electricity must be sold at 0·1*d.* per kilowatt hour. The assumption is made, that so long as 0·1*d.* purchases 3,410 British Thermal Units either from some form of electric radiator or from hot pipes, it is of equal value to the consumer. No account is taken of the practical elimination of the labour, dust and dirt effected by the electrical method. The fact also is disregarded that the householder has to pay 37*s.* 6*d.*–75*s.* per ton of coal in the London area, whereas the fuel clause in the contracts of the Central Electricity Board are based on prices lying between 13*s.* and 18*s.* a ton. It is only necessary to recall the wonderful visibility of the atmosphere prevailing during the general strike of 1926 to see what a boon it would be to city dwellers if the volume of combustion products from chimneys were diminished.

It is now generally recognised that the question of the heat insulation of buildings is of great importance, and so slab cork and slag wool are being used to diminish the heat leakage. Thermostatic control is now largely used to prevent rooms from being overheated. Although the thermostat is a very trustworthy device, it is the standard practice in heating installations where the water is heated electrically to provide two instruments in series. One of them, the control thermostat, operates at the normal maximum temperature, while the other, called the safety thermostat, is set several degrees higher. A margin of 20° F. below the boiling point of water is set for the control instrument and 10° F. below boiling point for the other. Luckily, the 'ageing' of thermostats is in the direction of lowering the operating point.

The universal use of filtering plant for the continuous purification of swimming pools, instead of changing the water twice a week, has greatly simplified the heating problem. Formerly, the problem was to warm very large quantities of water in the least possible time ; now it is merely to prevent the water from cooling.

Air-conditioning plant has now been greatly improved. The air enters the room at a given temperature and humidity and the vitiated air is extracted. The minimum standard adopted by the London County Council is 1,000 cubic feet of fresh air per hour per person for music and dance halls. In winter, this amount is quite satisfactory ; but in summer the temperature rises too high and so the fans are driven at a higher speed, often giving more than 2,000 cubic feet of air per hour per person. For cooling, powerful refrigerating plant is sometimes used. A 265 h.p. motor is installed for this purpose at the Masonic Peace Memorial Building in London.

University and Educational Intelligence

CAMBRIDGE.—The Arnold Gerstenberg studentship, founded in 1892 by Mrs. Leonora Phillips in memory of her brother Arnold Gerstenberg with the object of promoting the study of moral philosophy and metaphysics among students of natural science both men and women, has been awarded to R. C. Oldfield, of Peterhouse.

F. Goldby, of Queens' College, has been appointed University lecturer in anatomy, and H. W. Hull University demonstrator in anatomy.

Applications are invited for the Gwynaeth Pretty studentship for research in the etiology, pathology and treatment of disease. It is of the annual value of £200. Applications should reach Prof. H. R. Dean, Department of Pathology, before February 1.

OXFORD.—On December 1, Dr. R. T. Gunther continued his series of public lectures on the history of science in Oxford by a discourse delivered at Corpus Christi College. Remarking that the contribution to natural science by members of that College made up in quality what was lacking in quantity, he directed special attention to Nicholas Kratzer, who became a fellow of the College in 1517, the year of its foundation. In Kratzer's hands the development took place of the mural and pedestal sundial to such portable dials as the polyhedral timepiece made by him for Cardinal Wolsey, by whom he was constituted mathematical reader in the University. Thomas Hornsby, who succeeded Bradley as Savilian professor in 1762, was mainly

instrumental in the establishment of the Radcliffe Observatory. His own observations, which have only recently (1932) been properly reduced and published, by Drs. Rambaut, Knox Shaw, Jackson and others, are extraordinarily accurate. The famous Dean Buckland, who was admitted to the College in 1801, remained there until he became Canon of Christ Church in 1825. His palæontological collection was originally housed at Corpus Christi College.

THE RIGHT HON. WALTER ELLIOT will deliver the foundation oration at Birkbeck College, Fetter Lane, London, E.C.4 at 8.15 on Wednesday, December 12, when the one hundred and eleventh anniversary of the College will be celebrated. No tickets are required.

THE Commonwealth Fund of New York is offering twenty-eight Commonwealth fellowships in 1935, tenable by British subjects in American universities. Each fellowship is of the approximate value of 3,000 dollars annually. Tenure of a fellowship usually involves an absence from Great Britain of about 22 months, though a fellowship may be extended for a third year. Further information can be obtained from the Secretary, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

SPECIAL education in Uruguay is surveyed by Sr. Emilio Verdesio in a monograph of some 260 pages recently published by the Department of Public Instruction in that country as No. 1 of vol. 35 of *Annals of Primary Education*. This study, which is fully documented and illustrated with numerous photographs, has been published with the view of distribution wherever the case of defective or otherwise abnormal children is made a subject of scientific investigation. It describes open-air, seaside and riverside schools, schools for crippled and rachitic children, institutions for the deaf and blind, classes for children suffering from speech impediments, classes for backward children, auxiliary schools for the mentally deficient and "Escuelas Hogares" for problem children.

THE twenty-third annual Conference of Educational Associations will be held at University College, Gower Street, London, W.C.1, on December 31–January 7, under the presidency of the Marquess of Lothian. The presidential address, entitled "Liberty and Collectivism", will be delivered on December 31. On January 2, a joint conference on "Education for Leisure" will be delivered, when the principal speakers will be the Hon. Mrs. Franklin, Mr. Gerald Heard and Mr. A. C. Richmond. On January 5, a conference on educational and vocational guidance methods will be held at the National Institute of Industrial Psychology, to which members of the Conference of Educational Associations who are actually working in this field are invited. Among the subjects of discussions to be held at the Conference at Gower Street are the following, together with the principal speakers :—"Biology and General Science in the First School Examination" (J. K. King, J. Line and W. Sumner) ; "Zoos in their Educational Aspect" (Prof. Julian Huxley) ; "Psychology and Religion of the Future" (The Very Rev. the Dean of St. Paul's). Among the lectures to be delivered are : "The Objects, Value, and Methods of International Teaching in the Schools in Terms of the New World Situation" (Dr. Delisle Burns) ; "The All-Importance of the Study of Habits for the Knowledge of Evolution" (Prof. E. W. MacBride) ; "Some Reflections on the Scottish Mental Survey" (Prof. James Drever). Further information can be obtained from the Secretary, 29, Gordon Square, W.C.1.

Science News a Century Ago

J. D. Forbes and Airy

Forbes was always an indefatigable correspondent, and his "Life and Letters", published in 1873, contain many of his letters. He was the first to introduce the study of the undulatory theory of light in Scotland and on December 11, 1834, he wrote to Airy : "I have at length found leizure to read with great attention, and consequently with very great pleasure your undulatory tract, which quite fulfils my expectation as to the nature and extent of the evidence on this marvellous subject. I have been getting sundry pieces of apparatus made, and can now profit by your valuable practical lessons, as well as by the papers with which you have from time to time favoured me, and which I am now better prepared to appreciate." In the same letter he referred to the experiments on heat which he had mentioned to Quetelet about a week before. "I have lately," he said, "succeeded in establishing, as I think for the first time demonstratively and quantitatively, the polarization of non-luminous heat. I abandoned the method of reflection, which is the only one hitherto employed, and adopted that of transmission through piles of thin mica plates, for which the Thermo-multiplier is well adapted, and with entire success. I have also been endeavouring to determine numerically the refrangibility of non-luminous heat. I discovered, what I now find that Melloni had previously done, that the tourmaline transmits almost as much heat when two pieces are placed with their axes crossed as when parallel. Melloni saw quite as much as I also at first found, but I afterwards detected a slight difference."

Geological Survey of the United States

"We announce with great satisfaction a most important act of legislation by the Congress of the United States, the authorization of a geological survey of that fine country so rich in minerals and geological phenomena. It gives us pleasure also to add that President Jackson has committed the execution of this arduous undertaking to Mr. Featherstonhaugh, one of the members of the Geological Society of London [F.R.S., 1835] who has acquired deserved reputation as a practical and ardent geologist. This gentleman has been many years a resident of the United States, and it is of him that Mr. Conybeare says that he is eminently qualified, from his intimate acquaintance with European formations, to advance those comparative views which demand the principal attention in our science. We cannot but look with unmixed admiration upon the steadyness with which all the great interests of the United States are pursued ; the States have wisely concurred in a great act of legislation that cannot but redound to the best interests of their country and the substantial advancement of natural science. It is an act that Europe will admire, and that will ever reflect great honour upon the administration of the present distinguished chief magistrate of the United States." (*Phil. Mag.*, Dec. 1834, Editorial Note.)

Societies and Academies

DUBLIN

Royal Irish Academy, November 12. R. LLOYD PRAEGER: A contribution to the flora of Ireland. The paper is in part a third supplement to "Irish Topographical Botany", bringing knowledge of Irish plant distribution up to the present date, and partly an expansion of the same work, the old conservative concept of a species being replaced by that adopted in the "London Catalogue of British Plants", eleventh edition, and the distribution of the plants being shown according to the latter standard. J. M. O'CONNOR, M. MORIARTY and O. FITZGERALD: The physiological basis of the sensation of cold. The excitability of the skin in response to cold stimuli is influenced by its initial temperature. While rising in general with rising temperature, it falls sharply at about 29°, 35° and above 38°. These alterations in excitability can be explained by the stimulus to the skin being not merely the fall in temperature but also the fall in a physiological activity. This activity occurs in three phases following, so far as they can be examined, the Arrhenius equation, with different values of the constant μ. Paradoxical sensations are produced at the transition points. The amounts of oxygen used by the anæsthetised rabbit as a result of shivering plotted against skin temperatures correspond with the first two phases of the excitability of the human skin. The oxygen consumption of the rabbit in which shivering does not occur, or is suppressed by curare, is influenced by temperature in three phases corresponding, so far as comparison is possible, with the activity phases of the skin. The bearing of the results on the regulation of the body temperature is discussed. A. FRAZER-BRUNNER: New or rare fishes from the Irish Atlantic slope. A report on the more noteworthy fishes taken by the author during a cruise on a commercial steam trawler in the neighbourhood of the Porcupine Bank over depths of 100–300 fathoms. Fine meshed mid-water nets were fished while the vessel was drifting and yielded a number of interesting forms. Four new species were described, *Nematomurus farrani*, taken in the trawl, and *Dolopichthys inimicus*, *D. hibernicus* and *Gigantactis filibulbosus*, taken in the midwater nets, the last three being only represented by immature specimens. The types of the new species have been deposited in the British Museum. J. N. HALBERT: A list of Irish Hemiptera (Heteroptera, Cicadina). On comparison with the fauna of Great Britain, the Hemiptera show a disparity in numbers of species similar to what is known to occur in other groups of insects. The heteropterous section is now comparatively well known, comprising about 253 species, as against 485 in the British Isles. Information on the Homoptera is still scanty, only 156 species having been found in Ireland. While there are no endemic species, and certain families such as the Pentatomidae are poorly represented, several rare and interesting species occur including both northern and southern forms. There are a few species of south-west European origin and these are found in the south-east of Ireland, where the drier conditions may have been the deciding factor in their local distribution.

PARIS

Academy of Sciences, November 12 (*C.R.*, 199, 989–1076). The president announced the death of Admiral Fournier. CHARLES CAMICHEL and LÉOPOLD ESCANDE: Contribution to the study of reduced models of erosion by water. HENRI JUMELLE: The Plectaneia, Apocynaceæ of Madagascar. Descriptions and locations of eleven species. ALBERT CAQUOT was elected a member of the Section of Mechanics in succession to the late P. Vieille. J. DIEUDONNÉ: A problem of the theory of polynomials. GEORGES GIRAUD: Partial differential equations, linear or non-linear, of the elliptic type. ADOLPHE BUHL: Certain Monge-Ampère equations of which the integral surfaces produce certain invariant integrals. J. R. BRAÏTZEFF: The course of the function defined by a Dirichlet series in the neighbourhood of a singular point. MAURICE FRÉCHET: A general expression of repeated nuclei. J. GERONIMUS: The equivalence of two extremal problems. GEORGES BOULIGAND: Growth at a singular point. A. RAUCH: Case where a Borel direction of an integral function $f(z)$ of finite order is also a Borel direction for $f'(z)$. P. THULLEN: Domains of meromorphy. L. SACKMANN: A new method of investigation of an efflux in the immediate neighbourhood of the walls by self-recording of the fluid filaments. CONSTANTIN SĂLCEANU and CALIN POPOVICI: The photometric study of the brightness of the star cluster *M*13. MISSENARD-QUINT: The laws of evaporation. EDGAR PIERRE TAWIL: The laws of the production of electricity by torsion in quartz (strepho-electricity). In the case of a hollow cylinder, the internal and external surfaces are charged with equal quantities of electricity of opposite sign. The quantity is directly proportional to the moment of the couple and to the length of the cylinder, and inversely proportional to the area of the annulus at the end. WILLIAM JEUNEHOMME: The mechanism of the electrochemical chlorination of benzene. Results of a quantitative study of the electrolysis of a mixture of hydrochloric acid, methyl alcohol and benzene. G. KRAVTZOFF: The cathodic behaviour of organic salts of copper. Studies of electrolysis as a function of the time. M. LÉVY: A new method of spectrum analysis of non-periodic curves. GEORGES BRUHAT and PIERRE GRIVET: The rotatory power of quartz for rays perpendicular to the axis and its dispersion in the ultra-violet. ION I. AGARBICEANU: The Zeeman effect and the magnetic weakening of the fluorescence of S_2 and Te_2. ANDRÉ CHARRIOU and MLLE. S. VALETTE: The realisation of acetylcellulose films not deformed by water. For the purpose of aerial photography, the alteration of the linear dimensions of the film produced by immersion in water prevents precision surveys. By varying the chemical composition of the film, the author has succeeded in reducing the deformation to a very low value. GASTON MENIER: A method of ensuring soundness in embankments or barrages. MLLE. SUZANNE VEIL: The autophotographic localisation of radioactive ions in gelatine. In studying the electrolysis of barium chloride in gelatine, if the salt is radioactive, the action of the radium on a photographic plate can be utilised to show the distribution into zones. MAURICE HOLDERER: Why does water wet glass? It is suggested that owing to the variable valencies of the oxygen atom, there may be complex compounds formed between the water and glass, depending on the oxygen valency. It is pointed out that pure mercury does not wet glass, but can do so if a trace of mercury oxide is present. ROBERT TREHIN: Comparative study of the absorption spectra of aqueous solutions of hydrochloric acid and of other chlorides in the ultra-violet.

EDMOND GRILLOT : Lead acetochloride. The salt isolated had the composition Pb_2Ac_2Cl, 1·5 H_2O. Proof that this was a homogeneous compound was obtained. HENRY GAULT and THIBAUT WENDLING : Acetol condensations of acetoacetic ester with acetaldehyde. F. BOUCHAL and V. DOLEJŠEK : An application of Valouch's method, for measuring the constants of crystalline networks, to the precision method of Kunzl and Köppel. NICOLAS THÉOBALD : The fossil insects of the Oligocene strata of Camoins, Céreste and Aix-en-Provence. JEAN LUGEON : The localisation at a great distance of the foci of atmospherics without a radiogoniometer. FERNAND MOREAU and MLLE. C. MORUZI : The sexual bipolarity between Ascomycetes of different species. L. HÉDIN : The heredity of an abnormal maize. MME. SUZANNE LALLEMAND : The faculty and germinative energy of dry, irradiated seeds. The application of very large doses of X-rays (1,000,000 *r*) to dry seeds of the lentil causes the complete loss of germinating power. CHARLES JOYEUX, JEAN GEORGES BAER and PIERRE CARRÈRE : Researches on the evolutive cycle of *Euryhelmis squamula*. PIERRE CAPPE DE BAILLON, MAURICE FAVRELLE and GEORGES DE VICHET : The parthenogenesis of Phasmidæ. PAUL ANCEL and ETIENNE WOLFF : A direct teratogenic method. LOUIS PARROT : The evolution of a Gecko hæmatozoon (*Leishmania tarentolae*) in a stinging gnat of the *Phlebotomus* group (*P. minutus*). HENRI VALLÉE, PAUL RINJARD and MAURICE VALLÉE : Preventative inoculation against paratuberculosis in cattle.

VIENNA

Academy of Sciences, Oct. 18. KARL PRZIBRAM : Natural blue rock-salt (4). Velocity of growth and colour. The pyramidal growths of a blue rock-salt from Thuringia show varying colour. The crystals have grown at different rates along the different cube axes, sudden changes in the velocity relations having occurred. Pyramids which have grown rapidly are darker and more blue, whereas those of slower growth are paler and more violet. These observations accord with the view that the coloration depends on disturbance of the lattice. FRIEDRICH LAUSCHER : Relations between duration of sunshine and total solar radiation. EUGEN GUTH and ARTUR HAAS : Relations between the relativistic mass formula and classical mechanics. The deduction of the relativistic mass formula solely on the basis of the law of the mass of energy. EUGEN GUTH and HERMANN MARK : Intra-molecular statistics, especially of chain molecules. RICHARD WEISS and FRITZ MÜLLER : Triphenylmethanes the benzene nuclei of which are united (8). Reduction products of trimethylenephenylmethane triketone. HERIBERT GRUBITSCH : Investigations on the galvanising of iron. OTTO REDLICH and H. KLINGER : Theory of apparent molecular volume (3) : sucrose. It has been shown, with the aid of the Debye-Hückel theory, that the apparent molecular volume of dissolved electrolytes at high dilution is related linearly to the square root of the concentration. That this is a specific effect of free charges is confirmed by the observation that the apparent molecular volume of sucrose in aqueous solutions depends little on the concentration, and at moderately high concentrations of the sucrose is directly proportional to the concentration. RALPH ELBER : Report on the geographical and anthropological results of an expedition through Upper Guinea. JONAS DAGYS : B-growth factors in embryonic tissues and in budding sap. The experimental data recorded indicate that the B-group of growth factors may be divided into two sub-groups comprising (1) those which increase the formation of the dry matter of *Aspergillus niger* in presence of a co-factor, but have no influence on the budding of yeast, and (2) those which also favour increase in the dry matter of *A. niger*, but apparently without the aid of a co-factor, and also promote the budding of yeast and thus diminish its multiplication period. To the first sub-group belong the synthetic growth-promoting substances formed in the autoclave from monosaccharides and many organic acids or their salts, and, to some extent, also the birch-sap factor and rhizopin. Sub-group (2) comprises the constituents of wheat and maize seeds (or their seedlings) and of birch buds and leaves which promote cell-fission. TH. PINTNER : Processes in the development of cestode chains. RUDOLF SIEBER : Further results of palæo-biological investigations on the fauna of the rhætic reef-chalk of the Rötelwand (Osterhorn group, Salzburg) and of other rhætic reef-regions of the Northern Alps. HERMANN WENDELIN : *R*-Integrability of compound functions. AUGUST VERDINO and E. SCHADENDORFF : Condensations of aromatic amines with cholesteryl chloroformate. FRANZ WERNER : Third contribution to the knowledge of the fauna of the Ægean Islands : (1) Introduction and report on the journey, (2) Orthoptera. ADOLF MÜLLER : Preparation of pimelic acid.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 495–538, Sept. 15, 1934). T. H. GOODSPEED and FRED M. UBER : Application of the Altmann freezing-drying technique to plant cytology. The tissue is killed in liquid air and dehydrated in a vacuum at a temperature low enough to prevent diffusion or displacement of cell constituents. A commercial freezing unit charged with methyl chloride was used, with calcium chloride brine. Dehydration for periods up to two weeks and at temperatures between − 22° and − 32° C. have been used. The method seems likely to be of use in investigating the finer details of nuclear and cytoplasmic structure ; details of chromosome structure are well brought out in sections of lily anther. WILDER D. BANCROFT and JOHN E. RUTZLER, JR. : Reversible coagulation in living tissue (12). Different doses of sodium rhodanate may produce apparently opposite results. Experiments with sodium amytal anæsthesia in rabbits suggest that small doses of rhodanate force the amytal off the sensory nerves, thereby increasing irritability and tending to awaken the sleeper ; more rhodanate brings the sensory nerves nearer normal, thus permitting sleep. ERNEST B. BABCOCK : Genetic evolutionary processes. Extensive study of the genus *Crepis* (Compositæ) leads to the view that they are derived from 10-chromosome ancestors, which, probably by reciprocal translocation between non-homologous chromosomes, have given rise to 8- and 6-chromosome species. It is suggested that this transformation of chromosome complement must be recognised as a cause of evolution, which in some cases at least, is of more importance than gene mutation. A. H. STURTEVANT : Preferential segregation of the fourth chromosomes in *Drosophila melanogaster*. CHESTER STOCK : On the occurrence of an oreodont skeleton in the Sespe of South Mountain, California. A discussion of the probable age of these deposits. NORMAN LEVINSON : On a theorem of Carleman. F. E. WHITE : Some special cases of the

indeterminacy principle. D. H. WEINSTEIN: Modified Ritz method. B. F. SKINNER: A discrimination without previous conditioning. JANE M. OPPENHEIMER: Experiments on early developing stages of *Fundulus*. Differentiation to embryonic structures with the exception of yolk-sac epithelium occurs in blastoderms isolated at the thirty-two cell stage and later; younger blastoderms do not give such structures. Dorsal lip and embryonic shield grafts induce a certain amount of differentiation. The work suggests that, contrary to earlier views, differentiation is influenced by processes during and after gastrulation.

Forthcoming Events

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

Sunday, December 9

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—G. Tandy: "British Seaweeds".*

Monday, December 10

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. W. E. Swinton: "Dragons".*

UNIVERSITY OF LONDON (BROWN INSTITUTION), at 5—(at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1).—Prof. F. W. Twort: "Primitive Forms of Life" (succeeding lectures on December 12, 14, 17 and 19).*

CHADWICK PUBLIC LECTURE, at 5.30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Dr. F. R. Seymour: "Men and Masses".*

UNIVERSITY OF GLASGOW, at 8.30.—Prof. G. W. O. Howe: "National Progress in Electrical Engineering".*

Wednesday, December 12

ROYAL INSTITUTION AND BRITISH SCIENCE GUILD, at 9—(at the Royal Institution).—Dr. G. W. C. Kaye: "Sound and Noise" (Research and Development Lecture).

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP), at 8—(at the London School of Hygiene and Tropical Medicine).—Prof. E. Waldschmidt-Leitz: "Recent Developments in Enzyme Chemistry".*

Thursday, December 13

ROYAL INSTITUTION, at 9.—Dr. Alfred Noyes: "Poetry and Reality".

ROYAL EMPIRE SOCIETY (EDUCATION CIRCLE), at 8.—Discussion on "Character Training in Kashmir", to be opened by E. Tyndale-Biscoe.

Friday, December 14

ROYAL SOCIETY OF ARTS, at 4.30.—A. D. Blaschek: "Indian Forestry—Economic and Commercial Aspects."

SOCIETY OF CHEMICAL INDUSTRY (BIRMINGHAM AND MIDLAND SECTION), at 7.30—(at the University Buildings, Edmund Street).—Sir John Russell: "Applications of Chemistry in Modern Agriculture".*

BRITISH EMPIRE CANCER CAMPAIGN, December 12–13.—Conference on Radiation Therapy.

Official Publications Received

GREAT BRITAIN AND IRELAND

University of Cambridge: Solar Physics Observatory. Twenty-second Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1933 August 1–1934 July 31. Pp. 3. (Cambridge.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1595 (T. 3492): Aileron Stability, with Special Reference to Rolling-Aileron Motion and the Influence of Frise Type Hinge Moment Curves. By A. G. Pugsley. Pp. 29+5 plates. 1*s.* 6*d.* net. No. 1596 (Strut. 160): Flexural-Torsional Flutter of a Simple Cantilever Wing. By D. Williams. Pp. 18+8 plates. 1*s.* 3*d.* net. (London: H.M. Stationery Office.)

Thirty-second Annual Report, 1933–1934, of the Imperial Cancer Research Fund. Pp. 32. Eleventh Scientific Report on the Investigations of the Imperial Cancer Research Fund. Pp. ix+177+58 plates. 30*s.* Supplement to Eleventh Scientific Report: The Filterable Tumours of Fowls, a Critical Review. By L. Foulds. Pp. ii+42. (London: Taylor and Francis.)

OTHER COUNTRIES

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1933. Pp. 81. (Bangalore: Indian Institute of Science.)

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia. Memoir No. 4: Atmospheric Potential Gradient Observations at the Commonwealth Solar Observatory, Mount Stromlo, Canberra. By C. W. Allen. Pp. 47. (Canberra: Government Printer.)

The Peabody Museum of Natural History. Bulletin 3: Hybrid Ducks, including Descriptions of Two Crosses of *Bucephala* and *Lophodytes*. By Stanley C. Ball. Pp. 26+3 plates. (New Haven, Conn.: Yale University.) 25 cents.

Stanford University Publications: University Series. Biological Sciences, Vol. 2, No. 6: Contributions towards a Monograph of the Sucking Lice, Part 6. By Prof. Gordon Floyd Ferris. Pp. 56. 1 dollar. Biological Sciences, Vol. 2, No. 7: Contributions towards a Monograph of the Sucking Lice, Part 7. By Prof. Gordon Floyd Ferris. Pp. 56. 1 dollar. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.)

Smithsonian Miscellaneous Collections. Vol. 92, No. 5: Colonial Formation of Unicellular Green Algæ under various Light Conditions. By Florence E. Meier. (Publication 3256.) Pp. 14+3 plates. Vol. 92, No. 6: Effects of Intensities and Wave Lengths of Light on Unicellular Green Algæ. By Florence E. Meier. (Publication 3257.) Pp. 27+3 plates. Vol. 92, No. 7: Herpetological Collections from the West Indies made by Dr. Paul Bartsch under the Walter Rathbone Bacon Scholarship, 1928–1930. By Doris M. Cochran. (Publication 3259.) Pp. 48. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of the Interior: Office of Education. Guidance Leaflets, Leaflet No. 22: Optometry. By Walter J. Greenleaf. Pp. ii+11. (Washington, D.C.: Government Printing Office.) 5 cents.

Colony and Protectorate of Kenya. Forest Department Annual Report, 1933. Pp. 36. (Nairobi: Government Printer.) 1*s.*

U.S. Department of the Interior: Geological Survey. Bulletin 857–D: Notes on the Geology of the Alaska Peninsula and Aleutian Islands. By Stephen R. Capps. (Mineral Resources of Alaska, 1932.) Pp. ii+141–153+plate 5. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of the Interior: Office of Education. Pamphlet No. 49: Teachers' Problems with Exceptional Children. 3: Mentally Retarded Children. By Elsie H. Martens. Pp. iii+42. (Washington, D.C.: Government Printing Office.) 5 cents.

The Rockefeller Foundation. Annual Report, 1933. Pp. xix+477. (New York City.)

Merentutkimuslaitoksen Julkaisu: Havsforskningsinstitutets Skrift. No. 94: Strom- und Windbeobachtungen an den Feuerschiffen in den Jahren 1932 und 1933. Von A. Palmén. Pp. 55. No. 95: Havsforskningsinstitutets Verksamhet år 1933. Av Gunnar Granquist. Pp. 16. No. 96: A Study of the Sediments of the North Baltic and adjoining Seas. By Stina Gripenberg. Pp. 231. (Helsinki.)

Report of a Committee appointed by His Excellency the Officer administering the Government of the Straits Settlements and High Commissioner for the Malay States to Investigate and Report on the Present Economic Condition of the Coconut and other Vegetable Oil Producing Industries in Malaya. Pp. vii+108. (Kuala Lumpur: Government Press.) 2 dollars.

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 14: Coleopterous Pests of Stored *Derris* in Malaya. By N. C. E. Miller. Pp. ii+34+2 plates. 50 cents. Scientific Series, No. 15: Notes on Hymenopterous Parasites of Padi Pests in Malaya. By H. T. Pagden. Pp. ii+13+4 plates. 50 cents. General Series, No. 19: Reports of the Research, Economic and Agricultural Education Branches for the Year 1933. Pp. iii+84. 50 cents. (Kuala Lumpur: Department of Agriculture.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 4: Geology and Mineralogy. Vol. 2, No. 3: Cretaceous Mollusca from the Miyako District, Honshu, Japan (Lamellibranchiata and Gastropoda). By Takumi Nagao. Pp. 177–277+17 plates. (Sapporo: Hokkaido Imperial University.)

CATALOGUES

Cambridge Pressure and Draught Indicators and Recorders. (Folder No. 47.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Stereocartographe III. Pp. 25. Appareil pour leves aerophotogrammetriques. Pp. 16. Mezzo secolo di fotogrammetria, 1884–1934. Pp. 39. (Firenze: Officine Galileo.)

Classified List of Second-Hand Scientific Instruments. (No. 106.) Pp. 58. (London: C. Baker.)

Catalogue of Medical Books, including Dentistry, Nursing, Sexology, Ophthalmology, Pharmacy, Surgery, First Aid, Hygiene, etc. Pp. 68. (London: W. and G. Foyle, Ltd.)

Books for Pleasure and Profit at greatly Reduced Prices. (Catalogue 440.) Pp. 42. (Cambridge: W. Heffer and Sons, Ltd.)

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