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Scientific Methods and the Advance of Social Conditions

Life and Leisure in London*

THE last volume of the great "New Survey of London Life and Labour" has now appeared. We noticed the first in NATURE of March 21, 1931, p. 430, and have now to add a word of hearty congratulation to Sir Hubert Llewellyn Smith and his staff on having brought their ship into port. It is a fine piece of work, and both the thoroughness of the execution and the general hopefulness of the conclusions will bring happiness to Mr. Charles Booth in the shades and to all his friends who remember the devotion and the insight with which he initiated and carried through the earlier survey forty years ago. That was a scientific expression of the humanitarian spirit, parallel to, and no doubt largely inspired by, the same ideas which had just founded Toynbee Hall, as the practical expression. Both movements have been followed by hundreds of successors in all parts of the world. It is one of the most interesting features of this new survey that its director, Sir Hubert Llewellyn Smith, had a hand in both the earlier experiments in the 'eighties and 'nineties of the last century.

The present survey was undertaken in 1928 by the London School of Economics, and has been supported by the funds of more research foundations and charities' trustees than we can find the space to enumerate. The money has been well spent, for the results, established with the utmost impartiality and marshalled with skill, are a permanent record of the contemporary state of the largest aggregation of human beings on the earth. It is formally limited to an area lying somewhere between the County of London and the Greater London which comes under the Metropolitan Police. It deals with a population of about five and a half million, though its results would be in the main applicable to a much larger area and are broadly typical of most great urban centres at the present time. Hence its high scientific importance as a sociological document.

This ninth, and last, volume of the work, dealing with life and leisure, will probably attract more general attention than any of the others, because of the multitudes involved in all the main activities which it describes. We all go at some time to the 'pictures'; the wireless is as popular a pastime with the well-to-do as with the poor. Indeed it might be said that this levelling up, or levelling down, of the whole population by the aid of mechanism, is the most outstanding feature of the whole report. When one sees the sort of personal activities by which the more vigorous individuals strive to win spiritually above the mass, it is clear how very similar are the tastes and efforts of all classes in the nation. They all take to a garden when they can. They all, in similar proportions, run their rowing, football and cricket clubs. They all, though in a still smaller proportion, endeavour to follow some form of serious study. Everyone therefore will feel that there is something to his own account in what purports to be an inquiry into the conditions of the 'working classes'.

One ought perhaps to make two partial exceptions to this wide conclusion, both mainly connected with difference of income. Drunkenness has markedly gone out, we are told; and gambling has very much increased. The former is certainly true equally of all classes. What the report relates, in this matter, of the working classes in

* The New Survey of London Life and Labour. Vol. 9: Life and Leisure. Pp. xiv+446. (London: P. S. King and Son, Ltd., 1935.) 17s. 6d. net.

the last forty years, is only the social extension downwards of what had been going on among the well-to-do for more than a century. It may encourage us to hope for a similar diffusion of better tastes and wider interests in other matters. Cycling is another example of the same sort. But the vast increase in gambling seems exceptionally to belong to the wage-earning class. The chapter on this subject gives interesting and intimate accounts of how the betting business is actually carried on, and the fun which often arises from it in the family circle. As throughout the volume, the tendency is to look rather on the harmless and cheerful side, and, on the whole, it is both morally right and scientifically sound to do so. Clearly the life of the multitudes in the great urban centres is not generally degraded or unhappy, and the standard has risen very greatly in the period under review, both in comfort and in the pleasurable and harmless use of the increased leisure and material means which have accrued. This is the main point, and the surveyors take care to stress it, perhaps with a slight tendency to over-satisfaction. Those reading what they say will often reflect on the other side of the picture and sigh for the what might be. This rage for gambling, and the huge crowds which frequent the football matches, are one of the chief points which suggest such thought. The State is obviously justified in taking what measures it wisely can, to restrain the passion, when, as in the case of greyhound racing, a large new industry arises, consuming millions of money, in which practically the sole motive is stimulating gambling, already appealed to on many other fields.

The other most noticeable difference in the use of leisure, due mainly to difference in education and income, is the overwhelming preference for the cinema over the living drama or music. There are roughly three times as many cinemas as theatres and music-halls together, in the County of London, and no doubt the proportionate attendance in the former as compared with the latter would be greater still. When we consider that this includes the principal theatre area in the whole country, and that a majority of the towns in England have no theatre at all, worthy of the name, one must ask whether the State is justified in staying its hand, as it does, and treating all forms of amusement as equal before the law.

While holding firmly to the main principle that it is far better for people to do things for themselves than have them done by a State, however benevolent, one must recognise at the same time the duty, sometimes the necessity, for the authorities, who, after all, represent the deliberately constituted will of all, to intervene on occasions, to prevent a gross evil, to assist a better cause, to give, in fact, guidance rather than command. We do it rather too much in the schools, where the effort to inculcate a love and knowledge of the national classics—Shakespeare and Scott and others—has often the opposite effect to that desired. But, after the school-age, we go to the other extreme and tend to remain nationally indifferent, leaving to private enterprise the foundation of a national theatre, the encouragement of music, the employment of leisure. The more enterprising and intelligent of the public librarians endeavour to educate the taste of their readers; but such a policy of selection, though it seems to be having some effect in the quality of the books read, is by no means popular, and is actually disputed in theory by some quite serious people. "We pay the rates", it is said. "Why should we not have what we prefer to read?"

But the better opinion will surely be that there is room and full justification for further action, carefully devised and experimental, but not to be set aside on the vague denunciation of State socialism. The British Broadcasting Corporation, though tending rather to popularity in its programmes, is on the whole a successful move in the right direction. Where its resources have been used to maintain good concerts, open in the ordinary way to the public, it has been proved that there is a large and still unsatisfied taste for good music. The field here, with free and open-air concerts, is almost limitless.

On another—still wider—point, one is inclined to go beyond the terms of reference of these surveyors of London. One cannot look with complacency on the vast extensions of urban residence in connexion with our great cities, and especially with London; however much we may rejoice that the conditions of life are as much improved as the surveyors demonstrate. While tens of thousands of fresh residents are poured out each week to the suburbs of London, especially to the south, it has taken fifteen years of persistent and difficult contrivance to build up a community of a little more than ten thousand at a garden city (Welwyn) which is really in the country and offers advantages of a healthy, pleasant and natural life far beyond those of the best ordered urban area. Is there no scope here for further

strong and deliberate State efforts to mitigate the urbanisation of England and have a larger proportion of the people in country surroundings? It is a commonplace that the country is the natural home for childhood, and yet every decade for more than a century we have allowed a smaller proportion of our children to enjoy it.

Scientifically then, this "Survey" is invaluable, as confirming, by minute inquiry into a large typical area, the general conclusion which M. René Sand submitted to us recently in his magnificent "Economie humaine par la médecine sociale". That is, that a marked and demonstrable improvement has taken place in social conditions generally throughout the world, as a result of applying scientific methods deliberately to social needs. Both René Sand and this "Survey" fully admit the black spots, and the "Survey" studies these (for example, sex-delinquency and crime, in this volume) with the utmost care and sympathetic insight. But both authorities agree as to the main conclusion, and also that we may reasonably expect a further advance by pursuing the same methods, if possible with greater vigour.

Morally and politically, the "Survey" suggests some other large questions at which we have hinted above. Mechanism and the increase of leisure have given us a far larger population of tolerably well-off and semi-educated people, living in great and growing masses in urban areas in all industrialised countries. The supreme problem now faces us of how so to act that the highest human ideal may be opened to all, according to their capacity. This involves doubtless much well-directed collective effort. Still more it points to the cultivation by all sensitive and capable persons of a divine discontent with a falling off from the best, either in themselves or in those who share the common civilisation which we have inherited from the past. To keep this alive, and make it operative in ever-widening circles, must appear the highest moral and intellectual obligation on all with means of action; and every man has a certain field of action in himself. F. S. M.

Flow as a Property of Matter

First Report on Viscosity and Plasticity

Prepared by the Committee for the Study of Viscosity of the Academy of Sciences at Amsterdam. (Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam, Afdeeling Natuurkunde, (Sectie 1), Deel 15, No. 3.) Pp. viii+256. (Amsterdam: N. V. Noord-Hollandsche Uitgevers-Maatschappij, 1935.) 10 guilders.

THE problem of flow has diverse aspects. We have the flow of gases, the mechanism of which is tolerably well understood, so that in the case of certain simple gases the viscosity, and its variations with temperature, can be calculated. We have liquids, of which the viscosity is precisely defined by a constant and can be accurately measured: the mechanism of the flow is imperfectly understood, but it is certainly quite different from that of gases, as the contrasting effect of temperature in the two cases abundantly demonstrates. When we come to the movement of solids under stress, where even the definition of constants which shall describe the experimental facts presents grave difficulty, we are confronted with a still more complex problem. In general, a finite stress is needed to produce permanent set, but this appears to be about the only common factor of the behaviour of such different classes of bodies as polycrystalline metals, metal single crystals, doughs, clays, glasses, gels, rubber and living protoplasm, and in certain cases matters are made still worse by the phenomenon known as thixotropy, a term applied to the marked decrease of viscosity caused by shaking or similarly disturbing certain colloidal substances. The evident complexity of the problems long kept investigators from this field, but, within the last twenty-five years or so, serious attempts have been made to systematise our knowledge. Imperfect as our general theories still are, the time is definitely ripe for a collected and critical account of the present state of the subject, and all workers in the wide field will welcome the enterprise and applaud the courage of our Amsterdam colleagues in issuing the "Report" under notice.

The report deals with the measurement and physical significance of the different types of slow flow observed for liquids and solids, and excludes vortex motion. It opens with a general review of the field; a brief summary of the properties of the simple liquid is followed by an elegant description of Maxwell's theory of a relaxation time, which covers both true liquids and substances which definitely creep on loading and unloading,

although it is doubtful if any such substance quantitatively obeys Maxwell's original law. We then have what is probably the most complete and systematic description yet given of the various models that can be constructed of springs and damping cylinders (elastic and viscous elements), with the object of imitating the behaviour of true solids, reference being made to the electrical analogy in which resistance and condensers are the elements. With such models a rough general demonstration of the experimental effects can be given, but, once more, quantitative description leaves something to be desired. The work of the present writer has been so generously handled in the "Report" that he hesitates to refer to his suggestion, not here considered, that a rotating element, giving a "saturation value", if it may be so called, of the part of the flow which it contributes, may be usefully invoked in this field, and probably has a physical meaning.

A very full description is then given of Prandtl's model for explaining elastic hysteresis. This model is certainly elegant, but seems very artificial, demanding, as it does, regular rows of molecules slipping in the direction of the row, independent of the direction of the forces. It may have a physical significance when applied to single crystals, but it is difficult to see how it can represent very closely the state of affairs in, say, Chatterton compound, with which Braunebek has carried out experiments to verify it. Nevertheless, in view of the fact that it has not hitherto received much attention, at any rate in Great Britain, nobody will grudge the space devoted to it. The chapter, written by J. M. Burgers, closes with a sympathetic account of the present writer's attempt to formulate a theory of liquid viscosity. The whole chapter is clearly and concisely written, and the part dealing with the elements of the subject is a model of exposition.

The second chapter, likewise by J. M. Burgers, discusses the flow of some actual solids, and gives provisional definitions applying to the different stages, this classification being extended later, when the behaviour of polycrystalline metals is discussed. It is not, of course, possible to characterise plasticity by a single constant, but here and elsewhere in the report, notably in the chapter by C. J. van Nieuwenburg on the technical aspect of the subject, the use of what are called D-τ diagrams is emphasised, D being the steady rate of flow under stress τ. Such diagrams are naturally only possible when a constant rate is attained, and by their nature tell us nothing of the early hardening during flow under constant stress. The technical part of the report provides the physicist with a very interesting view of the significant work that is being done on industrial products, and should be of help to the technologists, especially as regards notation and expression of results.

H. G. Bungenberg de Jong deals with the flow of colloids, and provides much practical information. He restricts himself, however, almost entirely to dilute lyophilic colloids, which do not show the troublesome peculiarities of the more concentrated preparations. He also attempts to apply Einstein's theory to lyophilic sols, naturally without any striking success, since the conditions contemplated by Einstein are certainly not fulfilled, even approximately, in this case*.

One of the most valuable parts of the report is that in which W. G. and J. M. Burgers collaborate on the plastic properties of metals. They discuss the behaviour of polycrystalline metals under various loads in a more systematic way than is usual in textbooks, considering briefly the experimental facts of hardening under stress and age-hardening, and pointing out the significance, limited enough, of the experiments on the damping of vibrations of metal wires. Incidentally, they state that polycrystalline lead shows permanent deformation under even the smallest load, which is contradicted by the recent experiments of Bruce Chalmers. They then pass on to the plastic deformation of single crystals, round which so much discussion took place at the International Conference on Physics last year. Here, as with ordinary metals, one of the main problems is that of hardening under stress. The views of Smekal, Becker, Taylor, Orowan and others are discussed, but the statement that "it is not always an easy matter to arrive at a precise picture of the mechanism that the various authors have in view" will arouse a sympathetic echo in many breasts. The ingenious but somewhat artificial assemblages of flaws or dislocations as well as faults of other kinds can often be made to explain particular observations, but it cannot be said that the assumptions are always well established, or that a simple and convincing scheme has yet been produced. Even the appearance and distribution of the slip bands themselves are still imperfectly understood. The authors put forward a picture which is a combination of the Becker–Orowan theory, constructed to explain the dependence of the rate of flow on stress and temperature, and the Taylor theory, constructed to explain hardening. This is attractively presented and seems promising.

In the last chapter, H. J. Jordan deals with a subject unfamiliar to most physicists and chemists, namely, the mechanical properties of muscles. He distinguishes between the mainly elastic type of muscle, of which striated muscle is the general

* Dr. Eirich, of Vienna, recently described to me some very striking work, shortly to be published, which constitutes a great advance in this direction.

example, and the mainly plastic type, exemplified by the smooth muscles of hollow organs, strips of the cutis of holothurians being, apparently, the most convenient example for experiment. Various models, made up of elastic and plastic elements, effectively in series or in parallel, are discussed. Needless to say, the phenomena are extremely complicated and their interpretation difficult.

Although the book is written in English by Dutchmen, there are very few foreign turns of phrase, and none such as to render the sense in doubt. The general style is particularly lucid. The work, especially the part of it due to J. M. Burgers, alone and in collaboration with W. G. Burgers, is informed by a clear and critical spirit, and can without exaggeration be said to be indispensable to all workers in the subject. In the preface the prospect is held out of a second report, dealing in particular with problems of flow in colloidal structures. We trust that the reception of the report now before us will encourage the Committee to set about this task forthwith, and then to provide an index which will include the present volume. E. N. DA C. A.

Botanical Nomenclature

International Rules of Botanical Nomenclature, adopted by the International Botanical Congresses of Vienna, 1905, and Brussels, 1910, revised by the International Botanical Congress of Cambridge, 1930. Compiled by the Editorial Committee for Nomenclature from the Report of the Subsection of Nomenclature prepared by John Briquet. (Règles internationales de la Nomenclature botanique) (Internationale Regeln der botanischen Nomenclatur.) Dritte Ausgabe. Pp. xi+152. (Jena : Gustav Fischer, 1935.) 7 gold marks.

BOTANISTS who are interested in precision in nomenclature have awaited with some impatience the publication of the new edition of the "International Rules of Botanical Nomenclature" which would embody the results of the deliberations of the International Botanical Congress at Cambridge in 1930.

Precise botanical nomenclature originated in the "Lois de la Nomenclature botanique" drawn up by Alphonse de Candolle and adopted after discussion by the Paris Congress of 1867. Though the 'laws' were widely accepted, differences of interpretation and usage rendered increasingly imperative in the course of years a revision and amendment. Such revision was the chief work of the Vienna Congress in 1905, completed at Brussels in 1910. In the meantime, however, an influential section of American botanists had promulgated a "Code of Rules" which, while based on the de Candollean laws, differed in some essential points from the Vienna rules, and this Code had been adopted by a proportion of American workers. The aim of the Cambridge Congress was if possible to unify procedure, and to clarify and, where necessary, amend the rules in the light of experience gained in the intervening twenty-five years. The discussions were marked by a general desire to come to agreement on the various points at issue.

The burden of the work of preparation for the discussions at the Congresses and the editing of the results, since 1900, had fallen on Dr. John Briquet of Geneva, nominated *rapporteur général*, but his regrettable death in 1931 occurred before he had drafted the new edition of the rules. It devolved, therefore, on the remaining members of the editorial committee (Prof. H. Harms, Prof. Al. Mangin, and Dr. A. B. Rendle) to prepare the revised edition from Dr. Briquet's report of the discussions published in the general report of the Congress (1931) and from notes taken at the Congress by the recorders. As certain 'proposals' presented to the Congress by a group of British botanists were the basis of many of the alterations introduced into the rules, the first draft was prepared by the English member of the Committee in consultation with some of the British botanists. This formed the basis of discussion by the Committee, and is followed in the volume by the French and German translations by Prof. Hochreutiner (*vice* Prof. Mangin) and Prof. Harms respectively. Prof. Harms, as *vice-rapporteur*, acted as general editor.

Generally speaking, the alterations in the new edition are framed to render the rules more precise and easier of application. One result has been a sub-division of some of the rules, which now number twenty-four as compared with fifty-eight in the earlier edition. Greater precision is given to the conservation of names of certain genera to avoid disadvantageous changes by strict application of laws of priority ; the nomenclature of hybrids and half-breeds is rendered more explicit ; also the rules governing valid and effective publication, and those determining the selection of names when groups are divided, remodelled, transferred or united. An important addition is the insistence on nomenclature types as determining the names of taxonomic groups—

the type is that element of a group with which the name of the group is permanently associated. An alteration, the effect of which had not been adequately appreciated, was introduced into the rule dealing with homonyms. A saving clause was an addition to the final rule by which modifications accepted at one Congress remain on trial until the next, at which they will receive sanction unless undesirable consequences show need for further amendment or rejection. A supplement provides a list of proposed additions to the names of genera to be conserved and also lists of standard species typifying such genera.

The volume as published by Messrs. Fischer conforms in size and character of text with the two previous editions emanating respectively from the Vienna and Brussels Congresses of 1905 and 1910.

Epidemics and Crowd-Diseases

Epidemics and Crowd-Diseases: an Introduction to the Study of Epidemiology. By Prof. Major Greenwood. Pp. 409. (London: Williams and Norgate, Ltd., 1935.) 21*s*. net.

THE value of a scientific treatise lies not so much in the information which it imparts as in the inspiration which the reader derives from it to inquire further into the matters with which it deals. We have read "introductions to the study of" subjects, which left the impression that nothing remained worth inquiring into, and even destroyed all desire for such exercises. In his work on "Epidemics and Crowd-Diseases"—which will become a classic—Prof. Greenwood, far from doing this, introduces his readers to the study of epidemiology in such charming fashion that, as the tale unfolds, each chapter seems to end on a note of lively interrogation.

The volume is divided into two parts, general principles and methods, and special illustrations. The first four chapters, dealing with the history of epidemiology from Hippocrates and Galen through Graunt and Farr to the present time, and two chapters in the second part dealing with Jenner and Creighton, provide continuous entertainment as well as instruction, this being due to their literary style rather than their subject matter. The chapters on experimental epidemiology, artificial immunisation, nutrition, and the influence of occupation and of psychological factors upon crowd-diseases, are masterly essays, all too brief, on our knowledge of these matters. The special illustrations chosen are the typhoid group, cholera, typhus, measles, diphtheria, scarlet fever, smallpox, plague, epidemic diseases of the central nervous system, influenza, venereal diseases, tuberculosis and cancer. It is impossible to do more than enumerate these chapters, each of exceptional interest and critical value. A wealth of satire, not overdone and certainly salutary in its effects, pervades these chapters, as indeed the whole work, and adds pleasure to the reading.

The greatest living exponent of the application of the statistical method to epidemiology might be pardoned if he exaggerated the services which statistical research has rendered to the progress of medical knowledge; but Prof. Greenwood might rather be accused of under-estimating the achievements of statistical epidemiology and of undue pessimism as to the possibilities of such research in the future. In the opening chapter, for example, he tells us that so far as epidemics of catarrhal disease, common colds and pneumonias are concerned, we know scarcely any more than Hippocrates did about their general etiology. Again, in his account of "The Age of Pasteur and Galton", he asks whether the new statistical calculus has yet solved any of the age-old problems of secular variation, change of type or method of spread of infectious diseases; and having answered this with an emphatic negative, passes to the depressing conclusions that "we do not know enough of the elements of the subject to be fit to ask questions" of Dame Nature, and "at present, with all our knowledge of detail, we shall not reach the general 'laws' which Sydenham failed to discover".

It is difficult for us in this analytical period to 'see the wood for trees' sometimes. Our knowledge of the individual factors which combine to make the general etiology of crowd-diseases so complex becomes every year more complete, and when analysis has proceeded far enough—a tedious process seeming to our foreshortened vision to lead us farther from the solution of the general problems rather than nearer—the time will come when to some fresh mind with a genius for synthesis the fitting together of the carefully sorted pieces will appear amazingly simple. Perhaps the first steps in this synthesis are not so far away as Prof. Greenwood thinks; without doubt they will be brought nearer by the inspirations derived from the publication of such a work as this.

P. STOCKS.

Discoveries: Old and New

Unrolling the Map: the Story of Exploration
By Leonard Outhwaite. Pp. xiv+351. (London: Constable and Co., Ltd., 1935.) 16*s*. net.

THE appearance of yet another history of exploration may be taken to indicate a popular demand for such works and, if one may judge from some of his remarks, Mr. Outhwaite writes primarily for the general reader. He disarms criticism by confessing that he does not "pretend to refinement in historical scholarship" and generously acknowledges help both from distinguished scholars and from previously published works. As he frankly admits, there is little originality in his book. Its facts are in the main accurate, but he seems to have found the limitations of space very hampering, and many parts of the later chapters are little more than notes on explorers grouped under a general heading, such as "Others in Africa". This limitation has other curious results, such as the inclusion of all the work of the Duke of the Abruzzi in the chapter on the Arctic, and the relegation of "mountain explorers" to an appendix to that chapter. These are perhaps mere faults of arrangement.

There are, however, two serious criticisms to make of this work. Its title suggests a progressive development of the knowledge of the world which is not in accordance with facts. Until quite recent times, there were too many 'secret' discoveries and too many national or personal jealousies to make it possible for anyone to say how much of the world was known at any one time. Mr. Outhwaite may know now—but explorers, like, say, Columbus on his fourth voyage, would have given a good deal to see a map of the world as it was known to their contemporaries.

Mr. Outhwaite further attempts to illustrate his ideas with a series of maps. It is not quite clear what these maps are intended to show, but if the general statement in the introduction is applicable to all maps then there are many serious errors in the book. On many of them the whole of Newfoundland is shown as 'known', whereas in fact inland journeys were practically unknown until relatively recent times. There is much more of the world 'known' in 1490 than there is when Vasco da Gama made his voyage to India. In some of the maps showing the exploration of Africa in the nineteenth century there are similar errors. In short, the map does not unroll itself in quite the way Mr. Outhwaite intended, and when, as sometimes happens, his own statements do not agree with the maps, the reader is left in confusion. Nor is he helped in his search for a solution by the bibliography, which in the main consists of "a few volumes that will tempt the fireside explorer". Some at least of the distinguished authors quoted would perhaps be a little suspicious of such comfortable popularity.

It has been necessary to criticise Mr. Outhwaite's book partly because the publishers claim that it will be welcome to "students in need of a work of reference". It will, in fact, give them little help. On the other hand, the "schoolboy eager for one of the greatest true stories of adventure" and the "general reader" will find it, despite its awkward format, interesting, readable, and, up to a point, instructive. Even the student may study with profit the admirable drawings of ships, contributed by Mr. Gordon Grant, which combine art and scholarship in a manner which is much to be commended.

J. N. L. B.

Ornamental Shrubs and Trees: their Selection and Pruning
By Arthur J. Sweet. Edited by Walter P. Wright. Pp. xiii+64. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 5*s*. net.

OWNERS of gardens, large and small, will find this book very useful, for many people fail to get the best results from their shrubs and trees owing to their indifferent knowledge of pruning. All ornamental shrubs and trees do not need annual pruning; some give better results without it, others require an annual light thinning out of the older wood, and some respond most satisfactorily when the flowering branches are cut back each year after the flowers are over and entirely new wood is relied upon for future flowers. Moreover, some shrubs and trees can be pruned when they are dormant in late autumn or winter, but if the same treatment were given to others the flowering wood for the following season would be cut out; that is why the autumnal clean up of gardens should not be made the time for the annual pruning of shrubs and trees.

In the book under notice all the little peculiarities of different shrubs, regarding pruning, are dealt with, and by the aid of descriptive lists and diagrams it need not be difficult for the most casual amateur to find out the proper time and most approved method for pruning his shrubs and trees.

Theoretische Grundlagen der organischen Chemie

Von Prof. Walter Hückel. Band 2. Zweite Auflage. Pp. viii + 338. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 15.60 gold marks.

VOL. 1 of the second edition of Prof. W. Hückel's work was recently reviewed (NATURE, March 9, 1935, p. 384); vol. 2, divided into two main sections, contains a not inconsiderable amount of new material and there are certain changes in the presentation of the subject.

The first section (Book 3) on "Constitution and Physical Properties" contains the larger proportion of the new material included in the volume. This new material deals with dipole moment and with colloid problems in organic chemistry which, apart from the polysaccharides, are chiefly concerned at the present time with polymerisation of unsaturated simple compounds to products of high molecular weight. The author has purposely omitted to include the consideration of the physical basis of optical activity, a subject in which so much original work is being carried out particularly in England and in Germany at the present time.

Book 4 is concerned with various aspects of "Constitution and Velocity of Reaction" treated largely from the kinetic point of view. In this, not very much new matter is included, although there has been a rapid increase in our knowledge, particularly of the mode of reaction of simple organic molecules in the gaseous phase, since the publication of the first edition.

There is no doubt that Hückel's "Theoretical Principles" is a most stimulating work, in spite of the necessary restrictions which the author evidently feels it desirable to impose in a work of this kind; in his *Ausblick*, after referring to the work of Heisenberg and Schrödinger, the author indicates the importance of the application of quantum mechanics to the organic chemistry of the immediate future.

C. S. G.

An Introduction to Experimental Embryology

By Dr. G. R. de Beer. Second edition. Pp. xii + 148. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 7*s*. 6*d*. net.

THE appearance of a second edition of de Beer's "Introduction to Experimental Embryology" is evidence of its well-deserved popularity. The book deals with the whole subject of modern research into the form changes of animals. The field is so wide and the subjects touched on so varied, that perforce a very large number of experimental facts have to be included. It is Dr. de Beer's particular merit to have provided an exposition which is at once perfectly clear as to the actual data and also never loses sight of the main principles involved.

The achievement is the more remarkable as in point of fact there is no generally recognised set of principles extant which can be applied over the whole field. The author has had to select boldly, from the conflicting hypotheses which are available, one main thesis to which he can refer his experimental data. Dr. de Beer chooses the axial gradient theory, which has the somewhat dubious advantage of being so flexible that it can be more widely applied than many of the more specialised theories. Apart from any consideration of its ultimate scientific worth, however, it fulfils very well the function it is called upon to play in this book—the function of providing a connecting thread on which the data of experimental embryology can be strung together to make an interesting and not too mysterious story for beginners. If the vagueness which still attaches to the theory stimulates the reader to try to make precise in his own mind some of the questions which are raised, that too will have been not without its usefulness.

A Bibliography of Two Oxford Physiologists: Richard Lower 1631–1691, John Mayow 1643–1679.

By Prof. John F. Fulton. Pp. 62 + 7 plates. (Oxford: Printed at the University Press, 1935.) n.p.

THIS work is a reprint from the *Proceedings of the Oxford Bibliographical Society and Papers* (4, 1; 1935). Prof. Fulton states that he has chosen this subject owing to the recent interest caused by Dr. K. J. Franklin's studies on Lower and Prof. T. S. Patterson's critical discussion of Mayow's work. In a short introduction to Lower's bibliography, Dr. Franklin adds some supplementary matter to his previous studies, and maintains that the pre-eminent position occupied by Oxford in scientific achievement during the seventeenth century was due among others to Lower, who was alike great as an anatomist, physiologist and medical practitioner. Dr. Fulton himself has an equally high opinion of Lower, whom he regards as the foremost English physiologist of the seventeenth century after Harvey. On the other hand, he agrees with Prof. Patterson that Mayow has been credited with many things which had been definitely mentioned by other people, though he emphasises the fact that Mayow was the second English writer after Glisson to publish a treatise on rickets with novel and praiseworthy suggestions concerning orthopædic treatment.

The bibliographies of the two physiologists are each divided into three sections devoted respectively to their separate works, of which facsimiles of the title pages are inserted, contributions to other works, especially the *Philosophical Transactions*, and biography and criticism.

La Tchécoslovaquie: étude économique

Par Prof. André Tibal. (Collection Armand Colin: Section de géographie, No. 183.) Pp. 224. (Paris: Armand Colin, 1935.) 10.50 francs.

PROF. TIBAL'S economic survey of Czechoslovakia is mainly concerned with agriculture and the country's industries, but reference is incidentally made to educational, cultural and scientific matters. The book is most noteworthy for its account of the influence of the world economic crisis upon national life, and the methods that are being pursued to overcome the general stagnation. It is significant that the industrial and political leaders have sought the aid of men of science and have adopted some of their suggestions in attempts to surmount their difficulties. They are already meeting with a measure of success.

Solar Magnetism

By Dr. George E. Hale, For. Mem. R.S., Mount Wilson Observatory, Pasadena, California

THE recent celebration of Prof. Zeeman's seventieth birthday offers a favourable opportunity to describe current applications of his powerful method of research to the study of solar magnetism. Our latest results include the completion of the first observed 23-year magnetic cycle of sunspots and the conclusion of a long investigation of the sun's general magnetic field, made for the purpose of checking beyond question the original measurements begun in 1912.

Zeeman Effect in Sunspots

As explained eleven years ago in NATURE[1], I was led in 1908 to the discovery of magnetic fields in sunspots by a hypothesis based upon the results of two series of studies, begun at the Kenwood Observatory in 1890, and continued at the Yerkes and Mount Wilson Observatories. The first of these related to the nature of various phenomena of the solar atmosphere revealed by spectrographs and spectroheliographs. The hydrogen flocculi, as first shown by the $H\alpha$ line at Mount Wilson in 1908, indicated the existence of immense vortices surrounding sunspots, and suggested that electrically charged particles might be whirled within the spots in such a way as to produce appreciable electric currents. Such currents would set up magnetic fields, possibly of sufficient strength to be detected by a powerful spectroscope. Zeeman had shown how the spectrum lines of luminous metallic vapours between the poles of a magnet are widened or split into several components, polarised in distinctive ways. Meanwhile our studies of sunspot spectra, supplementing those made with less powerful spectrographs by Young, had reached a point where many lines on our photographs were not only widened but also separated into apparent doublets or triplets. These had previously been regarded as reversed lines, due to the superposition of two vaporous layers of different temperature and density. Such reversals actually exist in certain cases, notably in the lines of hydrogen and calcium. Thus, the true understanding of the sunspot spectrum had been obscured.

In the hope of disentangling the question, a new attack on sunspots was begun. Aided by the 60-foot tower telescope on Mount Wilson, equipped with a 30-foot grating spectrograph and suitable polariscopic apparatus, it was easy to test my hypothesis. The presence of magnetic fields was readily established in all the sunspots observed, and the polariscopic phenomena of the sunspot lines, varying as the solar rotation changed the angle between the lines of force and the line of sight, was quickly found to harmonise with Zeeman's laboratory results on the spectra of vapours. My solar work was greatly facilitated by experiments made in our own laboratory by King, provided with a Du Bois magnet and all the essential equipment.

Magnetic Polarity of Sunspots

The sunspot spectrum contains many thousands of lines, and its complete investigation is an extensive task. After a sufficient number of these lines had been examined in order to establish the existence, strength and general character of the magnetic fields, another phase of the problem was attacked.

Speaking broadly, sunspots in the northern hemisphere of the sun were found to be opposite in polarity to those in the southern hemisphere. But occasional apparent exceptions indicated the need for a more careful analysis. The earliest drawings of sunspots, made by Galileo and Scheiner, suggest their complex character. They often appear at first as single spots, but soon develop into groups, frequently containing many components, large and small. No observer could fail to detect, however, a remarkable tendency of spots to occur in pairs, consisting of large spots with small companions, or of two groups of small spots. Here was an interesting chance for polarity tests, which showed that such pairs are almost invariably bipolar: that is, they consist of two spots or groups having opposite magnetic poles. The smaller spots that frequently cluster about the preceding (western) and following (eastern) major spots usually agree in polarity with the larger spots they accompany, though this is not an invariable rule.

From such characteristics a scheme of magnetic classification developed, which has been used ever since on Mount Wilson in recording the magnetic phenomena of thousands of spots examined with

the 150-foot tower telescope and the 75-foot spectrograph. This long task, in which Nicholson, Ellerman, Joy and many others have taken part, has now covered more than two of the well-known sunspot cycles of approximately eleven years duration.

Law of Sunspot Polarity

It is well known that the first spots of each of these 11-year frequency cycles break out in comparatively high latitudes some time before the last of the spots of the previous cycle disappear near the equator. From 1908, the spots of the then existing cycle continued to show the same polarity, opposite in the two hemispheres, while slowly decreasing in mean latitude. Not long before the minimum of solar activity in 1912, the forerunners of the next 11-year cycle began to appear. To our surprise, their polarity was opposite to that of the spots of the preceding cycle. Moreover, the succeeding spots of the new cycle, which overlapped for a time the remnants of the old cycle in lower latitudes, retained the same reversed polarities for approximately eleven years. Then another frequency cycle commenced, with another reversal of polarity. Thus the complete magnetic cycle, bringing back spots of the same polarity as those first observed, occupies some twenty-two or twenty-three years, and comprises two frequency cycles. The northern and southern hemispheres represent this novel effect with opposite signs. The diagram shown in Fig. 1 summarises the changes of latitudes and polarities during the period 1908–35.

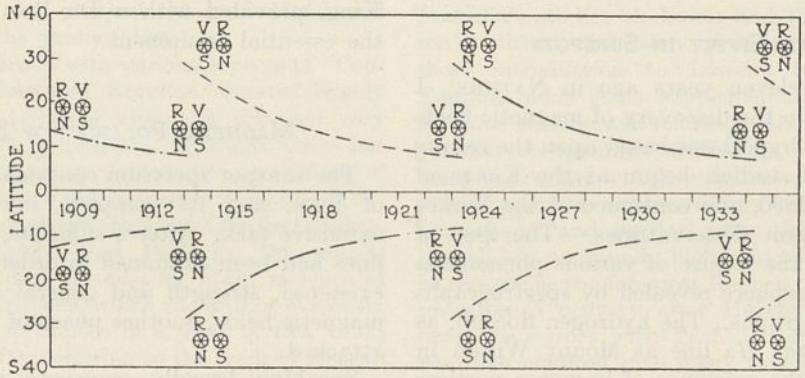

Fig. 1. Law of sunspot polarity. The curves represent the approximate variation in mean latitude and the corresponding magnetic polarities of sunspot groups observed at Mount Wilson from June 1908 until January 1935. The preceding spot is shown on the right.

A more detailed examination of the observations, many of which have been published in the *Astrophysical Journal* and the *Publications of the Astronomical Society of the Pacific*, would suffice to show that occasional exceptional phenomena complicate the explanation of these changes. About ninety-seven per cent of consistent results, however, obviously point toward some general solution, applicable to the sun and countless other stars, but still remaining in the form of the empirical law illustrated in Fig. 1.

General Magnetic Field of the Sun

Soon after the detection of strong magnetic fields in sunspots, I began to wonder whether the sun as a whole might possess a general magnetic field. There was no very promising theoretical ground for such speculation, but the magnetic field of the earth, with poles not far removed from the poles of rotation, was at least suggestive. Schuster had queried in 1891 : "Is every rotating body a magnet ?" and the structure of the solar corona resembles that of a magnetic field*. Thus while it was a far cry from the solid earth to the vaporous sun, it seemed worth while to undertake a trial.

The first attempts, made with the 60-foot tower telescope, were fruitless. In 1912, with the completion of the 150-foot tower telescope and 75-foot spectrograph, a better opportunity offered itself. Obviously no such widening and complete splitting of lines as had been found in sunspots existed in regions away from spots. But by using a purely differential method, comprising a compound quarter-wave plate overlying a long Nicol prism on the slit, it seemed barely possible that minute magnetic displacements of suitable lines might be detected by measurements on successive strips. Assuming the magnetic poles of the sun to correspond with the poles of rotation, and mounting the quarter-wave strips with their principal sections alternately at angles of $+45°$ and $-45°$ with the slit of the spectrograph, the displacements on

* In the present brief statement no attempt is made to enumerate other speculations and theories.

odd and even strips should attain maximum values on the central meridian at about 45° north and south latitude, and decrease to zero at the poles and equator.

In the search for such minute displacements, every precaution was taken to obviate any possible bias on the part of the measurers. Thus the quarter-wave plates were frequently inverted, and the measurer was never allowed to know in advance in which position they stood, nor the hemisphere or latitude of the photographs under measurement.

Great difficulties attended this investigation, which was continued for several years. Many members of the Mount Wilson staff joined me in the task, including Seares, Anderson, Ellerman and van Maanen, together with Miss Lasby, Miss Richmond and Miss Felker, while check measures and tests were made by Adams, Babcock and others. Several different types of measuring machines were employed, and every possible means of avoiding personal or instrumental errors was adopted. The results, fully described in a series of papers in the *Astrophysical Journal*, seemed to leave no room for doubt regarding the existence, polarity and approximate strength of a weak general magnetic field of the sun, having poles lying within a few degrees of the sun's poles of rotation.

The fact remains, as pointed out in these papers, that some of the many measurers engaged in the work could not detect the general field, though the results of all those who succeeded were in agreement regarding its polarity and order of magnitude. The difficulties of measurement can be appreciated only by those who have endeavoured to detect such minute displacements of lines, rendered broad and diffuse by the great dispersion employed. The observed displacements ranged from zero near the equator and poles to maximum values of 0·001 A. at mid-latitudes.

Several years ago I renewed this investigation with the cœlostat telescope (equivalent focal length 150 feet) and the 75-foot spectrograph of my solar laboratory in Pasadena. Having made a new series of photographs of the same dispersion as those previously taken on Mount Wilson, I endeavoured to measure them by several different instruments, including a Zeiss microphotometer and a tipping plate micrometer of the form used in our earlier work. The results showed little, if any, general magnetic field, and finally I thought it advisable to undertake new check measures of the plates made more than twenty years ago on Mount Wilson. More difficulties were encountered, and most of the experienced measurers who had overcome them before were no longer available. However, others kindly enlisted, and a study lasting four years has at last yielded a sufficient number of independent confirmations to satisfy us of the validity of our former conclusions.

As before, some of the measurers have been unable to detect the general magnetic field shown by our old plates. On the contrary, Dr. John Strong with an improved Zeiss microphotometer, used visually, and Dr. R. M. Langer with the original tipping plate micrometer, have found systematic average displacements of the same sign. Mr. J. Evershed, who very kindly volunteered to assist, obtained excellent confirmatory measures of our original plates at his observatory in England, using his own admirable method of measurement. Within the last few weeks [date of communication, September 14, 1935], Dr. Langer has obtained two more unmistakable confirmations with the aid of a new type of combined measuring, recording and computing machine, built in my laboratory after a design due chiefly to himself. The chief advantages of this machine are its speed of operation, permitting a very large number of measures to be made in a short time, and its complete freedom from any possibility of bias.

Taken altogether, the evidence is overwhelmingly in favour of the existence, polarity and order of magnitude of the general magnetic field of the sun given in our original papers. There is thus far no evidence of change of polarity at sunspot minima. As for any possible changes of intensity, every single determination is necessarily based upon thousands of measures, and hence represents mean values for many points on the sun. Thus much time may elapse before the question of variability can be settled.

The striking magnetic phenomena of sunspots, and the evidence we have offered that the entire sun is a magnet, would seem to have important bearings on the problems of terrestrial magnetism and the fundamental nature of magnetism itself. It is difficult to avoid the belief that the strong magnetic fields of the spots, and the much weaker general magnetic fields of the sun and the earth, arise from the same general cause, namely, the rotation of bodies carrying electrically charged particles. Many different hypotheses based upon this view have been tested, but there is much room for further work. While this will naturally deal at first with the simplest general assumptions, a detailed study of such anomalous phenomena as are presented by about three per cent of all sunspots should not be overlooked.

[1] "Sun-spots as Magnets and the Periodic Reversal of their Polarity", NATURE, **113**, 105, Jan. 19, 1924.

The Schools and Pre-Medical Studies

IN NATURE of July 20, 1935 (**136**, 90), appeared an article upon the recent report on the medical curriculum* dealing with the report from the point of view of clinical studies, but making no reference to the pre-medical studies and their relation to the work carried on in public and other secondary schools. The present article, which deals with this section of the report, is intended to be supplementary to that previously published.

The third section of the report deals with the pre-medical studies and may be briefly summarised as follows :

1. The period of pre-medical studies is spent with increasing frequency at school and only too often general education is stopped at too early an age in order to permit specialisation in science for passing the pre-medical examination.

2. In some cases, this has resulted in the formation of small groups working solely for this object, and thus segregated some, not only from the rest of the school, but even from other boys studying science.

3. The early specialisation is undesirable and could be avoided if a reasonable proportion of time was spent on science throughout the school period.

4. Greater use should be made of the Higher School Certificate examinations as a means of obtaining exemption from the First M.B. examination.

5. A common syllabus in chemistry, physics and biology is desirable for all First M.B. examinations, and suggestions for such a syllabus are given in the appendix to the report.

6. To ensure sufficient time for general education, and to avoid too early specialisation, medical studies proper, that is, anatomy and physiology, should not be begun before the age of eighteen.

It appears desirable to examine these criticisms and the suggestions, and to do so it is necessary to review briefly the work carried on in public and other secondary schools at the present time.

In the majority of schools, the work of the pupil is directed to attaining the standard of a School Certificate examination at the age of 15–16 years, and up to this stage in most schools there is little or no specialisation, each pupil commonly offering English, at least one other language, elementary mathematics, and from two (minimum) to five (maximum) additional subjects, usually including some science subjects.

A large number of pupils leave school when they have passed the School Certificate examination, but those intending to study medicine stay for an additional one or two years, and naturally their academic interests are centred mainly on their first professional examination. If these candidates have offered chemistry and physics (and possibly biology) for the School Certificate examination, and assuming they are about 16 years of age, it should be a matter of comparative ease for them to reach the standard of the First M.B. examination at the end of a further two years work without any intensive preparation, and the formation of special M.B. classes appears quite unnecessary.

Unfortunately, there are frequently complications so far as individual pupils are concerned. For some reason, it may be ill-health, slower development, or failure to pass the School Certificate examination at an earlier attempt, a pupil may already have reached the age of 17 years before becoming a post-certificate student. The tendency then will be for him to endeavour to pass his First M.B. examination at the end of a further year's work, a proceeding which must entail some intensive preparation and which probably segregates him to some extent from the rest of the science students.

In large schools, there is often also the difficult problem of a boy, who, having spent his time on the classical or modern side up to School Certificate stage, decides to study medicine. He has probably done little or no science, but is now transferred to the science side, and the problem becomes one for the science masters. To expect the boy to work with students of the science side who have already spent about three years working at science subjects is unreasonable, and therefore a special course of study has to be planned for him. Since this boy is endeavouring to pass in two years (or in extreme cases in one year) the same examination over which the preparation of the science side student has taken four or five years, the course of study is necessarily intensive, and demands all the time of the student, and even then the knowledge gained is in many cases superficial, and the examination is passed through the cultivation of a retentive memory rather than of scientific method. The general education of such a student must suffer, and if there is more than one pupil in such

* Report of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the Society of Apothecaries of London, on the Medical Curriculum. Pp. ii+34. (London : University of London, 1935.) 1*s*.

an unhappy position, it is easy to see how special M.B. classes arise.

As the report points out: "If all schoolboys and girls devoted a reasonable proportion of their time throughout the school period to the natural sciences there should be less need for a prolonged period of intensive preparation at the end of school life".

Putting on one side the special cases considered in the preceding paragraphs, one may now inquire: What provision is made for the continuation of the general education of post School Certificate students? Some specialisation is now inevitable, and as the report states "may not be undesirable", for those remaining at school usually have some definite objective, either a professional examination or a university scholarship, and the general work of these students is usually directed towards a Higher School Certificate examination. In this, a candidate is required to satisfy the examiners in a particular group of studies, for example, classical studies, modern studies, mathematics, or natural sciences, but, in addition, he has also to satisfy the examiners in at least one subsidiary subject which is quite outside the group in which he has specialised. This avoids, to some extent, undue specialisation, and it is probably in recognition of this fact that "the Conference would, however, approve of greater use being made of the Higher School Certificate Examinations as a means of obtaining exemption from the Examinations for the 1st M.B. or Basic Sciences".

Here again arise difficulties which could easily be removed. In some cases, a university will not recognise the possession of the Higher School Certificate of another university for exemption from the First M.B. examination. To take a definite illustration, a boy attending a school taking the Oxford and Cambridge Joint Board examinations can obtain exemption from London Matriculation by a suitable School Certificate of the Joint Board, but finds that he has no means of gaining exemption from the First M.B. examination at London by the Higher Certificate of the Joint Board, and his easiest course is to work for the First M.B. examination. There is no incentive for him to work at subjects other than the science subjects of the First M.B. and therefore his general education virtually ceases. If greater recognition was given by all universities to Higher School examinations for purposes of exemption from their own examinations, difficulties such as these could be avoided.

The need for a common syllabus for all First M.B. examinations has long been apparent to teachers who have been faced with the preparation of individual members of the same class for different First M.B. examinations. The difficulty may be made clearer by a consideration of the biological syllabuses of the First M.B. examinations of Cambridge and London. Since the introduction of the new syllabus in 1935 into the Cambridge examination, there is more in common than there was formerly. Thus in each syllabus the following types are mentioned: *Amoeba*, *Monocystis*, *Paramecium*, *Lumbricus*, *Scyllium*, *Rana*, *Lepus*; *Spirogyra*, *Pythium*, *Saccharomyces* and Bacteria. Peculiar to London are *Obelia*, *Hæmatococcus*, malarial parasite amd the flower structure of *Lilium* and *Pisum*; and to Cambridge: *Chlamydomonas*, *Protococcus*, *Polytoma*, *Pandorina*, *Eudorina*, *Volvox*, *Fucus*, *Hydra*, cockroach, and frog embryology. Truly, as is stated in the report, "the training would be more efficient if these differences, none of them great or important, could be removed".

Appendix A of the report presents a suggested common syllabus for the subjects of the First M.B. examination. It may not be out of place at this point to pause and consider the proposed syllabuses. In the preparation of the report, the representatives consulted various authorities from medical schools, and also headmasters and representatives of the Science Masters' Association; and it may be assumed that pre-medical studies were fully discussed, and the syllabuses given in Appendix A are the outcome of those discussions. The standard of work outlined by the syllabuses appears to be roughly that of the present First M.B. examinations, that is, somewhat lower than that of the Higher School Certificate examination in the separate subjects. This is probably wise, for whilst it will allow a candidate who has offered science subjects in the School Certificate examination to take his First M.B. examination with fair prospects of success at the end of a further year's work (a benefit to the older post-School Certificate student already referred to), it will probably require two years' careful work from a candidate who has previously done little or no science, unless he is 'crammed' for this particular examination, a deplorable event, but practically impossible to eradicate, since parents' wishes must be respected.

If the recommendation that medical studies proper should not be begun before the age of 18 years is carried into effect, then there will be little incentive for the post-School Certificate student of 16 years to take the First M.B. examination the following year, and he can continue the normal school course for a further two years and attain the somewhat higher standard required from Higher School Certificate candidates, providing his success will gain for him exemption from the First M.B. examination. The syllabuses will probably be well received by teachers, to whom the

adoption of the syllabus by all authorities is of greater importance at the present moment than the details of the contents.

It may be predicted, therefore, that the recommendations of the report so far as they are concerned with the pre-medical studies and the age for commencement of medical studies proper will receive the enthusiastic support of teachers in public and other secondary schools. If the recommendations are carried into effect, the complaints of undue specialisation and too low a standard of general education will largely disappear, and the medical students produced by the schools may be better fitted to "acquire that kind of culture which survives the forgetting of facts".

W. J. R. D.

Geology as a School Subject

AT the Norwich meeting of the British Association, a discussion was held in Section C (Geology) on "Geology in Schools". It was certainly appropriate that this subject should be discussed during the year in which Prof. W. W. Watts is president of the Association, for during a period of more than thirty years he has repeatedly pressed the claims of geology as a school science subject, and his presidential address to Section C in 1903 dealt comprehensively with the functions of geology in education. For various reasons, little progress has been made with the introduction of the subject into schools, although in the meantime there has been a great extension of science teaching.

The Norwich discussion may be summarised the more easily since it revealed a remarkable unanimity of opinion, practically all who spoke emphasising their agreement with the previous speakers. It was keenly felt that geology does not occupy the place to which it is entitled in the educational system, in schools, universities or in the wider field of adult education. Dr. A. K. Wells showed that the number taking geology in the University of London General Schools Examinations has fallen almost to zero. On the other hand, many speakers emphasised the fact that geology proves one of the most attractive sciences when once a student is introduced to it. As Prof. Watts said: "there are many types of mind to whom this science appeals as no other one does": it gives a new interest which frequently lasts beyond school days, and which gives meaning to every piece of country visited, an important fact in these days of wider travel. Prof. P. G. H. Boswell stressed the value of geology as a cultural subject, and quoted Mr. Ramsay MacDonald's statement that "if any one of the sciences were selected as the key to all the other sciences—as that which in its subject-matter and its history, the history of its evolution, enforces the true scientific method—geology might be selected as that science".

In the course of the discussion, many advantages of geology as a school subject were touched upon. Among these the most important appears to be that geology is perhaps the very best training ground in the collection and co-ordination of observed facts. It was also emphasised that the equipment necessary for teaching (more abundant and more easily obtained now than at any time) is probably less expensive than in any other science. Many rural schools are situated in areas which can be described as natural laboratories, and it is preposterous that scholars do not learn something of the meaning of these surroundings. On the other hand, Dr. H. D. Thomas referred to the valuable work in geology done in a London school, so that the teaching of the subject by no means needs to be confined to rural areas. Prof. A. Hubert Cox spoke of the excellent work now being done in some Welsh schools, and Mr. A. N. Thomas gave an account of the courses provided at Caerphilly.

It was also pointed out that in several sciences taught in schools the teaching has become increasingly dogmatic: even the experiments performed are "carefully designed to eliminate all confusing and collateral elements". At least some teachers of chemistry and physics consider that the elementary parts of those subjects must be mastered as quickly as possible, and that it is impossible for a student until he approaches the standard of an honours graduate to begin to assess for himself the real value of experimental evidence or to develop his originality and critical ability. There is a real danger that a pupil finishing his science training in school may have acquired a vast body of scientific information, but may have had little chance of developing that scientific outlook which is likely to make him a more valuable member of most communities. In geology, on the other hand, it is still possible for a beginner to feel the excitement of making new discoveries; a fossil or a dip observation in a temporary section may be vitally important. The co-ordination of such observed facts, and the examination of alternative hypotheses concerning which the

teacher is prepared to admit his own uncertainty, are all part of the training of the most elementary student.

Other changes in school organisation in late years have, however, affected the question of what sciences ought to be taught. In the first place, the great extension of the senior classes in elementary schools has opened up a new field. The teachers in these schools, to a large extent freed from the tyranny of examinations, have opportunities of devising courses in science on more original lines; often limited by lack of laboratories and apparatus, the teaching of science must become even more dogmatic unless it is extended to include subjects such as geology in which the provision of simple equipment offers no difficulties: moreover, as Prof. Watts emphasised, it is possible to do a considerable amount of geology without any special knowledge of other sciences.

In the secondary schools the position presents greater difficulties. The teaching is frequently dominated by examinations; the needs of the small proportion of pupils who may eventually proceed to the university to a large extent determine the subjects chosen; the curriculum is already crowded, at least so far as the School Certificate stage. But many educationists feel that all is not well with science teaching at this stage and that the tendency to early specialisation imposes serious limitations on the teacher. Recently the panel of investigators appointed by the Secondary Schools Examinations Council concluded that "at present the practice is to confine Science work too narrowly and this practice is encouraged by our examination system". They believe that "there is a general body of knowledge . . . which ought to be known both by the ordinary citizen and by those who may ultimately specialise" in some narrower field, and recommend the institution of a course in elementary or general science to be made obligatory for practically all candidates desiring a pass in science at the School Certificate examination. The scheme now proposed involves some physics, chemistry and biology; in the course of the discussion at Norwich the view was very strongly expressed that some geology should be included in this general course.

The difficulty, already widely discussed, of making a homogeneous subject out of this new group would not necessarily be made greater by the inclusion of geology. For geology occupies a central position among the sciences, having close contact with all, and it was suggested that the geology would help to synthesise the scheme. In many cases it would form a suitable basis for the study both of science and of the external world. In this connexion, Prof. H. H. Swinnerton referred to a Nottingham school where a course in local geology and biology forms the starting point of all science work.

Several speakers felt that the introduction of geology as a separate subject after the School Certificate stage, for Higher School Certificate pupils, was highly desirable. The higher work done in school represents for some pupils the last stage of organised study, for others it forms the basis of subsequent university work; but for both these groups the inclusion of additional science subjects in the curriculum of most schools is greatly to be desired. Usually not more than three subjects are studied to this higher stage, and often in smaller schools no more than that number of science subjects is available: the pupil's choice at best is limited, and he may be excluded from any course in 'science' because, for example, of a distaste for physics or mathematics. For those who are not likely to proceed to university work in science, the advantages of a scheme which includes geology will be apparent from the remarks already summarised.

It was pointed out that the case of the student who intends to go to a university to read science calls for still more consideration, for the position has been greatly altered by the growth of the Higher Certificate courses. In most universities satisfactory school work at the higher stage gives exemption from first year university courses. But whereas in the past a matriculated student going to the university had to choose (usually) four science subjects from a list of seven or eight, which mostly involved taking up at least one subject which he had not studied at school, the present student has already made his narrower choice at school. There is a probability, therefore, that students who may have marked abilities in sciences not taught at school may never discover that bent, and may indeed be deterred from reading science at all. The effect of these conditions on the geology departments at the universities was commented on, although obviously this in itself is no strong reason for instituting geology courses in schools.

The relations of geology to the geography taught in schools were also discussed by several speakers. Prof. A. Gilligan emphasised the importance of geological work as a basis for school geography, and Dr. M. E. Tomlinson gave her experience, as a geography teacher, of the great interest taken by both boys and girls in the geology which she had, of necessity, introduced into her geography lessons.

The president of the Section (Prof. G. Hickling) mentioned that a sectional committee had been appointed to consider questions affecting the teaching of geology in schools. A. E. T.

Obituary

Mr. A. Thorburn

WITH the passing of Archibald Thorburn, who died on October 9, at the age of seventy-five years, ornithology has suffered a grievous loss. For a generation his pictures of bird-life held a supreme place in the presentation of our native birds; and this because he combined the rare gift of scientific accuracy with a sense of composition and colour-values, rarely attained by any other artist in this field. He knew his birds and loved them, and this goes far to explain his success.

Some of Thorburn's finest work is seen in his pictures of birds which appealed to the sportsman. His illustrations in Lilford's "Coloured Figures of the Birds of the British Islands" made him famous, for they were gems of the first water. He also painted a large number of pictures of pheasants for a great monograph on these birds published in the United States many years ago, as well as most of the coloured plates in the fine monograph of our British game-birds, written by his old friend J. E. Millais. This was no small tribute to his genius, for Millais himself had won fame in this field.

From his own pen followed two sumptuous books, each in two volumes, illustrated by himself. One of these was devoted to British birds. The other, in every way worthy of its predecessor, followed later, on British mammals. His exquisite pictures of field-mice and other small rodents and insectivores have never been equalled; and his wonderful drawings of whales seem to vibrate with life. These two books will remain an enduring monument to a great artist. His sure grasp of colour-effects he probably inherited from his father, who in his day enjoyed fame as a painter of miniatures.

The world is the poorer by Thorburn's death. To the wife and son who survive him, his friends and that great host who knew him only by the treasures from his pen and brush, will extend their profoundest sympathy. W. P. P.

Mr. E. G. Hooper

MR. EGBERT GRANT HOOPER was born at Bath on July 2, 1855, and died on September 17, 1935. As a pupil of Frankland at the Royal College of Science, he was a brilliant student and acquired that knowledge of chemistry which he used to such advantage in his later career. In 1878 Grant Hooper joined the Government Laboratory at Somerset House, and was transferred with it to its present quarters off the Strand. While in the Laboratory, he was engaged in food, drug, and water analysis, and assisted the late Dr. James Bell in his pioneer work on the analysis of foods.

In 1881 the tax on malt was changed to a tax on beer, and this gave Grant Hooper the opportunity of utilising his knowledge of the chemistry of brewing. It is not too much to state that Grant Hooper's small textbook, the "Manual of Brewing", was one of the earliest to consider the art of brewing in the light of the chemical knowledge at the date of its publication. It continued in use by students up to the present century and passed through several editions. It was fortunate too, in this connexion, that Grant Hooper was an expert microscopist. His wide experience enabled him to carry through many official chemical investigations of importance, ranging from the determination of arsenic, to lead in paints.

In 1912 Grant Hooper was appointed Deputy Government Chemist, a position he occupied during the difficult War period until his retirement in 1919. He was an active member of the principal chemical societies, on which he served by acting on their councils and committees. Among his various offices were those of vice-president of the Institute of Chemistry and chairman of the London Section of the Society of Chemical Industry. Those who worked with him will always remember his readiness to help in difficulties and to place his wide knowledge at their service. J. J. F.

Dr. P. K. Kozloff

THE death is reported of Dr. Petr Kuzmich Kozloff, the well-known Russian explorer, which took place at Leningrad on September 27 at the age of seventy-two years.

Kozloff was a pioneer in the band of travellers, who, combining geographical and archæological exploration in the objective of their expeditions, during the last forty years have traversed the Gobi Desert from end to end, and have restored to Western knowledge the vanished civilisations of Central Asia. Among these, the greatest honour will always be due to Sir Aurel Stein and Sven Hedin; but the Russian expeditions to Turkestan at the close of the last century were among the first to show the way to the sand-buried cities of these now desert lands, from which English, French, German and Swedish expeditions have brought back a priceless store of the treasures of ancient Asiatic art and culture.

Kozloff had already been a member of two important expeditions when he led his own first expedition to Central Asia in 1899. This was followed by a number of explorations in the Gobi Desert in the years preceding the War, of which the most fruitful was that of 1907–9, when he discovered the dead city of Khara Khoto, with its well-preserved remains of buildings and its evidences of an unknown race, from which he brought back the relics of a library, including writings in an unknown language. Under the Soviet Kozloff made several further expeditions to the Gobi Desert, of which the last was in 1926. In 1923, with the assistance of the Soviet Government, he published a fully illustrated account of his explorations and of Khara Khoto.

News and Views

Prof. Hans Spemann

THE Nobel Prize for Medicine for 1935 has been awarded to Prof. Hans Spemann, professor of zoology in the University of Freiburg-im-Breisgau. The presentation is a fitting recognition of a series of investigations which have transferred a large group of phenomena from the domain of metaphysics to that of science, in a way which we are more used to associate with the eighteenth century than with our own. Since his earliest papers, written at the turn of the century, Spemann has devoted himself to the problem of why one part of an egg develops into a certain organ in the adult, another part into something else. When he began his investigations, there was no scientific answer to such questions; one had the choice of invoking, with Driesch, a non-material entelechy, or of putting one's trust, with Roux, in the physics and chemistry of the future. Spemann refused such theoretical flights. He restricted his speculation to the actual data he could obtain from experiment, and his experimentation again to an intensive study of the development of one group of animals, the Amphibia. After twenty years of research, remarkable alike for the clarity with which the problems were envisaged and the beauty and skill of the technical means by which they were attacked, he was able to demonstrate that, in the amphibian egg, the way in which any part develops is dependent on its position relative to a certain region which he named the organisation centre. The formulation of this concept provided the first step in the causal analysis of the differentiation of the several regions of the egg. But Spemann was not content to leave the organisation centre as an unanalysed biological entity. He proceeded to show that some, at least, of its effects are due to its chemical properties, the nature of which he is still actively investigating, in company with his pupils and many others who have followed him in the exploration of the rich country which he has opened up for science.

Prof. E. Maitland Wright

DR. EDWARD MAITLAND WRIGHT, who has been appointed to succeed the late Prof. H. M. Macdonald in the chair of mathematics at the University of Aberdeen, is only twenty-nine years of age. He took his degree at the University of London in 1926 with first class honours in mathematics. He was a scholar of Jesus College, Oxford from 1926 until 1930 and has been a research student in mathematics at Christ Church since. He gained both the Junior and Senior Mathematical Scholarships of the University and first classes in each of the mathematical 'schools'. He has also been a University Senior Student and, for one year, lecturer in mathematics at King's College, London. He was trained in research work in mathematics under Prof. G. H. Hardy in Oxford and Prof. Landau in Göttingen. He has published nearly twenty papers, mainly on the additive theory of numbers and especially on Waring's theorem. A book by Prof. Hardy and him will shortly be published by the Oxford University Press; it will be accurately, though, perhaps, deceptively described as "An Introduction to Arithmetic".

The New Physics

IN the Sir Halley Stewart Trust Lecture delivered on October 24, Sir William Bragg said that an important factor in the rapid progress of science, so marked in recent years, has been the discovery that in one of her chief aspects Nature's constructions are essentially 'particulate'. In the first place, matter is particulate. The atomic theory as now understood dates from the time of Dalton, who established the fact that atoms, of a limited number of kinds, combine in definite numerical proportions to form the substances of the world. This great generalisation is the foundation of chemistry. Forty years ago it was shown that electricity is also particulate, the ultimate unit, when of negative sign, being called the 'electron'. These two generalisations have prepared the way for a third; it has been found that energy may also be described as 'particulate'. The transfer of energy is effected in units, known as 'quanta'. It is now possible to demonstrate the single atom, though a hundred million in line cover only an inch, the single electron and even the single energy quantum. Accurate maps of various molecules can be drawn, showing the signs and positions of the atoms of which they are composed: just as an architect draws the plan of a building. We may study the single ring of six carbon atoms which, with attached hydrogens, forms the molecule of benzene, or the double ring of naphthalene and the treble ring of anthracene, these being of great importance in the dye industry; or the five-ringed structure which is typical of most of those substances that are known to produce cancer. We can examine the details of the long protein molecule which plays so great a part in animal life, or the cellulose molecule of plants, or the arrangements of the atoms in metals and rocks. Nature builds all the substances that we know on certain definite structural lines. It is because we have learnt this fact, and are learning how to follow, very haltingly it may be, that physical science is making such rapid headway.

Atmospheric Electricity

IN the third of the series of Sir Halley Stewart Trust Lectures on "Scientific Progress", on October 29, Prof. E. V. Appleton dealt with recent advances in the study of atmospheric electricity. The surface of the earth is negatively charged in fine weather, while the air immediately above possesses a positive

charge. Measurements made over the oceans by American observers in the non-magnetic ship *Carnegie* showed that there is a maximum effect all over the world at the same universal time (7 p.m. G.M.T.). It is now believed that the maintenance of the earth's charge is due to thunderstorms, which send an appreciable amount of negative electricity into the ground. In the upper atmosphere, the electrification is a thousand times denser than it is in the lower atmosphere. The marked solar control of the density indicates unmistakeably that the ionisation is due to solar radiation, and radio observations show that the cause of the electrification is ultra-violet light. A difference in the behaviour of the lower and upper levels of the ionosphere has been recognised recently. The lower stratum is found to be about twice as dense in summer as in winter, due to the more direct influence of sunshine. This is exactly the amount of variation predicted by theory. But for the higher region there is not the expected increase in summer. To account for this anomaly the theory has been put forward that, at a height of 150–200 miles, the atmosphere is raised to a high temperature by the sun. Expansion results from this heating, so that the electricity is attenuated in density. To account for the observed facts it appears necessary to assume that at this level the summer noon temperature is at least 2000° F. The density of the ionosphere appears to follow the sunspot cycle of 11 years. The minimum of solar activity occurred about the latter half of 1933, and both magnetic and radio observations now show that activity is increasing again. It is expected, as a result, that the radio-engineer will find substantial differences in the wireless wave-lengths best suited for long-distance communication.

Science Exhibition at Liverpool

THERE was a record attendance at the fifth public exhibition and soirée arranged by the Associated Learned Societies of Liverpool and District at the Liverpool Technical College on October 26. The exhibition was opened by the Lord Mayor of Liverpool, and the Mayor of Bootle attended; they were received and shown round the exhibition—twenty-six rooms arranged by twenty-three societies comprising more than two thousand members—by the president, Dr. H. J. W. Hetherington; chairman, W. Mansbridge; deputy-chairman, W. S. Laverock, and the secretary, Miss E. Warhurst. Lectures included: "Race, Place and Nationality in Europe" by Prof. P. M. Roxby; "Value of Milk in Nutrition" by Prof. H. J. Channon; "Spiders and their Silk" by S. T. Burfield; and "Recent Work on Vitamins and Hormones" by Dr. R. A. Morton. The Society of Chemical Industry showed films of crystal growth by H. Emmett, and citrous fumigation with cyanides. The bird room arranged by Eric Hardy included a working scale model of a proposed bird observatory or ringing-station for migration study in the area, the first photographs taken of the grey phalarope in Great Britain—by members of the Ornithological Section of the Liverpool Naturalists' Field Club—and a working model of a ship's oil separator as the solution to the waste oil menace to sea-birds. Dr. C. T. Green of the Liverpool Botanical Society exhibited an extensive series of hand-coloured photographic prints of British orchids, similar to his noted collection recently accepted by the British Museum. Diagrams and photographs from Bidston Observatory were shown by the Liverpool Astronomical Society, and short talks were given on meteorology and astronomy. Dr. W. B. Wright, district geologist of H.M. Geological Survey, showed his results of spore analysis of coals at the Liverpool Geological Society's room. There were also demonstrations and exhibits by the leading scientific firms and the Liverpool Corporation Electric Department.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions to the Department of Zoology is the Bird collection of reptiles and amphibians from eastern Asia Minor. This collection, consisting of 196 specimens, contains representatives of one new subspecies of lizard and of two others not previously represented in the Museum's collections. It is of especial interest as coming from a region which is comparatively little known and which is intermediate, both geographically and faunistically, between the better-known regions of Iraq and western Asia Minor. A collection of 280 land snails from Cyprus has been purchased and is of interest in connexion with an intensive study which is being made of insular variation in the land Mollusca of various Mediterranean islands. The Department of Geology has received the Pleistocene vertebrate remains (chiefly mammals) which have been collected by Dr. L. S. B. Leakey in considerable quantity and from a large number of localities in East Africa in the course of his recent expedition. Purchases for the Department include a number of rare fossil fishes from the Middle Eocene of Bolca, Italy. The Mineral Department has received by gift from Mr. V. Koren a specimen of gold in quartz from Tanganyika Territory; from Mr. E. E. A. Leach a large crystal of platinum, showing magnetic poles, from Potgietersrust, Transvaal; from Dr. R. Kirkpatrick a series of moldavites, mostly collected by himself, from Czechoslovakia; and from Dr. Germaine Joplin a series of rocks from Ben Bullen, New South Wales. The purchases include a series of Brazilian minerals, among them being a large, pale blue and white, zoned, tabular, and waterworn crystal of topaz, a cut citrine (yellow quartz), weighing 647·35 carats, a large cut, pink and green tourmaline weighing 57·47 carats, a golden beryl crystal, and several specimens of quartz. A cut lemon-coloured orthoclase, weighing 31 carats, has also been bought.

THE Department of Botany has received from Mrs. E. G. Wheelwright the bryological herbarium of the Rev. H. E. F. Garnsey (1826–1903). The collection contains 2,300 mosses mostly British. Though Garnsey's name is best known on account of his association with the translations of German botanical textbooks issued by the Oxford Press, he had a high reputation

as a bryologist. The herbarium of Robert Paulson has been presented by his widow. It contains more than six hundred flowering plants, but its value is in its 269 British and 200 foreign lichens, for Mr. Paulson was one of our best known amateur lichenologists. Mr. A. H. G. Alston, assistant keeper in the Department, recently visited southern Albania in company with Mr. N. Y. Sandwith, of the Kew Herbarium. About 550 numbers were obtained. The Lunxheriës Mountains and Mount Tomori were explored, and further collections were made about Voskopoj. A visit to Gur-i-Topit was forbidden by the authorities because of a revolution. The main interest in the collection is that it was made at a late season of the year when little exploration has been done in the region. It also supplements the previous collections made in Albania by these botanists. The herbarium of Maurice Depierre has been purchased. It consists of about 23,000 specimens representing the flora of Mont Blanc and the other mountains in the Haute Savoie, collected in the first half of the last century. It contains specimens collected by the Curé's friends, MM. Puget and Chevalier, and some of the labels are made out or verified by the celebrated Prof. Reuter, who published a catalogue of the plants of Geneva.

Trees and Health

As the subject of his Chadwick Public Lecture on October 23, Mr. R. St. Barbe Baker discussed "The Contribution of Trees to National Health and Efficiency". He commenced by tracing the history of trees on the globe, showing that in early times trees of certain species were regarded as sacred, a superstition of man—if indeed it were a superstition—which survives to the present day, since many jungle races still worship the forests, or trees in the forests. Mr. Baker correctly states that man has been a destroyer of trees and the forest for a long period in his history. This destruction in the early days of man was justified to enable him to obtain space for pasturing his flocks and raising crops; with the increase in numbers, however, the destruction and wasteful utilisation of the forest proceeded apace, resulting in the disappearance of ancient civilisations owing to the former prosperous lands becoming a desert. As Mr. Baker shows, this wanton waste of the resources of the earth is continuing at an increased pace, owing to the greater demands being made upon the lands for agriculture and other purposes by an increasing population at the expense of the forest. Mr. Baker's remarks on the subject of the French and British in West Africa concerning the forests and the advance of the Sahara are somewhat misleading. The French are in fact carrying out forestry work of considerable importance and high technique in West Africa. In Nigeria a very considerable recognition exists of the problems connected with agricultural methods, forests, the increasing desiccation, and so forth.

Two other points in connexion with Mr. Baker's lecture are worthy of note. Under certain conditions, trees and the health of man are closely connected. In most of the temperate parts of the world under salubrious conditions of land and climate this is true. Mr. Baker must, however, be aware that in certain parts of the globe it is far from the truth. Medical opinion in West Africa, for example, now holds that sleeping sickness due to the tsetse fly is increased by the presence of trees on the ground. Large belts of trees around towns and along main roads are now felled, and the area kept clean with the object of reducing the disease. Generalities are always dangerous. Many have welcomed the 'Men of the Trees' and the effort the Society stands for. At times, however, Mr. Baker would seem to forget that a Forestry Commission has been established in Great Britain and has now been carrying out excellent afforestation work for some fifteen years; also that many landowners throughout the country possess parks containing beautiful trees. It is not that the love of the tree is not deeply implanted in the British peoples. The trouble arises from the fact that the general public does not know or understand how to raise young trees. One has only to look at the trees upon some of the arterial roads to realise that there is little use in planting trees in Great Britain unless proper provision is made for their supervision. It would be a fine thing if the members of the Society which Mr. Baker represents would, individually, plant twenty-five trees on Armistice Day in this Jubilee year. But who is going to look after these trees for say the next fifteen years? Without such attention, how many will be alive at the end of two to three years? If the 'Men of the Trees' can solve the question of how young trees, planted in public localities in Great Britain, are to be properly tended until they have reached a size and height beyond the ordinary dangers to which the young standards are exposed, we shall be on the road to replacing in our generation what our forefathers have given us in the wonderful old trees to be found in this island.

Births and Deaths in England and Wales, 1934

PART I, consisting of Tables (Medical), of the Registrar-General's Statistical Review of 1934 has just been published (London: H.M. Stationery Office. 6*s*. net). The number of live births in England and Wales registered in the year was 597,642, giving a birth-rate of 14·8 per 1,000 persons living. This rate was 0·4 above that for 1933, which was the lowest ever recorded. The death-rate was 11·8 per 1,000 persons living, 0·5 below the rate for 1933. When allowance is made for the fact that the average age of the living population is increasing every year, the resulting corrected or standardised death-rate was the lowest ever recorded both for men and for women, the rate for the sexes together being just half of the corresponding rate in 1881–90. Mortality from infectious and parasitic diseases in general reached a low record of 1·3 per 1,000, notwithstanding increases for scarlet fever and diphtheria, and the tuberculosis rate declined once again to a new low record of 763 per million. Pneumonia gave the lowest rate save in 1930, which was also a very healthy year. The

cancer rate, corrected for the increasing age of the population, rose slightly to 1,003 per million, but was still below the levels reached in 1928 and 1929. A new feature of the review is the tabulation of a 'comparability factor' for each separate town and rural district, which shows at a glance whether the distribution of persons by age and sex in the population of that area would lead to the expectation of a death rate above or below that of the country as a whole, and makes it possible to correct the death rate by a simple multiplication for valid comparison with that of any other area similarly corrected. After correcting in this way, the administrative County of London and the south eastern counties of Kent, Surrey, Sussex, Hampshire, Isle of Wight and Berkshire gave a combined mortality rate after correction only 84 per cent of that of the country as a whole, compared with 113 per cent for the north of England, namely, Durham, Northumberland, Cumberland, Westmorland, Yorkshire, Lancashire and Cheshire.

Archæological Investigation under the Soviets

ARCHÆOLOGICAL activities in Russian territory, in which the work of the Historical Museum of Moscow has been reinforced by the co-operation, financial and other, of museum authorities in the United States, have produced results of no little historical importance. Archæologists on the staffs of the various Russian museums are now engaged, according to a report from the Moscow correspondent of the *Observer* in the issue of October 27, in examining material brought in by expeditions to the Crimea, Kazakstan in Central Asia, the Georgian Republic in the Caucasus and the Ural Province. From the Crimea comes further evidence relating to Neanderthal man in the form of stone implements from a settlement site—not a cave—on the Katcha River, while in the neighbouring village of Pychka rock-paintings in red, depicting battle scenes, were discovered, which are attributed to a pre-Scythic culture of the third millennium B.C. The expedition of the Historical Museum to Kazakstan was occupied in excavating a site of the Bronze Age, on which a communal hut, measuring twenty-five metres in length, has been uncovered, as well as an altar about which were the charred bones of domestic animals, vessels containing the remains of food and bone cubes, which are said to resemble modern dice. In the Caucasus, cave deposits were examined, which yielded a number of flint implements of the palæolithic age.

Illuminating Engineering

IN his presidential address to the Illuminating Engineering Society, delivered on October 8, Mr. A. W. Beuttell took an optimistic view of the future of illuminating engineering. He based his claim on the inevitable demand for more artificial light which must approximate more and more to daylight. At the moment, the cost of this light is prohibitive, and the problem is to produce more light whilst using no more energy. The keeping low of energy costs will increase the cost of equipment. It is now realised that having incandescent metals near their melting point does not give the solution. On the other hand, vapour discharge lamps, although we are only at the threshold of these fields of discovery, whilst giving cheaper light, do not give white light. The question is now being thoroughly explored. The disturbance of electrons causing light is produced by heat, but at present much energy is lost in the non-visible spectrum. This problem is of great importance owing to the future great demand for light and the well-defined field with which we have to deal, and the fact that the production of light is based on the fundamental principles which physicists study. In considering the production and use of light, the psychological aspect has also to be considered. Mr. Beuttell expressed the view that in both the physiological and psychological processes concerning light, cause and effect hold good. Whilst we are learning rapidly, it is necessary that specialists should pool their knowledge.

The Internal Combustion Engine and its Fuel

ON OCTOBER 9, Mr. H. R. Ricardo received the Melchett Medal of the Institute of Fuel, and after the presentation delivered his Melchett Lecture on the "Progress of the Internal Combustion Engine and its Fuel". This progress he characterised as one of the most startling developments of the last fifty years, and now, he said, more than eighty per cent of the total power output of prime movers is based on petrol. He traced the development of the views held on the cause and character of the phenomenon of 'engine knock' and the formulation of the well-known method of evaluating 'knock-tendency' by means of the variable compression engine. The value of aromatic hydrocarbons was established by this machine and later the practice of rating fuel by an 'octane-number'. The production of fuels with high 'octane-numbers' has permitted the use of higher compression ratios with consequent greater engine efficiency, culminating in the 60 horse-power per litre attained by the Schneider engines. Further increase in the octane-number of petrols is not anticipated, nor the use of supercharging in pleasure cars. The Diesel engine is displacing the petrol engine in heavy commercial vehicles, and will continue to do so even at the same cost of fuel per gallon, owing to the 70 per cent advantage in the figure of miles per gallon.

The King's Fund Miniature Hospital

IN order to make known more widely the great work of the voluntary hospitals, Mr. Saxe Wyndham in 1929 suggested to the King Edward's Hospital Fund for London that a model of a modern hospital, complete in its smallest details, would be likely to arouse the interest of the public and so help the King's Fund. The Propaganda Committee of the Fund decided to undertake this work, and a design for the model was commenced by the late Mr. Percy Adams, and completed after his death by Mr. Lionel Pearson. At first, there was some difficulty in obtaining the necessary funds, but eventually Messrs.

Humphreys, Ltd., of Knightsbridge, generously undertook the responsibility, and a number of other firms collaborated in the construction and equipment. The model is to a scale of one sixteenth of full size, and includes adults' and children's wards, complete with bathrooms, lavatories and sink rooms, and with circular solarium at the end, operating theatres, X-ray apparatus, staircases and working electric lift, board room and kitchen, balconies and garden, together with figures of doctors, nurses and patients. The work was executed by a staff of skilled craftsmen, and so far as possible every detail essential to a building of this kind has been reproduced in the model—furniture, bedding, screens, radiators and others too numerous to mention. The model is on view until further notice at British Industries House, Hereford House, Oxford Street, London.

Agricultural and Horticultural Research

THE year 1934, coming after a period of monetary anxiety, brought financial stability to the National Fruit and Cider Institute and Research Station at Long Ashton, Bristol. This gratifying state of affairs has allowed the completion, or further prosecution, of several important pieces of investigational work. Some results of these are published in the annual report of the Station for 1934 (Long Ashton, pp. 312, July 1935). A foreword by Prof. B. T. P. Barker, the director, outlines the administrative changes of the organisation, and also of the Berkeley Square Advisory Centre, Bristol. The principal contributions of research results are three papers on the maturity of fruit by Dr. J. C. Hinton (NATURE, Oct. 26, p. 687), whilst numerous studies of pests and plant pathology have been prosecuted. The cider investigations include a consideration of the suitability of various containers for apple juice, the role of pectin in cider-making, experiments on clarification of the juice, and preservation with sulphur dioxide. A soil survey of the Teart Land areas of Somerset is also being made.

Television in Australia

BAIRD TELEVISION, LTD. announces that as the result of negotiations with the Australian Radio Manufacturers' Patents Association, Ltd., of Sydney, the Association has been appointed the exclusive representatives in Australia of the Baird Company, both for the construction and operation of television transmitting stations and the manufacture of television receivers under the Baird patents. The Australian Radio Manufacturers' Patents Association, Ltd. is composed of a majority of the leading radio manufacturers throughout the Commonwealth of Australia, and they propose to develop television as an adjunct to sound broadcasting. Experimental transmitters will, it is expected, be erected in Sydney and Melbourne in the near future, with the view of providing ultimately a commercial high-definition television service.

Louis Lumière Celebrations

A MEETING to celebrate the fortieth anniversary of the invention of the *cinematographe* by Louis and Auguste Lumière will be held in the Hall of the Sorbonne, Paris, on November 6 at 9 p.m. The meeting will be held under the presidency of M. Mario Roustan, Minister of Education; and M. Albert Lebrun, President of the Republic, will be present. Among the discourses will be one given by Prof. C. Fabry, professor of physics in the Sorbonne and president of the French Society of Photography and Cinematography. During the celebrations, certain films made in 1894, and colour photographs of 1907–1935, will be exhibited. Further information can be obtained from the Secrétaire Général, 11 Avenue Casimir, Asnières (Seine).

Awards of the Institution of Civil Engineers

THE following awards of the Institution of Civil Engineers have recently been made for papers read and discussed at ordinary meetings: a Telford Gold Medal to B. M. Hellstrom (London); a Telford Premium jointly to F. W. D. Davis (London) and William Mackenzie (Hull); a Telford Premium to G. L. Groves (London); a Telford Premium jointly to C. Seager Berry (Baldock) and A. C. Dean (Manchester); a Telford Premium to E. J. Buckton (London); a Telford Premium to W. J. H. Rennie (Singapore); a Telford Premium and the Coopers Hill War Memorial Prize to A. W. H. Dean (New Delhi); a Telford Premium and the Indian Premium to M. G. Platts (Madras); a Telford Premium jointly to J. A. K. Hamilton (Cleveland, York) and J. Tudor Graves (Middlesbrough); a Telford Premium to Alexander Gray (St. John, Canada); a Trevithick Premium to George McIldowie (Newcastle, Co. Down); a Trevithick Premium jointly to W. T. W. Miller (Sheffield) and R. J. Sargant (Sheffield); a Manby Premium to M. A. Ravenor (London); a Crampton Prize jointly to V. F. Bartlett (London) and W. H. Cadwell (Mellor, Derbyshire). For papers published without discussion as 'Selected Engineering Papers': a Telford Premium to T. H. Hopkins (Bromley, Kent); a Telford Premium jointly to Prof. E. G. Coker (London) and G. P. Coleman (London); a Telford Premium to Ralph Poole (Bradbury, Cheshire); a Telford Premium to W. H. Weston (Glasgow); a Telford Premium to C. G. Watson (London). For papers read at students' meetings: the James Forrest Medal and a Miller Prize to James Halliday (Dunbar); Miller Prizes to R. S. Cogdon (Sunderland), Geoffrey Wood (London), R. G. Rowbotham (Buenos Aires), G. R. Coles (St. Albans, Herts) and J. L. Matheson (Stafford). The Charles Hawksley Prize has been awarded to Frank W. Curry (London).

Announcements

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 28 the following council was elected: *President:* Prof. D'Arcy Wentworth Thompson; *Vice-Presidents:* Prof. C. G. Darwin, Prof. R. A. Sampson, Principal O. Charnock Bradley, Prof. P. T. Herring, the Marquis of Linlithgow and Prof. E. B. Bailey; *General Secretary:* Prof. J. H. Ashworth; *Secretaries to Ordinary*

Meetings : Prof. F. A. E. Crew and Prof. J. P. Kendall ; *Treasurer :* Dr. James Watt ; *Curator of Library and Museum :* Dr. L. Dobbin ; *Councillors :* Lieut.-Col. A. G. M'Kendrick, Prof. James MacKinnon, Prof. W. Peddie, Dr. A. C. Aitken, Principal J. C. Smail, Sir Harold J. Stiles, Prof. J. Walton, Prof. Edwin Bramwell, Prof. T. H. Bryce, Prof. I. de Burgh Daly, J. A. Inglis and Prof. A. D. Peacock.

THE council of the Royal Society of Edinburgh has made the first award of the David Anderson-Berry Prize to Dr. C. M. Scott, lecturer in materia medica in the University of Edinburgh, for his essay "On the Action of X- and Gamma-Rays on Living Cells". This prize, which consists of a gold medal and a sum of money, was founded by the late Dr. David Anderson-Berry in 1930, and is awarded triennially to the person who, in the opinion of the council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases.

THE first evening meeting of the 1935–36 series to be held in the house of the Pharmaceutical Society of Great Britain, on November 12, will be the occasion of the presentation of the Harrison Memorial Medal to Prof. Arthur Smithells, director of the Salters' Institute of Industrial Chemistry, who will deliver the Harrison Memorial Lecture. The title of the lecture is "The Teaching of Chemistry". Prof. Smithells was chief chemical adviser (Anti-Gas Training) G.H.Q. Home Forces 1916–19 and was closely associated with the late Colonel E. F. Harrison, director of Chemical Warfare, in anti-gas work.

DR. BERNARD SMITH will deliver the Cantor Lectures of the Royal Society of Arts on November 18 and 25, and December 2, at 8 p.m. The subject of Dr. Smith's lectures will be "Geological Aspects of Underground Water Supplies".

DR. HERBERT DINGLE, assistant professor of astrophysics in the Imperial College of Science, South Kensington, is giving a course of ten Lowell Institute Lectures at Boston, Mass., beginning January 3. Dr. Dingle's subject will be "Through Science to Philosophy".

DR. W. H. MILLS, the Right Hon. Lord Riverdale, Prof. A. Robertson, and Mr. H. B. Shackleton have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. E. J. Butler, Sir Kenneth Lee, and Prof. N. V. Sidgwick have retired from the Council on the completion of their terms of office.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at 6 p.m. on November 7, Lieut.-Col. K. Edgcumbe will, on behalf of Colonel R. E. Crompton, Faraday medallist, honorary member and past-president, present to the Institution an oil painting of Colonel Crompton by Mr. George Harcourt. The painting was subscribed for and presented to Colonel Crompton by a group of 'Old Cromptonians' and other admirers on the occasion of his ninetieth birthday ; but, at his express desire, it is now to become the property of the Institution.

THE Rockefeller Foundation has recently awarded 14,000 dollars to the University of Michigan for the application of spectroscopic methods in medicine.

FOR many years the late Mr. Archibald Thorburn (see p. 710 of this issue) has presented the Royal Society for the Protection of Birds with a painting for the illustration of its annual greetings-card. The subject for Christmas 1935 is the goldcrest, the smallest of all British birds, alighted on a twig of oak. Copies may be obtained from the Royal Society for the Protection of Birds, 82 Victoria Street, London, S.W.1, price 4*s.* 8*d.* a dozen, inclusive of envelopes and postage. All proceeds from the sale of the cards are devoted to the funds of the Society.

MESSRS. CHAPMAN AND HALL, LTD. announce that they have been appointed sole British Empire agents for the publications of the Reinhold Publishing Corporation, which is the successor to the Chemical Catalog Company, Inc. In addition to numerous well-known scientific and technical books, the Reinhold Publishing Corporation controls the issue of volumes appearing under the auspices of the American Chemical Society. This scheme of publication was undertaken by arrangement with the Interallied Conference of Pure and Applied Chemistry, which met in London and Brussels in July 1919, when the American Chemical Society and the National Research Council mutually agreed to care for certain fields of chemical development. A complete catalogue (150 titles) is now available and can be obtained from Messrs. Chapman and Hall, Ltd., 11 Henrietta Street, London, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :

Assistants in the Departments of Mechanical Engineering, Electrical Engineering and Physics, and Mathematics of the Coventry Technical College—The Director of Education, Council House, Coventry (Nov. 8).

A principal of Aston Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham, 3 (Nov. 11).

A professional assistant at the Royal Observatory, Hong-Kong—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (Nov. 23).

An inspector of mines and petroleum technologist for service in Trinidad and Tobago—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (Nov. 30).

A librarian at the Institution of Automobile Engineering—The Director, 5 Bolton Road, Chiswick, W.4.

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. 723.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Helium Content of the Stratosphere

IT is often assumed that the absence of any systematic temperature gradient in the stratosphere is incompatible with large-scale mixing; winds, which in the troposphere ensure a constant composition of the permanent atmospheric constituents, are supposed to fall off rapidly as the boundary between the troposphere and stratosphere is passed, and above the level at which mixing ceases the composition of the atmosphere should therefore vary with the height. Over England, the boundary between troposphere and stratosphere lies between 10 km. and 11 km.; so far, however, we do not know where the large-scale mixing in the stratosphere becomes negligible. Chapman and Milne[1], therefore, in their well-known tables, provide for four cases in which effective mixing ceases and diffusion commences, at heights of 12 km., 20 km., 30 km., and 50 km. respectively. Maris[2] has suggested that effective mixing takes place up to about 100 km.

The most direct method of finding the level where diffusive separation actually begins is the chemical analysis of air samples; up to this height the composition must necessarily be the same as at the surface of the earth; above this level the lighter constituents of the air should be present in higher percentage. The lightest gas, hydrogen, would be the ideal indicator, but its proportion in air is so low that there is at present no method of sufficient sensitivity available. The gas which, owing to its lightness, is next best suited is helium, which has the additional advantage that no complication due to chemical reactions are to be feared. From the calculations of Chapman and Milne, it follows that the amount of helium should increase by 1 per cent in the first 75 metres of the undisturbed layer of the stratosphere.

Oxygen as an indicator is eight times less sensitive. Of the air samples brought back from an altitude of nearly 19 km. over Russia by the stratosphere flight of Prokofiev, Godunov and Birnbaum on September 30, 1933, only the oxygen content has been analysed separately; it showed no deviation[3]. The same result was found by Lepape and Colange[4], so far as the main constituents of the atmosphere are concerned; in nine samples of air, taken between 9·0 km. and 16·8 km., the content of oxygen, of nitrogen and of argon + neon + helium, was identical with that at the level of the earth. The proportion of helium + neon to the total of rare gases, however, was found on the average to be 27 per cent higher than at the surface, a result which the authors apparently regard as real, and not due to the inaccuracy of their method; this would mean a still greater change in the percentage of helium alone, without neon.

We decided to investigate the problem of the mixing of the stratosphere by measuring directly its helium content. With the co-operation of Sir George Simpson, director of the Meteorological Office, several sounding balloons have been sent up by the Upper Air Section of Kew Observatory and samples of the air obtained. Much greater heights can be reached in this way than in manned stratosphere flights. To reach high altitudes by such balloons, it is essential to keep the weight as low as possible, a fact which made it imperative to develop a method for finding the helium content in small samples of air with high accuracy. We can now separate the helium of a few cubic centimetres of air from all other constituents; the amount of helium so obtained is measured by a procedure described in previous publications on the micro-analysis of helium[5]. Details of the method, which enables us to determine the helium content of 2 c.c. of air with an accuracy of 1 per cent, will be published elsewhere.

For the automatic sampling, a device was used which comes into operation after the sounding balloon, at the top of its flight, has burst; an extension of an evacuated glass bulb is then broken, and while the vessel, attached to a parachute, begins to fall, air is sucked in; after an interval of 10–15 sec. the extension is sealed again. If the mechanism functions satisfactorily, the pressure of the air inside the vessel should correspond within certain limits to the highest value of the barographic record. In the following table the figures in each row are derived from one sample of air; at least three portions of each sample have been separately analysed with accordant results.

Helium content of the atmosphere at different heights over England.

Height in km. (Dines baro-thermograph)	Height in km., as measured by pressure inside vessel	Helium in 10^{-6} c.c. per c.c.	Helium surplus, compared with London air (per cent)
—	0	5·27 ± 0·05	
16·8	14·0	5·35 ± 0·07	1·7 ± 1·4
18·5	18·4	5·31 ± 0·05	0·7 ± 1·0
21·0	20·4	5·69 ± 0·06	8·0 ± 1·0

From our analyses, it seems to follow that, up to 18 km., we are not yet above the ideal boundary considered by Chapman and Milne, where mixing ceases and diffusion becomes effective; this is in good agreement with the results of the Russian explorers. At a height of 21 km., however, the helium content is already distinctly increased. So far, nothing definite is known about its constancy in different parts of the earth's surface, and the first analyses of a survey begun by us indicate that local variations actually occur. The value found for London, however, agrees within 0·3 per cent with the average of analyses from eight different places in Germany, Sweden, the United States, Central America, and over the Atlantic, and the 8 per cent helium surplus in the air from 21 km. height appears to be outside the range of these variations; but more samples are needed before it will be clear whether the helium found is characteristic for this height.

We hope to apply our method of analysis to samples from still higher levels of the stratosphere. We are continuing our own experiments with sounding balloons, but as for this purpose England is neither geographically nor climatically very favourable, we should welcome the co-operation of others interested in stratosphere research. Air samples of volume about 6 c.c. (N.T.P.) would permit us to carry out three independent analyses of the helium content.

In conclusion, we would express our gratitude to Sir George Simpson, director of the Meteorological Office, London, for the assistance he has given us in arranging for the collection of samples of air from the stratosphere.

F. A. PANETH.
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Imperial College of Science and Technology, London, S.W.7.
Oct. 15.

[1] S. Chapman and E. A. Milne, *J. Roy. Meteor. Soc.*, **46**, 357; 1920.
[2] H. B. Maris, *Terr. Mag.*, **33**, 233; 1928.
[3] NATURE, **133**, 918; 1934.
[4] A. Lepape and G. Colange, *C. R.*, **200**, 1340, 1871; 1935.
[5] F. A. Paneth and K. Peters, *Z. phys. Chem.*, **134**, 353; 1928.
F. A. Paneth and Wm. D. Urry, *Z. phys. Chem.*, A, **152**, 100; 1931.

Vertical Intensity of Cosmic Rays by Threefold Coincidences in the Stratosphere

A YEAR ago we communicated the results of an ascent with a Geiger-Müller tube counter by registering balloons into the stratosphere to a height of 28 km.[1]. We found that the curve of the number of impulses obtained with the counter is identically the same as the intensity curve obtained with an ionisation chamber.

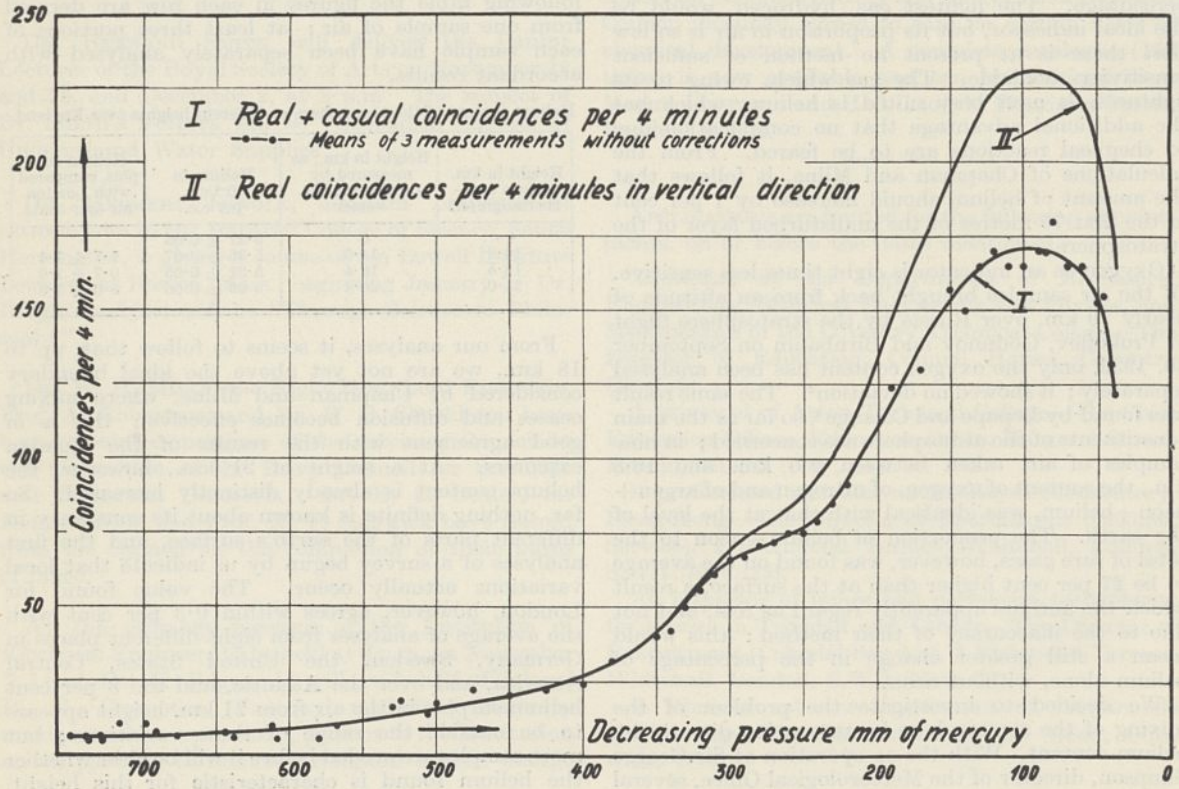
Recently, we succeeded in sending up a *threefold*-coincidence apparatus by balloons to a height of 22 km. (37·5 mm. mercury). The three counters had been arranged one above the other in such a manner that the area, 45 mm. × 50 mm., of the outer counters subtended a solid angle of only 20° about the zenith. Therefore, only the nearly vertical rays producing coincidences are recorded.

The data for pressure, temperature and counting rate were recorded every four minutes in the same way as previously described on a photographic plate[1]. The coincidence arrangement gave a high resolving power even at a high counting rate of a single counter. The apparatus was protected against the low air temperature by a case of 'cellophane'[2]. The temperature in the case varied only between + 25° C. and + 17° C. Therefore there was no influence of temperature on the recorded data.

Curve I (Fig. 1) shows the means of the results from two ascents and one descent. This curve requires correction according to the known probability of coincidence counting and of casual coincidences. Curve II shows the values thus reduced. There is to be seen a maximum at a pressure of 100 mm. of mercury and a well-marked hump at a pressure of 300 mm. The humps are obviously to be attributed to the components of the cosmic rays of primary or of secondary origin. It is remarkable that the same humps appear in the curve earlier found with one counter, if we transform the earlier curve indicating impulses from all directions to that showing impulses in the vertical direction by the method of B. Gross[3].

The curve tends to zero with decreasing pressure. But because of the latitude effect, it is not probable that the continuation of the curve will really pass through the zero. On the contrary, it is to be expected

FIG. 1.



that further ascents to greater heights will give a definite intensity of coincidence-producing rays near the top of the atmosphere.

A more detailed report will be published in the special number of the *Zeitschrift für technische Physik* for the Physikertagung, 1935.

We wish to thank the Deutsche Forschungsgemeinschaft for providing the means enabling us to make these investigations.

ERICH REGENER.
GEORG PFOTZER.

Physikalisches Institut,
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[1] E. Regener and G. Pfotzer, NATURE, **134**, 325; 1934. *Phys. Z.*, **35**, 779; 1934.
[2] E. Regener, NATURE, **133**, 364; 1933. *Phys. Z.*, **34**, 306; 1933.
[3] B. Gross, *Z. Phys.*, **83**, 214; 1933.

Radioactivity of Samarium

SEVERAL workers have investigated the radioactivity of samarium, and it is established that this element emits short-range α-particles. Mäder[1] has also reported the existence of a group of particles of range 1·37 cm., which he believes to be protons. To obtain fuller information about these particles, I have introduced samarium sulphate into the emulsion of an Ilford '*R*' plate, and examined the tracks which are produced. The technique of this method has been previously described[2].

After seven weeks exposure, numerous tracks are observed on the plate, most of which clearly belong to the short-range α-particle group. The accuracy with which the range in air can be determined from measurements of the length of the tracks is now known, and an account of the method used in making this determination will shortly be published. The range so determined is

$$R = 1{\cdot}13 \pm 0{\cdot}02 \text{ cm. standard air.}$$

This value is in good agreement with those previously published.

In addition to these short tracks, we have observed tracks which correspond to particles of much longer range, up to at least 3·5 cm. air. These are much less numerous than the short tracks, the relative frequency being of the order 1 : 100. So far, some 150 such tracks have been measured. The distribution curve of the measurements does not show any well-defined maximum, such as is always found with a group of α-particle tracks, and the 'scatter' of the measurements is much greater than is found, for example, with the tracks of uranium α-particles, for which numerous measurements have been made. This alone is strong evidence that we are not dealing with a group of α-particles. Furthermore, the mean separation of the grains is found to be 2·0μ for the whole group, and many of the individual tracks show greater values. The mean separation for the short-range α-particle tracks, obtained on the same plate, is 1·6μ. It has been pointed out previously[2] that this forms a criterion for distinguishing between α-particle tracks and proton tracks. It appears, therefore, that the long tracks cannot be attributed to α-particles, and we must conclude that samarium emits singly-charged particles.

It is not yet possible to make any accurate statement as to the range of these particles. The distribution curve suggests that more than one group may be present, but the greatest range must be in the neighbourhood of 3·5 cm. air. It is hoped that further observations will make it possible to decide these points.

I am indebted to Prof. Hevesy for supplying a specially pure sample of samarium, and to Mr. Dabholkar of this Department for help in the measurements.

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Wilson College,
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Sept. 13.

[1] Mäder, *Z. Phys.*, **88**, 601; 1934.
[2] Taylor, *Proc. Roy. Soc.*, A, **150**, 382; June 1935.

Emission of Positrons from Radioactive Sources

WITH the improved apparatus, already used by us in the investigation of positrons from thorium-active deposit, we have repeated our measurements of the positron spectrum, emitted by a thin-walled radon tube; a new determination of the ratio of the positron number to that of the β-particles of RaC was also made. The positron spectrum is shown in Fig. 1: for each point about 1,000 particles were counted. The ratio N_+/N_β was found to be $2\text{–}3 \times 10^{-4}$ (N_+ = number of positrons, N_β = number of β-particles of RaC). Surrounding the source with a 1 mm. lead sheet, we could compare the number of positrons emitted by the source with that produced by the γ-rays of RaC in lead: it was found that $N_+/N_+(\text{Pb}) = 0{\cdot}9\text{–}1$.

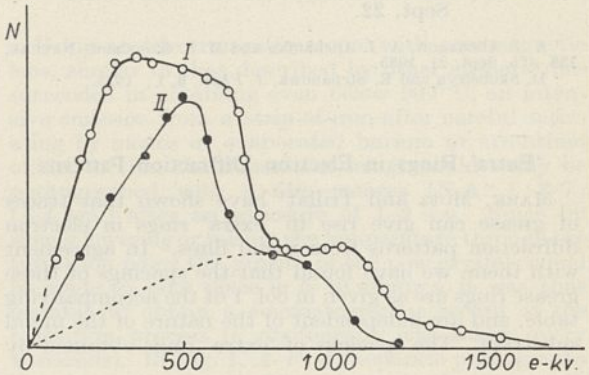

FIG. 1.

In the positron spectrum from the source, two discontinuities are observed at 760 and 1,200 e.kv., which correspond to the internal conversion of two strong γ-rays of RaC with energies 1,760 and 2,220 e.kv. The general shape of the spectrum does not correspond, however, either to the theoretical spectrum of internal conversion of γ-rays from RaC, or to the positron spectrum, produced in the thin (25μ) lead foil by γ-rays (curve II). By a method similar to that used in ouranalys is of the positron spectrum from thorium[1], it is possible to separate the portion of the spectrum due to the internal conversion of γ-rays from the total spectrum. The remaining main portion of the spectrum has the features of a continuous spectrum extending in energy up to 1,700 e.kv. The number of positrons belonging to this portion of the spectrum is of the same order of magnitude as that in the spectrum of

thorium-active deposit, that is, about 1 per 10^4 β-particles of RaC, and exceeds the number of positrons due to the internal conversion of the γ-lines 1,760 and 2,220 e.kv. by a factor of about 1·5.

Placing aluminium plates 0·5 mm., 1 mm. and 3 mm. thick in front of the source, we tried to reveal positrons produced by β-particles from RaC in traversing the aluminium. According to D. Skobelzyn and E. Stepanowa[2], these positrons greatly exceed (50–70 times) in number those originated by the action of γ-rays in the same substance. Our measurements showed a small difference in the positron number when passing over from the thin (0·5 mm.) to the thick (3 mm.) plate; this effect arising from the partial transmission of the positrons from the source through the thinner plate.

Having placed in our apparatus a strong radon source so that positrons of the source could not reach the counters, we irradiated by γ- and β-rays and also by γ-rays only a 25μ-thick lead foil. In this experiment the positrons going from the lead strip to the slit of the apparatus made an angle of 90° with the direction of β-particles and γ-rays. The number and the spectrum (II, Fig. 1) of positrons observed indicate clearly that most of the positrons are produced by γ-rays of RaC. Thus we are led to the conclusion that the cross-section for the production of pairs by γ-rays of RaC is at least several times greater than the cross-section for β-particles of RaC; as in the case of lead, so in that of aluminium.

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Sept. 22.

[1] A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew, NATURE, **136**, 475, Sept. 21, 1935.
[2] D. Skobelzyn and E. Stepanowa, *J. Phys.*, **6**, 1; 1935.

'Extra' Rings in Electron Diffraction Patterns

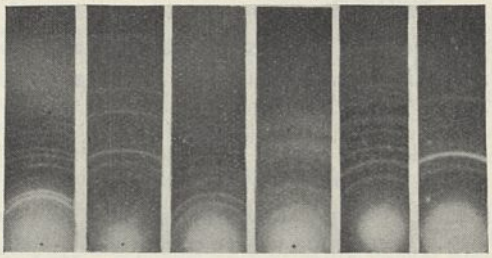
Mark, Motz and Trillat[1] have shown that traces of grease can give rise to 'extra' rings in electron diffraction patterns from metal films. In agreement with them, we have found that the spacings of these grease rings are as given in col. 1 of the accompanying table, and are independent of the nature of the metal substrate. The spacings of 'extra' rings obtained by

'Extra' Ring Spacings in Angström Units

1	2	3	4	5	6
4·02	4·81	3·85	4·49	3·75	4·93
3·62	4·00	3·46	2·57	2·93	4·09
2·90	2·79	2·81	1·69	2·44	3·37
2·43	1·83	2·45	1·50	1·81	3·24
2·30	1·61	2·31		1·57	2·85
2·17	1·49	2·15			2·57
2·01		2·05			1·70
1·92		1·83			
1·81		1·62			
1·71		1·49			
1·58		1·40			
1·47		1·29			

heating a metal in a gas are, however, quite different in that they depend not only upon the metal but also upon the gas and the nature of the heat treatment[2]. Thus, for example, we have obtained different 'extra' ring systems by drawing gold leaf through a Bunsen flame (col. 2) and by heating in oxygen at 540° C. during 30 minutes (col. 3). The reproductions 1–6 are from the corresponding electron diffraction patterns.

We have also found that amalgamation gives rise to 'extra' ring systems which, like those due to absorbed gases, have spacings dependent upon the metal. The spacings found for some gold, silver and copper amalgams, and given in cols. 4, 5 and 6 respectively, are quite different from those due to either grease or absorbed gases. The gold and silver amalgams were prepared by suspending the metal leaf in the vapour above a warmed drop of mercury until signs of amalgamation were visible at the lower edge of the leaf. Copper amalgam was obtained by immersion in a mercuric chloride solution.



1 2 3 4 5 6

In studying the absorption of gases by metals, it is therefore important to exclude the formation of 'extra' rings due to grease or amalgamation; whilst the former should, for the reasons given above, always be easy to recognise, the amalgam 'extra' rings appear to have much in common with absorbed gas 'extra' rings, at least in so far as the spacings of both vary from metal to metal.

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Oct. 16.

[1] *Naturwiss.*, **20**, 319; 1935.
[2] *Trans. Far. Soc.*, **31**, 1051; 1935.

Structure of Solid Oxygen

As is well known, solid oxygen appears in three modifications: α (below 23·5° K.); β (23·5°–43·5° K.); and γ (43·5° K. and melting point). In connexion with our investigations on the structure of solidified nitrogen and other gases, extensive work has been done with the object of determining the structure of the various forms of solid oxygen.

Already in 1927, McLennan and Wilhelm[1] published a powder diagram of α-oxygen which they tried to interpret by means of a rhombic cell. We found, however, that their interpretation could not account for the intensity distribution of the spectrum. Later on, powder diagrams of α- and β-oxygen were given by Ruhemann[2]. The two forms gave similar diagrams, which he tried to interpret by means of the rhombic cell proposed by McLennan; the result was not satisfactory.

In 1929 and following years, we obtained powder diagrams of β-oxygen, showing a large number of lines, but we found that the rhombic cell of McLennan could not account for the lines appearing in our diagrams. They were, however, satisfactorily interpreted by means of a trigonal (rhombohedral) cell, containing six molecules ($a = 6{\cdot}19$ A., $\alpha = 99{\cdot}1°$) corresponding to a density $\rho = 1{\cdot}395$.

In spite of considerable efforts, we have not yet been able to determine the arrangement of the molecules within the cell; but I think we can say safely that only the space groups C_{3i}^2, C_{3v}^5 or D_3^7 can come into consideration.

We have also been able to obtain quite good powder diagrams of γ-oxygen. The spectrum shows those features which are typical for a lattice with rotating molecules. The diagrams were interpreted by a *cubic* cell ($a = 6{\cdot}83$ A.) containing 8 molecules, corresponding to a density of $\rho = 1{\cdot}30$. In this case we have also been able to find the arrangement of molecules within the cell which satisfies the intensity distribution.

The lattice belongs to the space group T_h^6. The position of the individual atoms are not fixed by this space group, but only the molecular centres. The molecules rotate in the lattice, and they are grouped into pairs along the trigonal axis. The distance between the two molecules of a pair (3·48 A.) is somewhat smaller than the minimum distance (3·68 A.) between neighbouring pairs. This indicates that the molecules of the pair are tied up with stronger forces than molecules of different pairs.

The study of the absorption bands of liquid oxygen by Ellis and Kneser[3] also indicates the existence of groups (O_2–O_2). This tendency to form groups explains the fact that γ-oxygen, although it possesses rotating molecules, does not appear in a closest spherical packing of molecules, as in the case of β-nitrogen. The centres of the pairs (O_2–O_2), however, form a face centred lattice, and we may, therefore, say *that γ-oxygen forms a closest cubical packing of pairs of oxygen molecules.*

γ-Oxygen may also be regarded as belonging to the space group T^4. In this case we arrange the molecules in two fourfold equivalent positions with parameters x_1 and x_2. Putting $x_1 = -x_2$, the symmetry of the lattice is raised to that of the space group T_h^6.

As shown in previous papers also, the lattices of α-N_2 and α-CO approximately fulfil these conditions, and they are therefore closely related to that of γ-oxygen.

The lattice of γ-oxygen is obtained when in α-nitrogen or in α-CO each atom is replaced by a rotating oxygen molecule (O_2), and the parameters are subject to the relation $x_1 = -x_2$.

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Sept. 30.

[1] *Phil. Mag.*, (7), **3**, 383; 1927.
[2] *Z. Phys.*, **76**, 368; 1932.
[3] *Z. Phys.*, **86**, 583; 1933.

Cinematographic Record of the α⇄γ Iron Transition, as seen by the Electron-Microscope

RECENTLY E. Brüche and W. Knecht[1] described the electronoptical observation of the transition of α- into γ-iron. In their beautiful experiments, however, the emission of the test-piece (after activation by means of an evaporated barium layer) at the transition temperature of about 900° C. was so small that the actual occurrence of the process could not be observed on the fluorescent screen without sufficient adaptation of the eye. In order to obtain a fluorescent image clear enough to be photographed, the temperature of the test-piece had to be raised to about 1000° C. A photographic record of the transition could therefore only be obtained by observing whether, after lowering the temperature to the neighbourhood of the transition point and raising it again at 1000°, the texture of the test-piece had changed or not.

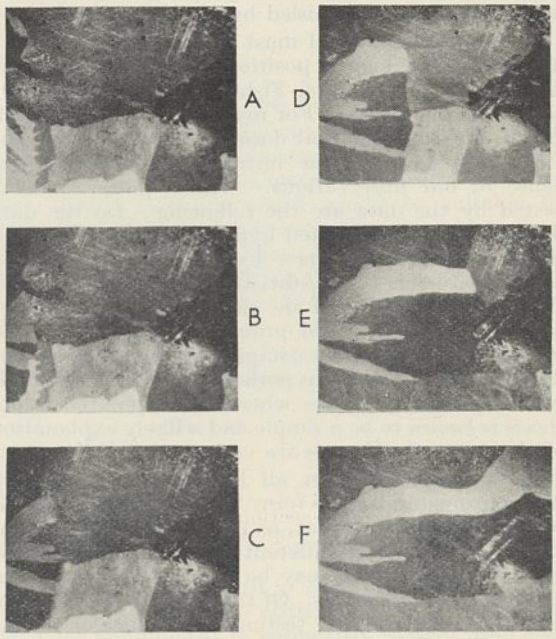

FIG. 1. Growth of α-iron crystals in the original γ-phase.

Using an 'electron-microscope' with one magnetic lens, similar to that described by other authors[2], we succeeded in obtaining even below 900° C. an intensive emission from a strip of iron after careful activating by means of evaporated barium or strontium oxide, so that the fluorescent image could easily be photographed with a film camera (N.A. 1 : 2·7; f=4 cm.) after an exposure of 1–2 sec. Since by slowly lowering or raising the temperature through the transition point the growth of the new crystals could be made to take place in 5–10 minutes, it was thus possible to obtain a cinematographic record of the transition process (a photograph was taken every 4 seconds). In Fig. 1, *A–F*, six separate photographs have been reproduced. They show clearly the growth of α-crystals (starting at the left) in the original γ-phase. It is of interest to remark that the progressive growth of the newly-formed crystals observed here is essentially different from the sudden formation of martensite needles in austenite, of which a cinematographic record by means of ordinary microphotography has been made by Wiester[3].

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Sept. 16.

[1] E. Brüche und W. Knecht, *Z. tech. Phys.*, **16**, 95; 1935. **15**, 461; 1934.
[2] M. Knoll, F. G. Houtermans und W. Schulze, *Z. Phys.*, **78**, 340; 1932. J. Pohl, *Z. tech. Phys.*, **15**, 579; 1934. See also E. Brüche, *Kolloidzeitschrift*, **69**, 389; 1934.
[3] H. J. Wiester, *Z. Metallk.*, **24**, 276; 1932. A similar cinematographic record of the α–γ-transition in iron and steel has also been obtained by H. Esser and H. Cornelius (*Stahl und Eisen*, **53**, 532; 1933).

Statistical Tests

I HOPE some space will be afforded me for comment on Prof. Karl Pearson's letters[1], since I fear that Prof. Pearson's expressed opinions are not calculated to engender trust in modern statistical methods. These have proved, however, to be of almost universal practical service in minimising the number of times an observer may be misled by his observations.

To commence with, I must answer Prof. Pearson's attack on the logical position of Prof. Fisher and myself. No doubt Prof. Fisher will have something to say on the matter. For myself, I would point out that I never assume that data are capable of proving either the truth or the untruth of a hypothetical cause of our observations. The hypotheses being tested by the data are the following: Do the data indicate that a stipulated hypothesis is not likely to be true; and the reverse hypothesis—do the data *not* indicate this? All statistical tests appear to me to be of this kind. If the data do not indicate—I am not using the word prove—that the stipulated hypothesis is false, the simplest explanation of the data is often that the hypothesis is true. This holds good especially in cases where the stipulated hypothesis is *known* to be a simple and a likely explanation of the data. Such cases are very numerous.

To attempt to cover all hypothetical frequency distributions under the term 'graduation formulæ' is to overlook the fact that, as used, such distributions are of two radically different kinds. The first kind contains those which may be *expected* to have given rise to our observations. Of this kind is the binomial distribution as used for testing bias in dice or throwing of dice. The 'limit' approximations, the normal distribution, Prof. Pearson's Type III, the Galton-Macalister, and the Poisson series, for example, may often be justified as 'expected' explanations; also the straight line, the parabola and the hyperbola and the aggregate of two or more samples. The manner in which they arise in theory may be assumed reasonably to resemble the manner in which they arise in practice in many cases. They are reasonable explanations of our data unless these themselves indicate that they are not. They are not mere graduation formulæ. Of the second kind are the distributions mentioned, together with a host of empirical distributions without simple theoretical basis, when they cannot *explain* the origin or cause of the data. These are truly mere graduation formulæ. They may be very useful as such but do not increase our knowledge of the work of Nature. Of such a kind is Makeham's formula. To use such formulæ to cover a combination of simple *explanations* of observations is to obscure the workings of Nature, not to elucidate them. Yet as mere graduation formulæ they may be ideal.

Prof. Fisher's school of statisticians aims at disentangling combined simple explanations of observations from each other and thus showing up likely *causes* of the data. It is true that in their work it is assumed generally that the observations or simple functions of them are samples from a normal population since the processes of analysis used are then more readily applied. It has been shown, however, that these processes of analysis are often fully justified where the fundamental assumption is not strictly justified, and that the methods are most valuable in minimising the number of times an observer may be misled by data. Mere graduation formulæ cannot ever perform this practical service.

My plea for the use of different levels of significance as criteria of judgment whether data do or do not indicate the unlikelihood of a given hypothesis has an analogy in engineering practice. I mean the use of the 'breaking strain' and the 'working load' of a given kind of rope. At strains near the breaking strain the rope is likely to break: at strains near the working load it is unlikely to break. At intermediate strains the likelihood of breaking cannot be expressed. With full knowledge the 'likelihood' could be expressed as a probability, but such full knowledge is not assumed. Reasonable safety is what is required. My aim is to make a safety-gap between "not shown to be an unreasonable explanation" and "may be considered a likely explanation". The notion does not apply to graduation formulæ, but only to expected causes. If no particular cause is expected it would appear safer to consider always that the sample exactly represents the form of the population. No other population is shown to be even *possible* by the sample itself. This does not preclude the use of a graduation formula to express concisely the general form of the sample and to provide parameter-distributions of very similar form to those applying to the sample-population.

H. J. BUCHANAN-WOLLASTON.

Fisheries Laboratory,
Lowestoft.
Oct. 8.

[1] NATURE, **136**, 296, 550, Aug. 24 and Oct. 5, 1935.

The Accessibility of Discoveries

WE are indebted to NATURE (**136**, p. 606) for an admirably sharp picture from Dr. Royds setting out his discovery (by its emission spectrum, which is in excess of its absorption as an atmosphere) of a layer of oxygen about a thousand miles deep at the base of the solar chromosphere. As he hints, his graph of intensities gives data for the law of distribution of oxygen-density with height: and he refers to a forthcoming *Kodaikanal Bulletin* for a discussion of this fundamental problem. But where is one to find it? When I was a member of the Indian Observatories Committee, the *Bulletin* came to me regularly, and was often of intense observational interest, which I sometimes exploited: but about twenty years ago my place on the Committee was vacated, and I have never seen a *Bulletin* since, nor do I know how to find one. Yet I am still favoured with personal copies of American and French astronomical reports. I am, moreover, by way of contrast, often overloaded with astronomical theory coming from the Royal Society and the Royal Astronomical Society, in the main too complicated analytically for my slow rate of appreciation, as an amateur no longer young. The brief accounts in *Science Abstracts* come therefore as a relief.

This note is presented mainly by way of illustration of current methods, especially in Government publications, against which I used to protest in vain when I had a seat in the House of Commons, of fixing prices on a scale that will recover the expense if all the copies of the edition are sold, regardless of the consideration that this price may prohibit the sale of any copies at all. And then what is the use?

JOSEPH LARMOR.

Holywood,
Co. Down.
Oct. 11.

Surface Structure Beneath the Pacific

IN *Science Abstracts*, *A*, July 25, 1935, No. 2944, which reached here yesterday, one reads that calculations by R. Stoneley from data for an earthquake in Mexico at Apia point to an upper layer of granitic material beneath the Pacific about 10 km. thick resting on ultrabasic rock.

A month ago I came here to relieve Mr. J. Wadsworth (director), on furlough, and have since interpreted records of a few minor shocks with origins less than 10° from Apia. I found, unexpectedly, that velocities given in Jeffreys' "The Earth" (second edition, par. 6–9, p. 116) very closely fit particularly the transverse waves, for upper, intermediate and lower layers, as for thicknesses cited therein. *P* phases are much fainter, but phases corresponding to longitudinal wave velocities appropriate to these three layers do seem to exist too, on some records studied so far.

Such layers exist in New Zealand, but publications read there created the impression that these layers may be absent near Samoa. My deductions, both in method used and as an attempt, have been quite independent of those by Stoneley. However, both results are favourable to a 10 km. granitic layer. References available here so far leave a doubt as to common agreement on the intermediate layer, because some writers call only the lower layer "ultrabasic". In my judgment, Wiechert records here are as clear on this point as are some published by Jeffreys cited earlier.

H. F. BAIRD
(Acting Director).
Apia Observatory,
Western Samoa.
Sept. 3.

Microscope Technique

IT is proposed to bring out shortly a tenth edition of the "Microtomist's Vademecum". I shall be glad to hear from other laboratory workers of any new and special methods which would be suitable for inclusion in the new edition. Correspondence from North and South America should be forwarded to the American editor, Dr. Theophilus Painter, Department of Zoology, University of Texas, Austin, Texas, U.S.A.

J. BRONTË GATENBY.
University Zoological Department,
Trinity College,
Dublin.
Oct. 15.

Points from Foregoing Letters

In order to find out at what height of the atmosphere large-scale mixing (winds) ceases to occur, Prof. F. A. Paneth and E. Glückauf have determined the percentage of helium in samples of air obtained by means of sounding balloons sent up from Kew. Up to a height of 18 km., the percentage remains practically constant, but at 21 km. a noticeable increase (8 per cent) was observed. The authors ask the co-operation of stratosphere investigators in various parts of the world in order to obtain small samples of air from high altitudes.

The intensity of cosmic rays in the upper atmosphere—up to a height of 22 km., corresponding to an atmospheric pressure of 37·5 mm. mercury—has been determined by Prof. E. Regener and G. Pfotzer with an apparatus recording only vertical rays. The curve shows a 'hump' in the intensity at a height corresponding to 300 mm. pressure, and a maximum at 100 mm. pressure, apparently due to primary or secondary components of cosmic rays. At greater heights there is a rapid fall in the intensity of vertical cosmic rays, but the authors expect that a certain definite intensity of cosmic rays (coming from interplanetary space) will be found at the top of the atmosphere.

By means of the new technique of registering the tracks of ionised particles upon photographic plates in the emulsion of which a small amount of a suitable substance (in this case, samarium sulphate) has been incorporated, Prof. H. J. Taylor has confirmed the emission of α-particles by samarium. The element also emits particles of greater penetrating power, which appear to be positively charged hydrogen atoms (protons).

The energy and relative number of positive electrons from a radioactive source has been determined by Prof. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew, and compared with the similar 'positron spectrum' produced by γ-rays in thin lead foil. From these, and from further results obtained by irradiating lead with γ- and β-rays together and with γ-rays alone, the authors conclude that when lead (or aluminium) is submitted to rays from such a source, most of the positrons produced are due to the γ-rays of radium C.

Dr. G. I. Finch and A. G. Quarrell submit photographs and measurements of 'extra' rings obtained by electron diffraction—by passing electrons through thin films of metals. The rings differ according to the nature of the metal and the treatment it has received. The authors emphasise that when studying the absorption of gases by metals by this method, it is important to exclude the formation of 'extra' rings due to the presence of grease or to amalgamation.

Prof. L. Vegard states that he has obtained good X-ray diffraction photographs by the powder method with γ-oxygen, one of the three forms of solid oxygen. He deduces that its crystalline structure may be represented by a cubic cell containing eight rotating oxygen molecules grouped into pairs (O_2–O_2), the distance between the two molecules of a pair being somewhat smaller than the minimum distance between neighbouring pairs. γ-Oxygen, Prof. Vegard states, represents the closest cubical packing of pairs of oxygen molecules, and its structure is similar to that of α-nitrogen and α-carbon monoxide.

Cinematographic records showing the transition and growth of crystals of α-iron (magnetic) in the original γ-iron (non-magnetic) in the neighbourhood of the transition point 900° C. have been obtained by Dr. W. G. Burgers and J. J. A. Ploos van Amstel, by means of an 'electron-microscope' with one magnetic lens.

Sir Joseph Larmor directs attention to the difficulty and expense involved in obtaining scientific periodicals and other publications with restricted circulation, and protests against the high price of certain Government publications.

Research Items

Kisi of Liberia

AMONG ethnographical papers presented to Section H (Anthropology) at the Norwich meeting of the British Association was an account by Miss E. D. Earthy of the Kisi of Liberia, a tribe little known to anthropologists, which speaks a semi-Bantu language, although surrounded by peoples of the Sudanic linguistic group, and has been little affected by European culture contact, being economically independent of foreign civilisation. Their villages are built on hill-tops in the forest, where the borders of Liberia, French Guinea and the Sierra Leone Protectorate meet. The people are probably of mixed Hamitic-Negro stock with a strong pygmy strain in some of the villages. The ruling class are of fine physique, and live by hunting, fishing and agriculture. Their chief food is rice seasoned by palm oil. Their currency is twisted iron rods, used for the bride-price and commerce in the markets. The paramount chief rules over a large number of clans and sub-clans. The tribe is totemic, and inter-totem marriage is forbidden. Polygamy prevails. Names up to the sixth child of either sex show the order in which the children are born. Both sexes have to undergo a severe course in the bush initiation school. Their religion is a mixture of animism and totemism. An important sacrificial rite takes place when the rice harvest is over. The sacrifice is performed on the top of a high and inaccessible mountain, of which the name is never divulged to strangers. The office of priest, as is that of trumpeter, is hereditary. The sacrifice is a sheep, which is slain by the priest, the blood being collected in a bowl held by a member of a special family, in which the office is hereditary, who touches the hand of each worshipper with the blood, which the latter must then rub over his face, especially the forehead. The priest then prays for the prosperity of the people and country. In returning, no one must look back at the mountain or fall, otherwise he will die.

Prehistoric Copper and Bronze

SOME further results of the analyses of copper and bronze from excavations in Sumeria and from other archæological sites in the Near and Middle East are given in the report of the Committee on Sumerian copper presented to Section H (Anthropology) at the recent Norwich meeting of the British Association. A chronological arrangement by Dr. Plenderleith of the results of the Committee's examination of specimens from Ur shows that the single object examined from the al'Ubaid period is of nearly pure copper; of eleven objects from the Royal cemetery, nine are bronze, while two contain only small proportions of tin; and that while both copper and bronze occur in the Sumerian period, objects of the Sargonid period are either of copper or contain only a small proportion of tin. To these must now be added four objects from Jemdet Nasr in which copper varies in percentage from 48·18 to 67·23; all show arsenic, varying from 0·20 to 0·93, and two show nickel in the proportion of 0·02 and 0·075 respectively. A copper rod from the same site, which was less corroded, gave percentages of copper, 82·33, nickel, 0·05, arsenic, 0·34, sulphur, 0·11. In none of these was tin present. In twenty-two specimens supplied by the Oriental Institute of Chicago from Tell Asmar, Khafaje and Alishar Huyuk, nickel was absent in two samples only, from Alishar. The Akkadian material from Tell Asmar showed no tin, and this metal was also absent from two objects of early dynastic age from Khafaje, and present only in the proportion of 0·40 in an early dynastic chisel from Tell Asmar. Some interesting results were obtained from copper objects from Tell Duweir (Lachish), Palestine. The metal had clearly come from sources other than those from which the Mesopotamian metal had been derived. It was, therefore, of special interest to examine ores and slag obtained from the Arabah district by Mr. J. L. Starkey. The ores proved to be a mixture of azurite and malachite with no tin, arsenic, nickel or lead.

The 'Rain Frog' of China

THE egg-laying habits of the rain-frog, *Kaloula borealis*, are correlated with amount of rainfall and temperature, so that under proper temperature conditions (something over 20° C.) a minimum threshold of about 40 mm. of rainfall is necessary. This amount of rainfall does not indicate the depth of the pools needed for egg-laying, since these may be drainage centres of larger areas (Ju-chi Li and Chang-shan Lin, *Pekin Nat. Hist. Bull.*, 10, 45; 1935–36). Larval development provides another aquatic complication, for unless the pool in which the eggs are laid lasts through three weeks, the larvæ cannot complete their development. Furthermore, the larvæ feed upon unicellular organisms, and so are dependent upon the influx of organisms and their multiplication, which again depend upon washings from the heavy rainfall and appropriate temperature. The food habits of the adults are somewhat similar to those of frogs and toads, and since they prey upon injurious ants belonging to the Formicidæ, it is possible that thereby they benefit mankind.

Malformation in Adriatic Copepods

FOLLOWING his previous work on the same subject, Dr. Fritz Früchtl summarises his records of malformation in various appendages of several marine copepods in his paper "Beitrag zur Kenntnis der Missbildungen adriatischen Planktoncopepoden" (*Sitz. Akad. Wissen. Wien.* Math.-naturwiss. Klasse. Abt. 1. Mineralogie, Biologie, Erdkunde, **143**, 5 bis 7 Heft; 1934). These include abnormal antennæ, caudal furca and legs, the last being most frequently affected. *Temora stylifera* has been found by the author to vary considerably in both the absolute and relative length of the caudal furca and the relation of the branches to one another; but there are also abnormalities in the setæ, and a peculiar form is here shown in *Temora longicornis*, in which one branch is quite unlike the other and much shorter, the armature differing greatly. A table is given of all the malformations seen, with dates and localities, involving ten species of the genera *Calanus*, *Calocalanus*, *Aetidius*, *Temora*, *Acartia*, *Sapphirina* and *Corycoeus*. It is evident that such malformations are of not infrequent occurrence, and it is of importance to note these carefully when observed.

Deterioration of Cut Sugar Cane in Egypt

ALTHOUGH the loss in sugar value of the cane during a delay between harvesting and milling has been mentioned by investigators in other sugar-producing countries, the observations made by Dr. Rosenfeld in the Egyptian field cannot be over-emphasised from the planter's point of view (Bull. 155, Ministry of Agriculture, Egypt). Certainly the fact that a four days delay in delivering the cut cane means the evaporation of all the profits on the harvest serves to give point to the investigations at Mallawi. Though the extent of loss varies with the type of cane grown, yet in no case is it small enough to make a delay in delivery anything but a serious risk—even in the coolest harvest time when deterioration is least. At the same time, in cases of unavoidable delay, certain elementary precautions will minimise the loss. Of the actual manner of deterioration, the 'masking' of the remaining sucrose by the invert sugar, glucose, is perhaps the most interesting, for it means that loss is not only due to inversion but also to the formation of the glucose on the sucrose crystals, so that the latter cannot be extracted. From the facts put forward it seems that a delay in harvesting, until immediate transport of the cut cane is assured, is at any time preferable to a hold-up between the harvest and delivery of the cane.

Production of Vegetables for Canning

SOME problems in the growing of vegetables for canning was the subject of a paper read on September 6 by Mr. W. B. Adam to Section M (Agriculture) at the Norwich meeting of the British Association. The canning industry in England has developed rapidly since 1928, and although the present output is still about one twentieth of that in the United States, it has now reached approximately 100 million cans per year. The research work, conducted at Campden, deals with all aspects of the industry, selection of variety being one of the most important lines of work, particularly as vegetables for canning are grown under contract, and a steady supply throughout the season is essential. Biochemical investigations are also being carried out to determine the age at which the vegetables can satisfactorily—the sweetness of green peas, for example, is lost after a certain stage in their development owing to the sugars being replaced by starch. Technical problems inevitably play a prominent part in the industry, questions of colouring being among those which have received special attention, and a new process for the treatment of green vegetables has been evolved at Campden. Vegetables are canned within a few hours from picking, so that they are actually preserved in a fresher condition than those bought on the market for home cooking. Further, biological investigations in the United States have shown that canned vegetables generally have a higher vitamin value than those cooked in the usual fashion, so that from a dietetic point of view the vegetable canning industry is entirely justified.

Air Seasoning of Indian Timbers

WITH the increasing demand for timber, the great waste due to the common use in the tropics and sub-tropics of green timber has gradually received recognition. If insect attack is left out of the question, the material in log form is subject to splits, shakes, end-cracks and decay, whilst converted timber owing to bad stacking and other evils incurs even greater loss by depreciation. Furthermore, the climate itself, with the great degree of variation in temperature and moisture throughout the year, results in enormous waste, both before and after the finished article has been turned out. The difficulties in India, as is pointed out in Dr. S. N. Kapur's "Manual on the Air Seasoning of Indian Timbers" (Forest Research Institute, Dehra Dun. Delhi: Manager of Government Publications, 1934), are due to the absence of any large-scale wood-using industries in the country other than railway workshops and ordnance factories, most of the wood-working industries in India being carried on in a small way, usually employing manual labour, their requirements of timber being small and consisting of a variety of species and thicknesses which preclude the installation of any expensive plant like seasoning kilns. It is for this reason that the author holds the opinion that an improvement in the general wood utilisation in India can only be brought about by the introduction of proper methods of air seasoning. It is, therefore, with this question of air seasoning that the manual deals under sections devoted to moisture, shrinkage, the mechanism of wood seasoning, seasoning defects and their causes, the practice of girdling trees before felling (as is usually done with teak), water seasoning, green conversion, requirements of seasoning such as sheds, etc., practical methods of stacking timbers for seasoning, and the seasoning of railway sleepers. In a second part, the author deals with the air seasoning characteristics of various species.

Caledonian Orogeny of North-East Greenland

IN his preliminary report on this subject, C. E. Wegmann presents a discussion of the problems involved which is a model of its kind (*Medd. om Gronland*, **103**, No. 3, 1935). He shows that the sediments of the East Greenlandic geosyncline (up to 9000 m. thick over a width of not less than 200 km.) indicate a deep-going interruption of the Greenlandic shield on such a scale that the geosyncline must be looked upon as a tectonic element of first order in the architecture of the earth's crust. In Caledonian times, immense migrations of sub-crustal material due to igneous activity took place. In part, the material penetrated the rocks by a process of 'molecular migration', leading to the formation of large felspar phenocrysts, 'augen gneisses' and migmatites in great variety. Wegmann draws a distinction between a migration of elements through a stationary framework and a migration through a framework undergoing internal and external movements. He points out that where quartzites and schists are interwoven with felspar, not all the material has migrated, but only the part of it which rendered possible the formation of the felspar. When crystallisation outlasts the movements, the relict structures disappear, and the result is a granite of more or less massive character which nevertheless is itself only a mixed rock that has migrated as a mobile mass from its original place of development. Such granite is not to be regarded as the source of the migrating elements. The conclusion is reached that igneous phenomena so transformed the infra-structure of the Caledonian material that the conception of the mountain complex as being of germanotype character is deprived of support based on the opinion that the basement rocks are rigid, undeformed Archean masses. Every

line of evidence indicates that the mountain chain must be regarded as a deep-going interruption of the Pre-Cambrian shield. The later history is briefly summarised; further problems are indicated; and a detailed memoir on the whole—which will be eagerly awaited—is promised at a later date.

Geography of the North Sea Bed

A BATHYMETRICAL map of the North Sea floor compiled from the Admiralty Charts accompanies a paper on the subject by Mr. R. G. Lewis in the *Geographical Journal* of October. The map brings out a number of features that are often overlooked and raises a number of problems. River erosion explains many of the features, and Mr. Lewis traces what he calls the Silver River, the extended Rhine, to the west of the Dogger Bank and then northwards by changing courses. But more difficult to explain are certain features that are not clearly the outcome of river work, and suggest tectonic movements. There are a number of narrow elongated depressions. In the English Channel there are comparable troughs not connected with the river that once flowed there. Mr. Lewis suggests that these may be due to folds on the floor which have disappeared. A fold would hold up the water behind it. The water would flow along the course of the fold in a deepening channel until it found an outlet. Eventually the flow of water would destroy the anticline. Another problem that awaits explanation is the failure of the sand and gravel which lies over most of the floor to fill these depressions. The small elevations south-east of the Dogger Bank suggest not erosional features so much as heaps of moraine matter.

Specific Heats of Crystals

THE August 1 issue of the *Proceedings of the Royal Society, A*, contains the Bakerian Lecture by Prof. R. H. Fowler on "The Anomalous Specific Heats of Crystals". The lecture contains a general survey of the theoretical position and gives a new tentative theory of the contribution made by molecular rotation. The theory of specific heats is primarily the construction of the free energy function of the solid in terms of an assumed model for the crystal lattice, and this in turn involves the construction of a 'partition function' giving the probability of the different energy states. Assumptions were made by Einstein and by Debye which led to partition functions and to specific heat formulæ, and Debye's work has been recently extended by Blackman in a detailed consideration of cubic lattices. Fowler classifies as 'anomalous' any variation of the specific heat which does not arise from normal modes of vibration (small oscillations) of the atomic lattice. Such anomalies must arise in any case in which there is not a monotonic increase of specific heat with temperature. He classifies them into three types. In the first type the anomalous specific heat occurs around a certain temperature and, in some cases, in any event, the extra specific heat is used in exciting the atoms, for example, to states of higher orientational energy. The second type is distinguished by sudden disappearance of the anomaly above a certain temperature, and its explanation involves co-operative interactions between atoms of the lattice. Examples are the ferromagnetic interaction disappearing above the Curie point and the order-disorder transitions recently described by Bragg and Williams. The rotational contribution specially discussed by Prof. Fowler is of this type. The third type is the discontinuous absorption of heat at a transition temperature between phases.

Use of Electron Lenses for β-Rays

O. KLEMPERER (*Phil. Mag.*, Oct.) has applied to β-ray spectroscopy the known focusing effect of a short coil on electron beams passing axially through it. A short coil, with or without an iron mantle to concentrate the field, was used to focus the β-rays from a small radioactive source (Th *C*) on the window of a Geiger counter placed about a metre away. By varying the current in the coil, the power of the lens may be varied, and different β-ray energy groups brought into focus. This method is analogous to the focal isolation of light according to the method of Rubens and Wood, and good β-ray spectra could be secured. A further development was the construction of a magnetic analogue of an ordinary spectroscope, with magnetic lenses for telescope and collimator and a uniform magnetic field for a deflecting prism, but the experiments have not yet been completed.

Cerin and Friedelin

BY extracting ground cork with alcohol, Chevreul in 1807 obtained a material which he believed to be a wax and called cerine. In 1898, Thoms obtained it in a pure state and believed it to be related to the phytosterols because of its colour reactions. Another constituent of cork extract was prepared in 1899 by Istrati and Ostrogovich who, in return for the interest taken by Friedel in their investigation, named it after him. N. L. Drake and R. P. Jacobsen (*J. Amer. Chem. Soc.*, **57**, 1570; 1935) have now reinvestigated these materials. They find that the empirical formulæ of friedelin is $C_{30}H_{50}O$ and that of cerin $C_{30}H_{50}O_2$, plus or minus 2H, within the limits of error. The hydrocarbon to which friedelin is related is $C_{30}H_{52}$. The molecular weight was determined by the saponification of several enol esters. The colour reaction was not due to pure friedelin but to a sterol present as impurity. The presence of a double bond in friedelin is inferred from molecular refraction data and the colour reaction with tetranitromethane. Addition of bromine and hydrogenation were not effected, but one of the double bonds of ergosterol behaves in this way.

A Rectifying Valve for Radiological Work

MESSRS. PHILIPS METALIX, of 145 Charing Cross Road, W.C.2, have sent us a booklet on high tension rectification which should prove useful to the radiologist and the radiological engineer. They will find in it an explanation of the functioning of rectifying valves and the relative efficiency of various types. There is also given an account of the gas-filled valve, their latest production. They point out that every operation in the production of radiograms, from the time of switching on the mains until the removal of the film from the fixing bath, must be performed with the highest efficiency, if consistently good results are to be obtained. As a rule, the rectifying valve does not receive the consideration it deserves, and yet its performance is essential to good work. It often causes additional expense by wastage of films, and its failure can irremediably damage the X-ray tube and other valves in the circuit. The technical matter contained in this booklet will assist the radiologist in understanding present-day equipment.

International Institute of Documentation

COPENHAGEN CONGRESS

MICROPHOTOGRAPHY, as a means of distribution of data, rivalled such veteran subjects as decimal classification and cataloguing in discussions at the Copenhagen Congress of the International Institute of Documentation, on September 10–14. Marking the fortieth anniversary of the world bibliographic or documentation movement that arose out of the 1895 International Congress of Bibliography, this thirteenth Congress in a part of its programme provided, in effect, a 'clearing house' for current progress upon microphotographic duplication as visualised or practised in many lands.

Nearly fifty reports were presented to the Congress, and the advance volume of the Congress is an important addition to the literature of finding, classifying, preserving and distributing written information.

Held under favourable weather conditions of Copenhagen's waning summer and arranged with Danish hospitality by the local committee, of which Oscar Thyregod was the leader, the Congress brought together representatives from about a dozen countries to discuss problems of mutual interest in a medley of German, English and French.

The president of the Congress, Dr. J. Alingh Prins, president of the Dutch Patent Office, said in an opening address that documentation has three stages : (1) investigation as to what has been written about a subject or put into the form of a document ; (2) filing the material so that the place of each subject may be determined instantly ; (3) placing the material at the disposal of those who need it.

With regard to filing and classifying material, Dr. Prins said : "Collected material, which is not filed, is of little importance. What system of classification should be adopted ? In theory this does not matter ; the main thing is, that *one and the same* system is used nationally and internationally. We are convinced that the most serviceable system is the decimal system, invented by Melvil Dewey, and considerably improved in Brussels by Lafontaine and Otlet and since then brought to a high stage of development by the international classification committee of our Institute under Donker Duyvis, with the co-operation of a large number of prominent persons from different countries."

Decimal classification, and the sessions of the committee charged with keeping the system in step with advancing knowledge, bulked large on the programme, with reports on its use in Germany, Switzerland, England, America, Holland, Norway, Sweden, Denmark, Finland and other countries.

Of fundamental importance was the paper presented by Dr. S. C. Bradford, keeper of the Science Library, London, which analysed the situation surrounding library service in the general field of science, including societies, research institutions, business and industrial organisations, etc., and came to the conclusion that a central library of science and technology would alleviate many of the disabilities under which scientific and technical work is carried out at the present time. A communicated paper by E. Lancaster Jones explained the classified bibliography operated by the Science Library. A paper by Watson Davis, director of Science Service, Washington, told of suggested applications of microphotographic duplication in making available existing literature in libraries and publishing scientific papers and monographs that cannot at present be issued promptly or in full.

Television was foreseen as a future tool in library service by Dr. Walther Schürmeyer, director of the Library of Art and Technology at Frankfurt, whose paper stressed primarily the possibility of applying photographic methods to the distribution of information from libraries.

How photographing of library cards upon motion picture film, and making enlargements from these convenient and inexpensive negatives, is done was the subject of a paper presented by Paul Vanderbilt, librarian of the Pennsylvania Museum of Art, who used this technique experimentally in connexion with a union catalogue of Philadelphia libraries. Experience with use of film copies and microphotoprints at the Huntington library in America was reported in a communication from Dr. L. Bendickson, and there was also a communicated report on photographic methods in connexion with documents and libraries by Dr. H. Joachim, director of the Zeiss Ikon concern at Dresden.

The question of the photocopying of books and literature in view of the copyright laws and rights of authors was the subject of one session. The standardisation of the format for film copies so as to simplify the exchange of film copies between different countries was urged in resolutions, with a recommendation for the use of 35 mm. film, perforated both sides, with width of image of 24 mm. and a reduction of approximately 12 to 1.

The International Institute of Documentation reaffirmed at the Congress its desire to "work with every international organisation which pursues related aims, for example, in the field of publication and of the working organisation of special publication such as film".

Several related efforts in the field of documentation were made known and explained by documents distributed at the congress. The International Institute of Intellectual Co-operation of the League of Nations reported the progress in its endeavour to co-ordinate world efforts in the field of documentation, and the International Office of Chemistry, Paris, made available a report, "L'Utilisation du Film comme Support de la Documentation", giving proceedings of its April conference.

The prevailing spirit of the meeting was the hope that there would be co-operation effected through the International Institute of Documentation with both international organisations dealing with particular fields of knowledge and national organisations that bring together the documentation activities in various geographical areas.

Mingled with the meetings there were visits to libraries, publishing firms, schools and places of historical interest. These events and lunches arranged in famous Copenhagen restaurants allowed informal discussions of mutual problems in many languages, a function of any Congress that is often even more important than the set and formal proceedings.

International and Absolute Electrical Units

AT the recent meeting in Paris of the International Committee of Weights and Measures, the subjoined draft memorandum relating to international and practical absolute electrical units was approved for publication. The document makes clear the position of the Committee and shows that for practically all engineering purposes the change to the suggested new units involves no difficulty.

1. In accordance with the authority and responsibility placed upon it by the General Conference of Weights and Measures in 1933, the International Committee of Weights and Measures has decided that the actual substitution of the absolute system of electrical units for the international system shall take place on January 1, 1940.

2. In collaboration with the national physical laboratories the Committee is actively engaged in establishing the ratios between the international units and the corresponding practical absolute units.

3. The Committee directs attention to the fact that it is not at all necessary for any existing electrical standard to be altered or modified with a view to making its actual value conform with the new units. For the majority of engineering applications the old values of the international standards will be sufficiently close to the new for no change even of a numerical nature to be required. If for any special reason a higher precision is necessary numerical corrections can always be applied.

4. The following table gives a provisional list of the relations between the international units and the corresponding absolute practical units, to the fourth decimal place. Since differences exist between the standards of the international units held by the various national laboratories affecting the fifth decimal place, and, further, because all the laboratories which have undertaken determinations of the values of their standards in absolute measure have not yet obtained final results, the Committee does not consider it desirable for the present to seek a higher precision. At the same time it hopes that it will be possible to extend the table of these ratios with a close approximation to the fifth decimal place well before the date fixed for the actual substitution of the practical absolute system for the international system.

1 Ampere international	=	0·999 9	"Ampere absolute"
1 Coulomb	,,	=	0·999 9	"Coulomb	,,
1 Ohm	,,	=	1·000 5	"Ohm	,,
1 Volt	,,	=	1·000 4	"Volt	,,
1 Henry	,,	=	1·000 5	"Henry	,,
1 Farad	,,	=	0·999 5	"Farad	,,
1 Weber	,,	=	1·000 4	"Weber	,,
1 Watt	,,	=	1·000 3	"Watt	,,

Sixth International Congress of Entomology

THE Sixth International Congress of Entomology, attended by some four hundred delegates, was held at Madrid on September 6–12. On account of the financial restrictions, some of the mid-European countries were not so fully represented as at past Congresses, but despite these difficulties, entomologists from practically every country were present. The opening session had as its chairman His Excellency the President of the Spanish Republic, who greatly impressed the Congress by his personality and warm welcome.

The Congress itself was presided over by that veteran entomologist, Dr. I. Bolivar Urrutia, director of the Museo Nacional de Ciencias Naturales, Madrid. A heavy programme, divided into sections devoted to general, ecological, agricultural, forest, medical and veterinary entomology, with, in addition, sessions allotted to apiculture and nomenclature, provided something of interest for everyone, and oonsidering the warm weather and the variety of languages in which the papers were presented, the meetings were very well attended. As these papers will be published and may then be read and digested in the quiet of the study, it is unnecessary to detail them severally by name here, but we might say that some of the illustrated ones, as, for example, Dr. F. W. Edwards's account of the British Museum Expedition to Ruwenzori, Dr. B. Mayne's film of the life-cycle of the malarial parasite in the body of the mosquito, Dr. Escalera's one on apiculture, and Dr. Kamal's 'talkie' of *Prodenia littoralis* seemed to be much enjoyed. The Sunday sessions were held at El Escorial, and though most of the delegates spent their time exploring the beautiful and historic buildings and collecting their favourite families of insects in the neighbourhood, the meetings were well attended by the more enthusiastic seekers after knowledge.

Only a small part of the time, however, was devoted to serious scientific matters. The President of the Republic received and entertained the Congress at the Palace, and entomologists must have felt just a little awed on walking up the grand staircase between the lines of fully-accoutred lifeguards; the Mayor of Madrid entertained it to music, and during the subsequent proceedings, outlined to some of the members in excellent English the town-planning schemes of the city; the organisers, to a charming *fiesta* of Spanish art, to lunches and *merienda* and a final evening banquet, and bore the expenses of excursions to such historic places as El Pardo, El Escorial (as mentioned above) and Toledo. A whole day was devoted to a sight-seeing trip to the Guadarramas, the Alpine Biological Station being visited *en route*, the Forest of Valsain, San Ildefonso (La Granja) and Segovia, where members gazed with delight on the beautiful west façade of the cathedral lit up by the setting sun. An afternoon visit to

Aranjuez provided an opportunity of viewing the luxuriant growth produced by irrigation.

Honorary doctorates were conferred by the University of Madrid on Prof. M. Caullery, University of Paris; Dr. R. Goldschmidt, director of the Kaiser-Wilhelm-Institut, Berlin-Dahlem; Dr. R. Jeannel, Muséum Naturelle d'Histoire, Paris; Prof. F. Silvestri, Portici, Italy; and Mr. B. P. Uvarov, Imperial Institute of Entomology, London.

During the week preceding the meeting some of the members went on an excursion through the Picos de Europa under the guidance of Dr. F. M. de la Escalera, and after the Congress others visited southern Spain and the Canaries.

It is to the admirable organisation of the secretary, Dr. C. Bolivar y Pieltain, and his committee that the success of the recent Congress was due, and the lavish hospitality set a standard which few countries could hope to live up to, but there will remain in our memories also the courtesy and helpfulness of the people of Madrid to those who were ignorant of both customs and language.

It was decided to hold the seventh International Congress of Entomology in 1938 at Berlin under the presidency of Dr. E. Martini, and it is expected that the ninth will be held at Amsterdam in 1945 to coincide with the centenary celebrations of the Dutch Entomological Society.

Tercentenary of the University of Budapest

THE recent celebration of the tercentenary of the Royal Hungarian Péter Pázmány University of Budapest was worthy of a people that has played a great part in the intellectual and political life of Central Europe. The Hungarian nation began its corporate life in 896 when the Magyars entered the country from the plains of southern Russia and the slopes of the Carpathian mountains. In the fourteenth century, and again in the fifteenth century, universities were founded, but they lasted only a comparatively short time and none survived more than a few years after the disastrous Turkish victory in 1526. In 1635, when the greater part of Hungary was still under Turkish rule, Péter Pázmány, Archbishop of Gran (Esztergom) and later Cardinal, Prince Primate, founded a new university at Nagyszombat; more than a hundred years later it was transferred to Buda and in 1783 to Pest. The two cities Buda and Pest were united in 1872. Since 1922 the University has been known as the Royal Hungarian Péter Pázmány University of Budapest. This leading university of Hungary has now more than 5,000 students: its success is a remarkable demonstration of the intellectual aspirations and the national spirit of a nation which was deprived by the Treaty of Versailles of the greater part of its territory.

Unfortunately no list of delegates was given to the representatives of foreign universities and academies who assisted at the celebrations, and it is therefore impossible to mention the names of the foreign delegates. The celebrations began in the evening of Wednesday, September 25, with a reception in the Hotel Gellért. On the Thursday morning, the delegates and the university staff met in the great hall of the University and went in procession to the neighbouring University Church, where his Eminence the Cardinal Prince Primate, Dr. Jusztinian Serédi, assisted by a brother cardinal from Vienna and several bishops, celebrated Mass: Liszt's music was beautifully rendered. It was a memorable service. At the conclusion of the service the foreign delegates signed their names in a special commemorative book and, after visiting the University library where a collection of charters and old books relating to the Péter Pázmány foundation was exhibited, were entertained at luncheon in the Grand Hotel Hungaria, where several speeches were made by foreign ministers and some of the delegates. In the evening an invitation performance at the Opera House, illustrative of Hungarian drama and national life, was followed by a reception given by the Minister of Education.

On Friday morning, September 27, the delegates of the University staff met under the central dome of the Parliament House to take part in the principal academic event of the celebrations. His Serene Highness, the Regent of the Kingdom of Hungary, their Royal Highnesses the Archduke Joseph and his son, the Archduke Francis Joseph, were present. The Rector Magnificus, Dr. Julius Kornis, opened the proceedings and, after other members of the University had spoken, a representative of the University of Bologna spoke on behalf of the foreign universities, and the foreign secretary of the Royal Society of London was asked to speak on behalf of the whole body of academies. The latter paid a special tribute to the memory of one of the greatest sons of Hungary, the founder of the Hungarian Academy, Count István Széchenyi, "a man whose enlightened attitude towards learning, breadth of vision and spiritual ideas are worthy of our most respectful and grateful homage". Delegates were then called upon to present their addresses: English, Scotch and Welsh universities were represented, universities of the Irish Free State, of Austria, Belgium, Egypt, Denmark, Latvia, France, Finland, Germany, Greece, Holland, Italy, Norway, Poland, Spain, Sweden, Switzerland, the United States of America, and other countries.

In the afternoon some of the delegates were present at the laying of the foundation stone of a new University hospital for lung diseases. Each medical professor has his own University hospital. An informal entertainment was given by students in the evening.

In the morning of September 28 a large number of honorary degrees were conferred. Unfortunately, the two English graduands, Sir Charles Sherrington and Sir F. Gowland Hopkins, were not able to receive their degrees in person.

In the afternoon the Regent received the delegates in the Royal Palace and talked with many of them with equal fluency in German, French and English. In the evening the visitors had the privilege of hearing Beethoven's "Missa Sollemnis" with an impressive accompaniment of a liturgical drama produced by the director of the National Theatre.

The celebrations were admirably organised: the attractive Hungarian national uniform worn by the University officers, the brilliant robes of the cardinals, the white, brown and black vestments of members of monastic orders, and the variety and wealth of colour represented by the gowns and hoods of delegates contributed to the gaiety and splendour of a great occasion. The celebration was an important national event which made a very favourable impression upon the international company and created a feeling of sympathetic interest in the welfare of a courageous nation. Delegates who had the good fortune to be guests of the University in one of the most beautiful of European cities will long retain the pleasantest memories of the friendliness of the Rector Magnificus, the Ministers of State and the University officers with whom they came into contact.

Educational Topics and Events

CAMBRIDGE.—The managers of the Balfour Fund have made a grant of £100 to F. R. Parrington, of Sidney Sussex College, for researches on the fish fauna of the Achenarass quarries.

It is proposed to confer the degrees of M.A. and M.D. *honoris causa* upon Dr. J. A. Ryle, regius professor of physic, and the degree of M.A. on Dr. G. P. McCullagh, University demonstrator in pathology.

LEEDS.—Mr. Frank Stuart Atkinson has been appointed to the chair of mining, in succession to Prof. Ritson, who takes up his appointment at the Royal School of Mines at the beginning of January next. Mr. Atkinson is a qualified mining engineer. He was educated at Chesterfield Grammar School and the University of Sheffield, and has had a long and varied experience of practical work; he has been manager of the Hatfield Main Colliery since February 1927.

LONDON.—The title of Edwards professor of Egyptology in the University has been conferred on Mr. S. R. K. Glanville, in respect of the post held by him at University College.

The title of emeritus professor of bacteriology in the University has been conferred on Dr. J. W. H. Eyre, formerly University professor of bacteriology at Guy's Hospital Medical School; and that of emeritus professor of civil engineering in the University on Mr. A. H. Jameson, who has retired from the University chair of civil engineering at King's College.

OXFORD.—Dr. John Mellanby, professor of physiology in the University of London, has been appointed to the Waynflete professorship of physiology, to hold office from January 1, 1936.

The Council of the Institution of Naval Architects has made the following awards: 1851 Exhibition Commissioners post-graduate scholarship in naval architecture, £250 per annum for two years, to Mr. Harrison Lackenby, of Armstrong College, Newcastle-upon-Tyne; Sir William White post-graduate scholarship in naval architecture, £150 per annum for two years, to Mr. Ian C. Bridge, of the University of Glasgow; Earl of Durham Prize, to Mr. D. H. Burnett, of H.M. Dockyard, Devonport.

Science News a Century Ago

Meeting of the Entomological Society

AT a meeting of the Entomological Society held on November 2, 1835, the president, the Rev. F. W. Hope, being in the chair, several communications were read, one of which was a notice of the ravages of the black caterpillar upon the leaves of the turnip in Kent, by W. W. Saunders. "Relative to this communication Mr. Yarrell stated some additional circumstances regarding the destruction of the turnip last summer and autumn, by the insect in question, which were the larvæ of a species of Saw-fly (Tenthredinidæ) termed by the farmers 'the blacks'. In the dry summer of 1818 these insects were equally destructive, and so rapid is the destruction caused by them, that in a couple of days a fine field of turnips is reduced to the mere skeleton of the leaves. Mr. Hope gave an account of some other insects which had this year been equally injurious to the turnip in Shropshire, Herefordshire and Worcestershire and suggested several plans for their destruction."

Beginning of Faraday's Researches on Electrostatics

"HAVE been thinking much lately," wrote Faraday in his Diary on November 3, 1835, "of the relation of common and voltaic electricity; of induction by the former and decomposition by the latter, and am quite convinced that there must be the closest connexion. Will be first needful to make out the true character of ordinary electrical phenomena. The following notes are for experiment and consideration.

"Does common electricity reside upon the surface of a conductor," he went on, "or upon the surface of the electric in contact with it? I think upon the electric, and must work out the results on that view. It will make a great difference in the collation and connexion of the various electrical phenomena and also in their explication."

Then follow a dozen or so pages, written on the same day, of speculation on such points as the effect of the form of a conductor on its electrical behaviour, on the relation of two surfaces under induction, and on the state of the dielectric, or as he called it, the "electric", during the persistence of inductive action. Together with the queries are ideas and suggestions for experiments by which they may be tested.

This was the beginning of Faraday's researches on electrostatics. The work on electrochemistry had been completed early in the year, and very little had been done during the summer months. Now, in the autumn, he was ready to begin again, and the first step was to put down on paper the ideas for experiment that had come crowding to his mind; next, in a few weeks time, he would be devising the necessary apparatus.

New Session of the Geological Society

ON November 4, 1835, the Geological Society held its first meeting of the session. A paper by Dr. Buckland was first read on the discovery of the beaks of four extinct species of fishes, referable to the genus *Chimæra*, and found in the Oolitic and Cretaceous series of England. The paper was accompanied by an appendix by M. Agassiz, describing the distinctive characters of each species.

A communication by Mr. Murchison was next read, containing an account of the quarry in the new red sandstone at Rhone Hill, near Dungannon, in which

numerous ichthyolites had been found, and of the geological structure of the adjacent district. A slab of the sandstone, presented to the Society by Mr. Greer, the proprietor of the quarry, was laid upon the table, and exhibited on a surface not exceeding two feet square impressions of above 250 fishes.

M. Agassiz afterwards gave a succinct account of his researches on English fossil fishes. The number of species which he had noticed amounts to about 400, of which 300 were new, and he stated that the specimens, too imperfect to be described at present, announce the existence of a still greater number of species.

King of Denmark's Medal for Astronomers

IN the *Athenæum* of November 7, 1835, was a statement regarding the founding by the King of Denmark of a gold medal, of the value of twenty ducats, to be given to the first discoverer of a telescopic comet. The discoverer who desired to be considered for the award, if in any part of Europe except Great Britain, had to send immediate notice of his discovery to Prof. Schumacher, of Altona, and if in Great Britain, or any other quarter of the globe except the Continent of Europe, to Francis Baily, of Tavistock Place, London. The medal was to be adjudged twelve months after the discovery of the comet, and no claim could be admitted after that period had elapsed. Prof. Schumacher and Mr. Baily were to determine whether a discovery was to be considered established or not, but if they differed in opinion, Dr. Olbers, of Bremen, was to decide between them.

Societies and Academies

PARIS

Academy of Sciences, September 30 (*C.R.*, **201**, 533–572). CHARLES CAMICHEL, LÉOPOLD ESCANDE, ETIENNE CRAUSSE and JEAN BAUBIAC: Linear hydraulic elements and the resistance of immersed bodies in permanent or transient regime. RAYMOND MINDLIN: Contribution to the problem of equilibrium of elasticity of an indefinite solid limited by a plane. BERNARD LAFFAILLE and FLORIN VASILESCO: The *flambage* of thin cylindrical plates. JOHN ELLSWORTH: The asymmetry of the light curves of variables with eclipses attributable to a tide lag. F. DUSCHINSKY: The bands in the neighbourhood of spectral lines in the ultra-violet. GASTON DUPOUY and PIERRE JACQUINOT: The proportionality of the deviations in the field in the Zeeman effect of three mercury levels. HORIA HULUBEI: New "*hors diagrammes*" emissions in the $K\alpha$ spectra of elements included between Cu(29) and Rh(45) inclusively. MLLE. O. HUN: The cryoscopic study of the total hydration of the ions of sodium bromide. MLLE. MARGUERITE QUINTIN: The heat of dilution of cadmium chloride. MLLE. SUZANNE VEIL: The electromotive forces due to bringing together metals in gelatine, and the importance of the Volta effect in batteries. JEAN CHÉDIN: The Raman spectrum of nitric anhydride. The Raman spectra of nitric anhydride in organic solutions (chloroform, carbon tetrachloride) differ from those given by the same substance in nitric acid or in sulphuric acid. PIERRE LAURENT: A new compound of phenol and aniline. From measurements of the dielectric capacity of mixtures of phenol and aniline in various solvents (benzene, carbon tetrachloride, cyclohexane and ether) the existence of the compound ($C_6H_5NH_2$,$2C_6H_5OH$) is deduced, and this has been isolated in the form of colourless crystals melting at 29·2°C. ANDRÉ LÉAUTÉ: The capillary separation of tars. When studying the ascent in capillary tubes of tars and bitumens, it has been noticed that two liquids appear in the tube, the upper a clear yellow fluid, the lower black tar. This explains the appearance of yellow exudations on the surface of tarred roads. ANDRÉ CHRÉTIEN and GEORGES VARGA: Two new compounds of titanium tetrachloride and hydrochloric acid. The cryoscopic study gives indications of the existence of the compounds $TiCl_4$, 6HCl, and $TiCl_4$, 2HCl. The first of these is a new type. JOSEPH HOCH: A new general method of preparation of the *N*-carboxethylketimines, $RR'.C=N.CO.OC_2H_5$. The diethylacetals of the ketones are condensed with ethylurethane in the presence of a trace of aniline hydrochloride. JACQUES FROMAGET: The upper Trias of the western border of the Tran Ninh (Haut Laos). CHARLES FRAIPONT: A skull of *Homo neanderthalensis* from the grotto of Engis (Liège). A detailed examination of the small skull found along with the celebrated Engis skull in 1828. ANGEL H. ROFFO: The action of solar rays (ultra-violet) on the skin, and the accumulation of cholesterol. The effect of the sun's rays, especially the ultra-violet rays, produces a local accumulation of cholesterol under the skin. W. KOPACZEWSKI and S. MARCZEWSKI: Anaphylaxy from the point of view of altitude. A study of the effects of reduction of atmospheric pressure, corresponding to an altitude of 10,000 metres, on animals sensitised by an injection of protein. RAYMOND-HAMET: The physiological inversion of the hypotensor effects of adrenaline.

ROME

Royal National Academy of the Lincei, May 19. V. NOBILE: The possibility of new trends in the theory of astronomical refraction and of incidental contributions to the physics of the atmosphere (2). F. SBRANA: Monodrome parallelism on a surface. U. CASSINA: The construction of the plane osculatory to a quartic of the first species. A very simple linear construction of finite character is given. N. SPAMPINATO: (1) Functions totally derivable in a real or complex algebra endowed with modulus (2). (2) A characteristic property of totally derivable functions. B. SEGRE: The bi-relations on the non-developable surfaces of space and the geometric conditions for projective equivalence between them (2). G. BOZZA: The deposition of crystalline suspensions. (1) General theory. The general relationships between the various factors involved in the deposition and separation of crystalline granules from suspensions are deduced for the case when the granules are of such dimensions that the surface influences between granules and liquid are negligible. C. SCHAEFER and L. BERGMANN: A new optical method for the determination of the elastic constants of crystals. Diffraction centres may be formed in a quartz cube by exciting this to rapid elastic oscillations by means of a field which oscillates 10^7 to 10^8 times a second. If monochromatic light is passed through the vibrating crystal, a diffraction figure is formed which depends on the elastic properties of the crystal and on the direction of the rays, but is independent of the form of the crystal and of the type of the excitation. Various examples are described. G. WATAGHIN: The theory of protons and neutrons. By a slight modification of

Dirac's equations, these may be made capable of indicating some of the known properties of protons and neutrons. G. C. WICK: The oscillation and rotation spectrum of the molecule HD. M. SAVIANO: Water metabolism. (9) Variation of the diuresis and urinary *p*H in animals on acidogenic and alkalogenic diets. The more abundant the diuresis, the more nearly does the reaction of the urine approach that of the blood. With animals on an alkalogenic diet, the urine may even become less alkaline than the blood. V. FAMIANI: The development of Jensen's sarcoma in certain particular conditions of nutrition.

Forthcoming Events

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

Monday, November 4

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION), at 8.—Prof. I. M. Heilbron: "Chemical Elixirs of Life—the Recent Developments in the Chemistry of Sterols, Lipochromes and Related Compounds" (Jubilee Memorial Lecture).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Prof. Kenneth Mason: "The Himalaya as a Barrier to Modern Communications".

Tuesday, November 5

ROYAL HORTICULTURAL SOCIETY, at 3.30.—(in the Society's New Hall, Greycoat Street, Westminster, S.W.1).—Sir William Wright Smith: "Problems connected with the Classification of Plants". (Masters Memorial Lectures. Succeeding lecture on November 26.)

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. W. Neilson Jones: "Notes on a Biologist's Visit to Southern California".*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. J. B. S. Haldane.*

INSTITUTION OF CIVIL ENGINEERS, at 6.—J. D. Watson: Presidential Address.

Wednesday, November 6

UNIVERSITY OF LONDON, at 5.—(at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1).—Sir Daniel Hall: "The Improvement of Native Agriculture in Relation to Population and Public Health" (Heath Clark Lectures. Succeeding lectures on November 11, 13, 18 and 20).*

ROYAL SOCIETY OF MEDICINE (HISTORY OF MEDICINE SECTION), at 5.—Dr. E. J. Holmyard: "The Pharmacology of Mediæval Islam".

WARBURG INSTITUTE, at 5.30.—H. Mattingly: "The First Age of Roman Coinage" (succeeding lectures on November 13 and 20).*

UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Gröndahl: "Norwegian Life in Town and Country".*

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION), at 6.—R. A. Watson Watt: Inaugural Address.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—M. J. Leahy: "Stone Age People of the Hagen Area, Mandated Territory of New Guinea" (Film).

INSTITUTE OF CHEMISTRY (LEEDS AREA SECTION).—Dr. C. H. Desch: "Metals in the Chemical Industry" (Jubilee Memorial Lecture).

Thursday, November 7

ROYAL SOCIETY, at 4.30.—F. W. G. White and L. W. Brown: "Some Measurements of the Reflection Coefficient of the Ionosphere for Wireless Waves".

J. P. Gott: "On the Electric Charge collected by Water-Drops falling through a Cloud of Electrically Charged Particles in a Vertical Electric Field".

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. Julian Huxley.*

Friday, November 8

BEDSON CLUB, ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. J. W. Cook: "The Synthesis and Biological Effects of Carcinogenic Hydrocarbons" (Bedson Lecture).

ROYAL INSTITUTION, at 9.—S. R. K. Glanville: "Weights and Balances in Ancient Egypt".

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 3 (Wood Preservation Series, No. 1): Experiments on the Preservation of Mine Timber—Progress Report No. 1. By J. Bryan and N. A. Richardson. Pp. ii+10+3 plates. (London: H.M. Stationery Office.) 6*d*. net.

Dam the Thames: a Matter of Sanitation, Comfort and Economy; a Plan for a Tideless River in London. Second edition. Pp. 16. (London: Thames Barrage Association.) 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1653 (S. 210): Static Stability Tests of Six Full Scale Twin Float Seaplanes. By R. K. Cushing, A. S. Crouch and R. W. Angell. Pp. 20+10 plates. 1*s*. 6*d*. net. No. 1657 (S. 215): Water Performance of Seaplanes; Tank Data to determine Effect of Wind, Variation of Loading or a Change of Air Structure. By W. G. A. Perring. Pp. 4+3 plates. 6*d*. net. No. 1662 (T. 3612): Turbulence Tests of the R.A.E. Wind Tunnels. By Dr. R. G. Harris and A. Graham. Pp. 6+3 plates. 6*d*. net. (London: H.M. Stationery Office.)

Sale of Food and Drugs: Extracts from the Annual Report of the Ministry of Health for 1934–35 and Abstract of Reports of Public Analysts for the Year 1934. Pp. 15. (London: H.M. Stationery Office.) 3*d*. net.

Other Countries

Smithsonian Miscellaneous Collections. Vol. 94, No. 6: The Abdominal Mechanisms of a Grasshopper. By R. E. Snodgrass. (Publication 3335.) Pp. ii+89. Vol. 94, No. 7: A New and Important Copepod Habitat. By Charles Branch Wilson. (Publication 3336.) Pp. ii+13. Vol. 94, No. 9: Review of the Genus *Chlænobia* Blanchard (Coleoptera: Scarabæidæ). By Edward A. Chapin. (Publication 3338.) Pp. 20. (Washington, D.C.: Smithsonian Institution.)

Bulletin of the Bingham Oceanographic Collection: Peabody Museum of Natural History, Yale University. Vol. 5, Art. 1: Report on Hydrographic Observations in the Gulf of Mexico and the Adjacent Straits made during the Yale Oceanographic Expedition on the *Mabel Taylor* in 1932. By Albert Eide Parr. Pp. 93. (New Haven, Conn.: Yale University.)

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 319: The Mineral Requirements of Milk Production; The Annual Cycle of Mineral and Nitrogen Metabolism of the Milch Cow, as affected by Alfalfa Hay, Timothy Hay, Bone Flour and Ground Limestone. By Ernest B. Forbes, with the collaboration of Alex Black, Winfred W. Braman, Donald E. H. Frear, Orme J. Kahlenberg, Frank J. McClure, Raymond E. Swift and LeRoy Voris. Pp. 152. (State College, Pa.: Pennsylvania State College.)

Illinois Biological Monographs. Vol. 13, No. 3: Evolution of Foliar Types, Dwarf Shoots and Cone Scales of Pinus; with Remarks concerning similar Structures in Related Forms. By Clifton Childress Doak. Pp. 106. (Urbana, Ill.: University of Illinois.) 1.50 dollars.

Proceedings of the United States National Museum. Vol. 83, No. 2979: New West Indian Cerambycid Beetles. By W. S. Fisher. Pp. 189–210. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. The Fauna of Burnet Cave, Guadalupe Mountains, New Mexico. By C. Bertrand Schultz and Edgar B. Howard. Pp. 273–298. (Philadelphia: Academy of Natural Sciences.)

Research at the Indian Institute of Science, Bangalore, 1934–1935. Pp. 70+14 plates. (Bangalore: Indian Institute of Science.)

Canada: Department of Mines. Wood Fuel Burning Tests. By E. S. Malloch and C. E. Baltzer. (No. 761.) Pp. 6. (Ottawa: King's Printer.) 10 cents. [1810

Catalogues

pH Values: What they are and How to determine Them. Fourth edition, revised and enlarged. Pp. 24. (London: The British Drug Houses, Ltd.)

Sodium Mandelate—Boots in the treatment of Urinary Infections. Pp. 4. Hepastab in the treatment of Pernicious Anaemia. Pp. 26. (Nottingham: Boots Pure Drug Co., Ltd.)