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Progressive Science and Social Problems

THE attention which is to be given at the Aberdeen meeting of the British Association to the relations between the advance of science and the life of the community may well make the meeting one of the most notable in its history. To a noteworthy degree the Association has adopted a policy urged upon it some thirty years ago by Sir Norman Lockyer, "to promote the application of scientific methods and results to social problems and public affairs".

This policy may be regarded as the direct outcome of the interest and discussion aroused by the presidential addresses and certain sectional addresses at the York and Leicester meetings. The programme indicates that the majority of the organising committees of the various sections have given very careful consideration to the memorandum placed before them by the Council suggesting that papers, discussions or symposia bearing upon the relations between the advance of science and the life of the community should be included.

Section A (Mathematical and Physical Sciences), for example, is arranging a discussion, to be opened by Mr. C. C. Paterson, on developments in photoelectric cells and their applications, as well as on the repercussion of such developments in the economic and general social life of the community. Even on the scientific side this discussion should meet a great need, for the *modus operandi* of the 'talking film', for example, is understood by comparatively few. The economic and social problems involved have scarcely received clear and critical formulation, nor are the potentialities of the photoelectric cell for the automatic control of processes or the prevention of nuisances anything like so widely grasped as is desirable by industry or by the community at large.

The discussions before Section B (Chemistry) on vitamin C, and on the chemistry of milk, may be relied upon to provide social and economic as well as scientific interest. Of wide general interest also is a full and varied programme arranged by Section F (Economic Science and Statistics). This includes an important discussion on economic planning which will be summed up by Sir Josiah Stamp; papers on risk and its significance in modern economy, statistical investigations into industrial fluctuations, economic anomalies of unemployment relief, and the

organisation of the Scottish fishing industry will deal with particular economic problems of great social importance. Equally significant discussions are being arranged by the Section through its Department of Industrial Co-operation; Sir Josiah Stamp is to open a discussion on the need for a technique of economic change, while jointly with the Section L (Educational Science) an authoritative discussion has been arranged on the planning of a national policy of technical education and industrial recruitment. The presidential address to Section L will deal with the organisation of scientific work at the universities, while a session devoted to the development of post-primary education during the present century bears directly on the social and economic problems visualised in the Council's recommendations, and is closely related to the strictures recently passed on our educational system in regard to education for citizenship.

Much of the original impetus towards the consideration of the social consequences of scientific discoveries was derived from Section G (Engineering). The discussions on the reduction of noise, and Sir James Henderson's paper on the development of inventions as a stimulus to economic recovery, indicate no lack of interest in social implications in this Section, while Section E (Geography) can point to papers on the Aberdeen planning scheme and town planning generally, as well as to a specific discussion on the relations between scientific progress and social life. Papers to be presented before Section I (Physiology) on nutrition in relation to disease, and a symposium of food preservation, indicate the close concern of this Section with social problems; with the discussion on nutrition, Section M (Agriculture) is also associated. The presidential address to the latter section deals with scientific progress and economic planning in relation to rural industry and country life. It will be followed by papers dealing with the planning of agricultural production, the diffusion of scientific knowledge to the farmer and with the sociological problems of the countryside. Cattle rearing and feeding problems will be considered at another discussion.

The presidential address to Section J (Psychology), "Psychology and Social Problems", is also concerned directly with the theme of the Council's recommendations, while the social significance of a discussion on psychological and child guidance clinics and papers on industrial fatigue, bilingualism, vocational guidance, or a sociologist's view

of unemployment, equally attest the way in which the Section is seeking to focus attention on the social problems of the community.

The programme set before the Association at its Aberdeen meeting accordingly betokens a welcome assumption of scientific workers of their civic responsibilities, and indicates that an influential section of the scientific world is coming to think with intelligence and imaginative insight about social affairs. Though the indictment Sir Ernest Simon brought against both schools and universities in regard to education for citizenship is largely deserved, there are obviously honourable exceptions among the ranks of men of science themselves. The discussions before Section L (Educational Science) may, however, make some important contributions towards the realisation of Sir Arthur Salter's plea that a framework of elementary general knowledge added to specialised knowledge should be an indispensable condition for obtaining a university degree, particularly an honours degree.

The question of education is in fact fundamental in the consideration of the social aspects of science. It is not merely that the man of science must be capable of appreciating the non-technical social factors involved as well as the technical and scientific issues; he must secure also the sympathy and understanding of the lay public. A real problem of to-day is that of enabling the common sense of the people to receive the best services of expert statesmen and administrators for the co-operative enterprise of reconstructing the forms of government to fit this scientific age.

The Aberdeen meeting of the British Association is indeed planned to reach that public to an extent not previously contemplated, and if the exposition of scientific and technical knowledge and methods is commensurate with the scope of the programme, some very valuable educational work may be done. The scientific world has to popularise, not merely or even chiefly, its proposals for the scientific control of civilisation, but also the knowledge and method from which those proposals derive their force. Unless we succeed in conveying to the man in the street such a broad understanding of scientific knowledge, there is real danger that a scientific programme may be regarded as the mark of yet another purely political party.

While under modern conditions science and politics can no more be kept apart without damage to the State than science and social questions,

science is entirely unfitted to figure in the programmes of any political party. Unquestionably, as the field of scientific inquiry is extended into social, economic and political questions, the results of such methods and inquiries may lead to conclusions and to policies or programmes for action which are contrary to existing party principles or prejudices. The task of securing action upon the facts is, however, scarcely one for scientific workers as such. It is their responsibility as individual private citizens to do all in their power to secure the appropriate action. They have, however, one further public responsibility which they cannot lightly evade. This is the task of awakening public opinion to the grave danger incurred in the neglect to take action along the lines indicated by the results of impartial and scientific inquiry. In this work the organised expression of scientific opinion through the British Association, the British Science Guild, the Association of Scientific Workers or other means yet to be determined should be of decisive influence, for it is essential to educate public opinion to the importance of the general principle rather than on a particular question in which vested interests may easily confuse the real issues. The organisation of scientific opinion in a way that would be quite irresistible is well within the bounds of possibility, given the requisite will and vision among scientific men themselves.

For such reasons as these, the Aberdeen meeting of the British Association may come to be regarded as a landmark. There is now much more general agreement that our forms of government are at a transition point and may require considerable modification if they are to meet our needs under modern conditions. However far functional change is carried in a democratic system, some means must be found by which the scientific and technical expert can take his part in the work of administration. The possibilities in this direction have already been indicated by the functioning of the expert committees of the League of Nations. On the other hand, it is vitally important that whatever system of government is developed should allow full freedom of growth and development in scientific and technical matters. To limit the field of scientific inquiry, to prescribe research, or to allow obsolete prejudices persistently to bar action in accordance with scientifically ascertained facts, is treason to the scientific spirit, and speedily results in its atrophy. It is in an atmosphere of freedom and not one

of autocratic restrictions that the specialist can function in the way required. Above all, his contribution must not impose a further system of restriction or limitation on the general community. The closer association of science in the task of government is only possible on terms which admit of full and free discussion, of unfettered disinterested inquiry, of undiminished loyalty to truth and a vision characteristic of the great age of Greece.

For the scientific worker himself, he must be imbued with the ideal of service of the whole community, akin to the spirit in which scientific inquiry itself is undertaken. That spirit of service more than any other has prompted the scientific workers who meet in the British Association to inaugurate the many discussions to which we have referred. It has induced many of them to accept responsibilities of citizenship and of education from which they would willingly be free in order to pursue their scientific inquiries with greater energy. Their continuance in such tasks, their co-operation in the machinery of government to an ever increasing extent, cannot, however, be maintained on any sectional terms. Their help will be given in a spirit of wholehearted and unselfish service for the whole community as part of their allegiance to the supreme claims of truth, and no State which permits the wavering of that spirit or that allegiance can hope to withstand the pressure of modern conditions.

Matter and its Architecture

The Crystalline State. Edited by Sir William Bragg and Dr. W. L. Bragg. Vol. 1 : *A General Survey.* By W. L. Bragg. Pp. xiv + 352 + 32 plates. (London : G. Bell and Sons, Ltd., 1933.) 26s. net.

THE goal of chemistry is the determination of the atomic arrangement in space, which will be able to account for all the properties of matter under consideration. The greatest achievements in this direction have been obtained by the application of purely chemical methods, essentially because of the wonderful artistic skill of generations of chemists. Since von Laue's discovery of the diffraction of X-rays, and Sir William and W. L. Bragg's first X-ray analysis of the crystalline state, however, the way has been opened to a much more intimate knowledge of the atomic pattern. It is characteristic that the first results of the X-ray method dealt with the

stereochemistry of the solid state, which always had been nearly impossible to attack with previous methods. The X-ray method afterwards proved to be no less important for the structural analysis of liquids and of single molecules in the gaseous state, and this side of the development is by no means neglected in the first volume of the work before us; the title seems adequate because of the preponderant rôle the crystalline state has played in the great majority of investigations.

The first chapter gives an introduction to the general properties of the crystalline state. It furnished at the outset an opportunity to indicate how, with the introduction of the X-ray method, the centre of interest has changed. W. L. Bragg says: "In the past the study of the external crystalline form has been of the greatest importance, because it has been the principal means of identification and classification. The fundamental property of the crystal, however, is its atomic pattern and the external form is only one result of this pattern—a relatively unimportant feature, which depends in a complex way on external factors."

Having in this way centred the interest on the conception of a pattern based upon a space lattice, the second chapter is devoted to the diffraction caused by such a lattice. Here the author shows in a beautifully simple way how *three* conditions are required in order that the scattered waves may reinforce each other, and how two of these three conditions can be expressed as a reflection of the incident waves on any set of internal crystal planes, whereas the third leads to the famous Bragg-condition, between the angle of incidence, the distance of consecutive planes and the wave-length. The author underlines further that the pattern unit has no effect on the *positions* of the diffracted beams, whereas the configuration of the unit has, however, an important effect upon the *intensities* of the different spectra. Leaving the details of the interpretation of the intensities for a later chapter, the reader is sufficiently prepared for a discussion of the experimental methods. In the third chapter the Laue-method and its representation by suitable projections, the method of the ionisation spectrometer, the method of the rotation photograph, and the powder method, are treated; whichever one is to be employed depending on the form in which the crystalline material is available, whereas it is always of great advantage if more than one method is possible.

Everywhere in the book great care is taken to ensure that the reader does not feel lost in general considerations but remains in immediate contact with the actual facts. Thus the whole of the next chapter is devoted to the discussion of examples of crystal analysis. A few characteristic lattices are chosen (KCl, NaCl, ZnS, diamond, CaF₂, FeS₂), and step by step without effort the reader feels himself following a most agreeable guide.

The fifth chapter, on crystal symmetry, is the touchstone which shows the high skill of the author. Not that anyone doubts that W. L. Bragg possesses this particular aptitude, but in my opinion he has especially in this chapter excelled himself. After reading it I think nobody can possibly resist accepting his statement that "the complexities of crystal symmetry are more apparent than real".

The reader is next introduced to the principles of structure analysis. It is emphasised that it is always necessary to use a process of trial and error, and to the uninitiated it may appear at first sight as if complex structures could not successfully be dealt with. By many beautiful examples W. L. Bragg himself has amply shown that this is not so. Although as he says, "it is not possible to substitute the observed intensities in a formula which automatically yields the atomic parameters", no reasonable doubt is possible that in actual cases, notwithstanding the hundreds of parameters to be determined, correct atomic arrangements have been attained.

An investigator dealing with such questions should, of course, know as much as possible of the interplay of atomic forces in general, and of the arrangements which are preferred by the atoms. In the seventh chapter, the longest of the book, will be found the best opportunity to learn all that is desirable. The heteropolar bond, van der Waals' forces and atomic repulsion, the homopolar bond, the peculiar binding power of the hydrogen atoms, the metallic bond, the structure of alloys, the structure of organic compounds, the determination of the electron distribution in the molecules, are some of the topics. As in the same chapter Born's calculation of the energy of ionic lattices, and the explanation and calculation of the double refraction due to Silberstein's induction effect between the atoms, can be found, it is evident why this chapter had to be long.

Although it is true that ultimately the atomic arrangement in the pattern is of primary importance, it is not less true that many properties of

matter in the solid state are influenced by the size and orientation of the crystalline particles. So, what W. L. Bragg calls the 'geography' of the crystalline mass is also very important. Moreover, in this field much can be learnt by the X-ray method, and that is why a whole chapter, the eighth of the book, has been devoted to 'crystal texture'. It covers the field from the structure of liquids to that of cellulose fibres, wool and hair.

At this point, a first survey of the whole field being completed, the question of the structural analysis by waves in general is taken up a second time in Chap. ix on "X-ray Optics" and in Chap. xi on the "Diffraction of Electrons". Here the calculation of the scattering power of different atoms in its connexion with their electronic distribution, the use of Fourier series for the representation of the electronic distribution in crystals and for the interpretation of the reflected intensities, and last but not least, a treatment of the wave-properties of electron beams, are given. It is in connexion with accurate measurements of diffracted beams, so many of which we owe to Sir William Bragg and to W. L. Bragg themselves, that all these considerations become significant. By such a combination of a refined theory with experiments of high accuracy, we have already learnt a great deal more about the crystalline and the atomic structure, and we may confidently expect still more in the future.

A short summary of the application of X-ray methods to problems of pure and applied science in chap. X and a last chapter, xii, on the historical side of the subject make the volume complete in every respect. Six appendices on the production and properties of X-radiation, on the emission spectra and absorption edges, on absorption coefficients, on atomic scattering factors, on the deduction of the formulæ for the intensity of reflection and a table on the nomenclature of the space-groups will be of great use to everyone who is himself engaged in X-ray work.

The volume under review is intended to be complete in itself. It certainly is. Nevertheless, Sir William Bragg and W. L. Bragg intend to write a second and a third volume, in which the various branches will be developed in greater detail, with the collaboration of experts in the different parts of the subject. Once completed, the three volumes will be the most magnificent standard work produced for a long time, while the high note of the present volume can scarcely be surpassed.

P. DEBYE.

Studies in Comparative Religion

- (1) *Pagan Survivals in Mohammedan Civilisation*. By Dr. E. Westermarck. Pp. viii+190. (London: Macmillan and Co., Ltd., 1933.) 8s. 6d. net.
- (2) *High Gods in North America: Upton Lectures in Religion, Manchester College, Oxford, 1932*. By Prof. W. Schmidt. Pp. vii+149. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 7s. 6d. net.
- (3) *East and West in Religion*. By S. Radhakrishnan. Pp. 146. (London: George Allen and Unwin, Ltd., 1933.) 4s. 6d. net.
- (4) *Christian Myth and Ritual: a Historical Study*. By Prof. E. O. James. Pp. xv+345. (London: John Murray, 1933.) 12s. net.
- (5) *A Short History of Religions*. By E. E. Kellett. Pp. 607. (London: Victor Gollancz, Ltd., 1933.) 5s. net.

IT is instructive to reflect that, of the five books grouped together here, all dealing with the history of religion, each employs a different method of attack. That a subject should permit of this variety of treatment in the study of cognate material, without in any one instance incurring justly the charge of superfluity or irrelevance, argues a degree of vitality that is exceptional in academic studies.

It is the more gratifying to note these signs of vitality, as recently there has appeared to be a flagging in the attention given to the comparative study of religions. 'Origin' and studies of the component elements of the Christian religion, such as that by Dr. James, have a constant appeal for a certain class of student; but the criticism that comparative studies have divorced their material from its context has had no little effect. Yet it is difficult to arrive at general laws—the aim of philosophic study—without some measure of abstraction.

On the other hand, the trend towards realism in anthropological studies demands more than an analysis of belief, however subtle, which hangs *in vacuo*. Hence the emphasis now laid on the study of ritual. The administrator, for example, may well ask what is the advantage of the study of a religion which has no apparent relation to conduct; for conduct in a specific environment, after all, is the matter with which he is immediately concerned. To this point of view, the reply is that even the study of Christian origins

is not without its practical bearing. The problem of the early Church was not dissimilar from that of an administration charged with the rule of a people living under tribal institutions. In the early Church, just as in the modern instance, a conflict of authority called for compromise. The Church, after setting its face against the practices of paganism, solved its problem by adopting such practices as were conformable to its usage to meet the needs of those of its members who, as citizens in secular life, still felt the need, or were bound to participate in communal ceremonial, just as under, let us say, the West African system of indirect rule, an adjustment is effected as between the rule of the administration and tribal custom in which a higher and a subordinated loyalty may co-exist.

(1) Prof. Westermarck's "Pagan Survivals in Mohammedan Civilisation" embodies the text of a course of lectures delivered in the University of London in 1931. The author describes a number of popular beliefs and practices of the Moslem world, taking Morocco as his starting point, and shows that in their present context they can only be regarded as survivals, like flies in amber, from a pre-Moslem phase of culture. Some of them are unquestionably of Arab origin, antedating the rise of Islam, while others are native to the respective countries into which the Moslem faith has been introduced.

For an analysis of this character, Morocco affords an excellent, if difficult, field; for while it is agreed that the Arabs who settled in the country were probably few and had little lasting effect on its culture, apart from its religion, the Berber himself is of mixed origin and from earliest times has been subjected to a succession of influences from ancient Egypt, Libya, Carthage, Rome and the north. How far these varied influences have affected the culture of the area may perhaps best be studied among the various survivals with which the author deals in the many forms and ramifications of the belief in the evil eye.

The lectures are close-packed with detailed information so skilfully handled as to hold the reader's attention from the first page to the last.

(2) Pater Schmidt's book also embodies the text of a course of lectures—a series on the Upton Foundation of Manchester College, Oxford, delivered in the autumn of 1932. Unlike Prof. Westermarck, whose study of survivals is based on direct observation in the field, the author is

concerned with the analyses of material recorded by others, applying a theory and a particular method to a specific geographical area—North America. His lectures aim at showing that the religious systems of certain of the Indians of North America, classified in accordance with culture areas, imply the recognition of 'high gods', who are not otiose, but are creators, associated with the affairs of man, and objects of worship.

Without entering into a discussion here of the general theory of 'high gods', which the author has expounded fully elsewhere, it may be pointed out that in the instance of America, the view taken here of the primitive character of Amerindian belief, which is equated with the pygmy stage of human development in the Old World, demands a much earlier entry of man into America than either geologist, palæontologist or physical anthropologist is at present prepared to concede.

(3) In "East and West in Religion"—again a series of lectures delivered at Manchester College, with other discourses—the author's point of view is that the study of comparative religion, having advanced beyond the stage in which 'values' were in danger of being depreciated by the study of 'origins', its task is now the promotion of understanding on the basis that each religion has had, or still has, its contribution to make to human advancement. Hence he proceeds to show in these lectures how the West, having adopted an Eastern religion and adapted it to its needs, may still receive from the thought and religion of the East—here taken as essentially represented by India—some contribution towards the solution of ethical and religious problems of the day.

(4) In his study of Christian myth and ritual, Dr. James also is concerned with the analysis of a specific instance as an example of a type. The Christian religion is placed in an anthropological setting by a demonstration that certain elements in the precedent agricultural cults of ancient Egypt and Mesopotamia, the cult of the Divine King, have disintegrated and have been re-evaluated to take their place in the Christian cult, in which the central element is the death and resurrection of the deity, whence the pre-eminence of the Easter ceremonial over that of the Nativity in the early Church. Dr. James then proceeds to show how this concept of the divinity of the king, and the relation of his vigour to the prosperity of the country, is to be discerned in the whole ceremonial of the Church, coronation rites, ordination, marriage, burial and so forth, as well as in

popular customs and calendrical observances which have survived among the folk.

(5) The last book on our list requires little comment. It is an excellent historical survey of the main facts in the history of religions down to modern times, in which the treatment is impartial and objective. It is a marvel of compression.

Maps and Survey

Maps and Survey. By Arthur R. Hinks. Third edition. Pp. xiv+283+28 plates. (Cambridge: At the University Press, 1933.) 12s. 6d. net.

THE first edition of this work was published in 1913; subsequent editions, testifying to its popularity, have followed at intervals of ten years. It is not intended to be a textbook of surveying but "an explanatory introduction, unobscured by much detail, which shall exhibit the general nature of the operations, and the relations to one another of the various parts of the subject". In this respect we think it amply fulfils its object. The first seven chapters treat of maps viewed in their every aspect. Under the head of the history of early maps is collected, in a small space, an amount of information which could not be come by without reference to many original sources.

The modern map, on which no two people thoroughly agree, is fully dealt with. The various methods of representing topographical features are discussed in detail. Judging by the criticism one often hears, the public do not always appreciate the difficulties of the map designer. He has to produce something pleasing to the eye and at the same time a faithful, and easily understood, representation of the ground. This might not be difficult if the topography in each sheet were similar. But he has to deal with an infinite variety of ground covering the same series of maps, and of necessity must employ, if not the same at least a similar set of symbols, for it would be inconvenient to have the method of representation changing from sheet to sheet of the same series. In fact, as in many other things, compromise must largely enter into map design. British official maps and foreign maps, especially those of Europe, are treated in some detail, the chief features being commented on of the maps of each country.

The last six chapters are devoted to modern survey methods and instruments. Most of these are models of popular exposition of sometimes difficult subjects, while others, such as the chapter

on the geometry of air photographs, may rather frighten the non-technical reader. Nevertheless, the ordinary reader who wishes to learn as much as possible about maps and how they are made cannot fail to have his interests immensely widened by one who is a master of the subject.

We recommend this book not only to the student of maps and survey, but also to the Colonial administrator. It would be to his own and his country's advantage if he were to study it, for it is "the truest economy to push forward the survey of a country at the earliest possible moment". This, however, is very often not recognised by those in administrative positions, who frequently display a lack of interest in maps and everything connected with them. The book contains a set of well selected illustrations.

H. L. C.

Progress in Enzyme Chemistry

Ergebnisse der Enzymforschung. Herausgegeben von F. F. Nord und R. Weidenhagen. Band 3. Pp. xii+355. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 28 gold marks.

WORKERS in the domain of enzyme chemistry, the boundaries of which continue to enlarge, have begun to look forward to the appearance of the "Ergebnisse", with its neat summaries of particular branches of research, and we believe they will not be disappointed with this the third issue. As before, it is international, four of the articles being in English; they have been selected to cover sections which have not previously been summarised. It is proposed briefly to indicate the subjects chosen.

W. Frankenburger deals with enzyme reactions from the point of view of heterogeneous catalysis. Dean Burk of Washington discusses azotase, that enzyme system or complex in the aerobic soil organism that catalyses the change of gaseous nitrogen from a free to a fixed state. It differs from the majority of enzyme systems in that its activity is normally limited by the extent of growth, that is, by the amount of cell synthesis. Its nature has so far been investigated by means involving the methods of physical rather than organic chemistry, and as yet knowledge remains vague as to the stages during the conversion of nitrogen into protein.

Under the title of the action of enzymes in the living cell, A. Oparin of Moscow describes experiments dealing with the inactivation of enzymes on adsorption and their reactivation by elution;

perhaps a similar mechanism regulates enzyme activity in the cell. Of considerable interest is the article by G. A. van Klinkenberg of Oss on the specificity of diastase, which the Germans term amylase, developing Kuhn's striking discovery that there are two forms of this enzyme—one setting free α -maltose and the other yielding β -maltose from starch. This work has scarcely as yet received general recognition, though it is possibly the most important step forward of recent years in relation to the whole vexed question of the structure and hydrolysis of starch. The author considers in a summary that starch hydrolysis is brought about by two enzymes rather than by several: he emphasises the great variability in the physical character of different starch preparations.

There follows a lengthy account of the breakdown of starch and protein by the enzymes of malt by Albert Hesse, this being a well-studied industrial operation about which there is always something new being discovered.

The same applies to oxidation-reduction systems as catalysed by enzymes described by Hans von Euler, who comments among other things on the yellow flavine enzyme and vitamin B₂.

Robert Sonderhoff describes yet another yeast

enzyme—the dehydrating system—whilst K. Bernhauer of Prague deals at somewhat greater length with the important oxidising fermentations caused by the lower organisms, particularly mould fungi and bacteria. Such reactions include the formation of gluconic acid, also acetic, fumaric, citric and oxalic acids, some of which are to-day technical manufacturing processes: in this field there is a fairly clear understanding of the course of events.

Phosphagen and its place in muscle biochemistry is described by P. Eggleton of Edinburgh, whilst there is a comprehensive article by H. A. Krebs from Cambridge on urea formation in the animal body, which gives a most useful summary of the urea synthesis from ammonia. The latter author emphasises the twofold significance of urea formation, namely, the conversion of the very poisonous ammonia into an extremely indifferent substance by a means avoiding the sacrifice of organic acids which, without urea synthesis, would be necessary to neutralise the ammonia formed in protein metabolism.

An article on catalase by Zeile is followed by one by F. J. W. Roughton on the newest of the enzymes, namely, carbonic anhydrase.

This volume contains a subject index to itself and to the two previous volumes. E. F. A.

Short Reviews

Extra-Sensory Perception. By J. B. Rhine. Pp. xiv + 169 + 3 plates. (Boston, Mass.: Boston Society for Psychic Research, 1934.) n.p.

DR. RHINE has published in the volume before us the record of some 90,000 trials conducted at Duke University, North Carolina, in what the author terms "extra-sensory perception (E.S.P.)". The phenomena described by these words are substantially the same as those usually named in England 'clairvoyance' and 'telepathy'. The ability of the subjects is tested by the use of certain designs on cards, packs of the latter being 'called through' under various conditions (clairvoyance), or the design is merely imagined by the agent and thence transmitted (telepathy). The results of the guess are recorded in every case, and when subjected to mathematical analysis, are found to exclude entirely the chance factor as an explanation of the high scores obtained.

The object of the experiments was to answer the question as to the occurrence of E.S.P. by mathematically indisputable evidence, and also to gain some insight into the conditions of that occurrence. Dr. Rhine claims to have demonstrated the first conclusively and to have made some headway towards his second objective. He appears to have been fortunate in obtaining so

many subjects who were able to demonstrate their remarkable gifts, although it is possible that other investigators have been more critical in their requirements, for Dr. Rhine, it would seem, was convinced of the reality of E.S.P. before he started his own experiments, mentioning such suspicious tests as those formerly given by the Creery Sisters as contributing to his conviction. Moreover, his own report is singularly lacking in those details which are vital to a proper understanding of his methods, as for example a full description of the cards employed and the means adopted thoroughly to shuffle them. A repetition of the experiments under much more stringent conditions would seem desirable, as it is clear that, if confirmed, the phenomena present problems of great interest and complexity.

The Flora of Iceland and the Færoes. By C. H. Ostenfeld and Johs. Grøntved. Pp. xxiv + 196. (Copenhagen: Levin and Munksgaard; London: Williams and Norgate, Ltd., 1934.) 6s. net.

THE appearance of a modern flora of Iceland and the Færoes in English will be much appreciated by tourists and also by those botanists who are interested in boreal and arctic floras but cannot read Danish or Icelandic. The text follows Engler

and Prantl's system of classification and is of the descriptive key type, there being a general key to groups and families at the beginning. Many distinctive genera and even species are keyed out at this stage, a fact which may often save a great deal of the user's time. There are further keys to the species under each genus, providing a sufficient description of each species, together with information as to habitat, localities in each island group, time of flowering, etc.

The work includes much of the latest research on the floras of these regions. In addition, the authors have had the assistance of specialists in certain critical genera and this much enhances the value of the book. The chief criticism which may be made is that the international rules of nomenclature are not always adhered to, particularly in respect to hyphenated trivial names, while the taxonomy is sometimes rather out of date; for example, the treatment of *Habenaria*.

The format of the book is excellent, the printing good and the type judiciously selected. There are a few typographical errors, one of the most serious being *Agrostis cania* for *canina* on p. 20. A glossary, indexes to the popular names used in the two countries and two sketch maps add much to the usefulness of the book, which is of convenient pocket size.

V. S. S.

La fécondation chez les animaux et chez les végétaux.

Par Dr. Henri Coupin. (Actualités scientifiques et industrielles.) Pp. 203. (Paris: J.-B. Baillière et fils, 1934.) 22 francs.

DR. COUPIN has produced a descriptive account of gamete and zygote formation in the principal kinds of plants and animals, with 112 figures and an index of the names of the plants and animals cited. The matter is arranged according to a scheme explained in the introduction. The first division is made to depend upon whether the zygote is formed inside or outside the body of the organism. In each of these categories we have a series showing isogamy and one showing heterogamy. The further subdivisions depend upon the mobility or immobility of the gametes. So far as possible technical terms have been omitted. Subjects such as nest-building and special mating habits are treated to some extent under the various groups. The information given appears to be generally reliable, but the scheme of arrangement naturally leads to the various types of plants and animals being grouped in a somewhat unusual manner. One result of this is that coelenterates are all considered as being forms in which the zygote is produced within the body of a parent animal.

The book can scarcely be described as one to be read through, but the main facts have been collected between one pair of covers as an extended summary of the subject, which should be useful to students, and for reference when not too much detail is required. Whether the matter in the form in which it is here presented will be of interest to those whom the author calls "les profanes éclairés" is more doubtful.

Allgemeine Konstitutionslehre in naturwissenschaftlicher und medizinischer Betrachtung. Von Prof. Dr. O. Naegeli. Zweite Auflage. Pp. vii + 190. (Berlin: Julius Springer, 1934.) 16.20 gold marks.

IN recent years two general works have appeared dealing with human heredity from the genetical point of view, namely, that of Ruggles Gates, and the Baur-Fischer-Lenz volume which has been translated into English. Various other books have been written treating particular aspects of the subject or dealing in greater detail with limited fields.

Dr. Naegeli's treatment is from the constitutional viewpoint, yet he says little of Kretschmer but introduces a number of general biological discussions. A section of 26 pages discusses the conception of species, with illustrations mainly from botany, including several coloured figures of orchid varieties. The section on hybridisation also takes its material mainly from the plant world. The final 50 pages are devoted to a discussion of the relation between constitution and infectious diseases, including tuberculosis and various forms of anæmia. A classified list of human abnormalities is given with, for the most part, very little regarding the methods of their inheritance. The author appears to have been unable to make up his mind whether to write a book for medical men or for naturalists, but perhaps this will appeal especially to his Swiss fellow-countrymen in medicine who, it is well known, receive an exceptionally wide biological training.

A Garden in the Veld. By R. E. Boddam-Whetham. Pp. 290. (Wynberg: The Specialty Press of S.A. Ltd.; Ashford: L. Reeve and Co., Ltd., 1933.) 16s.

IN this book the author relates her experiences in laying out and cultivating—as a flower garden—the ground of the homestead of a newly acquired farm in the Orange Free State in South Africa. The writer admits that she commenced activities as a beginner with little knowledge of plants or gardening. The photographs bear testimony to the success that has been attained and to the skill she had obviously acquired as a cultivator under somewhat exacting conditions.

A special chapter is devoted to 'wild flowers', or the cultivation of ornamental indigenous species, but relatively few species are dealt with. Here the difficulty of successfully cultivating many of the wild plants is pointed out. It is regrettable that plants are sometimes referred to by common names only; for example, 'silver-lace', 'cotton-bush' (not *Gossypium*) with the result that readers outside the area cannot be expected to know what plant or type of plant is intended.

The book is written in a light or popular style and the notes and advice that the writer offers should be of interest and help to others, similarly situated in the 'high-veld' in South Africa, who are desirous of improving their gardens and surroundings.

Research and Road Traffic

By MERVYN O'GORMAN, C.B.

VARIOUS are the routes by which people attain the state of being 'firmly convinced' or 'absolutely sure': some will have been at pains to assimilate a sufficiently cogent proof, others will have got there by accepting idly what is called 'common knowledge', others more easily still by reiterating sufficiently an unproved but specious assertion. Politically, all these convinced persons are important—notably the last group—for reiteration is one of the instruments of politics. This group may be quite unaware of standing on weak ground but, on occasion, their subconscious recognition of futility is revealed by this token: that they are roused to a surprising anger by reasoned dissent, whereas the others can mostly entertain discussion, welcome a new viewpoint and derive pleasure from that valuable stimulus to thought—reasoned argument. The road traffic problem is one of multitudinous complexities but is so deceptively simple in appearance that assertions concerning its solution are rife, and strong convictions fortified only by 'it stands to reason' are almost universal. Everybody knows! This very universality would be convincing (such is another of the strange routes that lead us to our fixed judgments) were it not that a good few of us have a healthy suspicion of views upheld by imputing ill motives and supported by an indignation which, however well warranted at large, is directed with animus and without proof against some arbitrary mark.

It is into this matrix of somewhat unpromising public opinion that Sir Auckland Geddes, Dr. C. S. Myers and others—all too few—are instilling a self-questioning doubt so that, one day (the sooner the better!), a public demand must arise for such scientifically guided experiment and research as shall reveal the true prime causes of road traffic troubles—and substitute knowledge for guesses and emphasis. Dr. Myers and the staff of the National Institute of Industrial Psychology, as well as Sir Auckland Geddes, probably have their private theories, and even their prejudices, on road questions, but their minds are sharp enough to cut through the emotional fringe. They perceive (1) that they in fact do not know, (2) that no one else knows. Hence their desire that the Government shall be instructed to appoint disinterested persons to *find out* by the only known method—the scientific one.

The modes of appeal to the public of Sir Auckland Geddes and Dr. Myers are, however, widely different. Sir Auckland, knowing that his English audience have nice, kind and (ashamedly) sentimental hearts, warms them by a picture for their souls' awakening. He writes: "this morning, I saw a fair-haired infant turned out with a 'kiddy-car' to play on an arterial road along which lorries, omnibuses and cars were passing in endless streams". Appealing to gentlemen, he selects a blonde!—then he comes to business:

"may we have an authoritative scientific inquiry to find out what we ought to do and avoid doing . . ." on one hand, for road safety and, on the other, for "the fullest possible development of the manifold uses of the internal combustion engine applied to Road Transport" (*Times*, July 7). He gave piquancy to his appeal, for he preceded the sentence quoted with the words: "Now that Parliament has almost finished its labours on this subject . . ." thus exposing the humour of thirty-three years of Parliamentary legislation in road matters, namely, preselecting the culprit, ordaining his punishment and then, perhaps, inquiring as to who might be responsible. In the circumstances he is right: better inquire late than not at all. It might turn out that the chief blame and responsibility for seven thousand deaths yearly on the road should fall on the triviality and ignorance of Parliament—albeit such home-truths—if true they be—should be stated very circumspectly by a wise committee of inquirers.

Having for years advocated this research, I observe that Sir Auckland Geddes' method of pleading is effective. I have had minor proofs. An appreciable number of persons have troubled to cut out his letter and post it to me! Some do so with approval, and one actually with anger—as at a transparent attempt to delay by research the pleasing institution of extra punishments and speed limits which 'stand to reason'.

In the journal of the National Institute of Industrial Psychology, the *Human Factor*, for July-August, Dr. C. S. Myers goes to work otherwise. He is not content with the mere advocacy of research. He does it. He leads by example. He has an organisation, and limiting himself to one subsection of the problem—the drivers—he has measured their speed of reaction, vision, vigilance, resistance to distraction, judgment of speed and size, etc. He and his staff do many of these tests in ingeniously simple ways, such that they cost little and can be applied to batches of eight persons. In this way, it appears, the time of the complete examination is shortened to about thirty minutes*. Having obtained groups of results and ascribed a tentative figure of merit to each man tested, he proceeds to standardise them, or rather to give to his laboratory observations a 'road user' value by comparing his figures of merit with those obtained from the records taken by the men's employers in relation to their previous and subsequent driving on the road.

It is good to hear that these selection tests have,

* The instrument by which a driver controls a dummy motor vehicle, while it appears to travel along a road, of which the image is projected on a cinema screen, is of wonderful ingenuity—but in my view, unless altered, this device is liable to mislead both examiner and examinee, especially whenever the latter is acutely responsive to the optical suggestion of an acceleration which fails to eventuate. In my own case I was made 'sea-sick' for some thirty-six hours after fifteen minutes of the test and therefore, feeling ill, I certainly drove below my form—which happens to include no road casualties in the last thirty years and only a trivial one in the six years preceding that.

on trial, proved to be economically remunerative to certain employers of road vehicles. "Thus in Paris," Dr. Myers says, "whereas the frequency of accidents caused by taxis, private cars and lorries *increased*, between the years 1923 and 1932, by 145 per cent., the accident frequency caused by the omnibuses and trams of the General Transport Company of Paris since their use of selection tests during the same period *decreased* by 30 per cent." Thus we have an instance of how research on one single element (and not the biggest element) in road traffic movement can save life and money.

This kind of verification is admirable. I trust that we may expect this class of testing to become habitual with employer companies. It will incidentally accumulate information of great value to governments.

Equally admirable is Dr. Myers' scientifically inspired restraint. We learn that he resisted the quick enthusiasm of a certain politician who was swept along too fast by zeal for this excellent work. Dr. Myers adhered to his conviction—born of knowing his job—that to make such a test compulsory on all applicants as a condition for obtaining a driver's licence should not be yet. It is one thing to use it for what it was designed, namely, selecting the safer men among a firm's practised drivers, and quite another to use it to bar persons for ever from acquiring driving experience on the basis of a test calibrated in terms of practised drivers. *Experto crede*.

No form of test so far enforced by any foreign government for the granting of driving licences, and none that has been advocated for Great Britain within my knowledge, deserve other than the fervent opposition of pedestrians as well as motorists. They can do nothing for safety—they do not discover the cause of the driver's faults—nor are his really bad habits likely to appear until the inspector has left and his supervision been forgotten. Examination in the Road Code is good and should be enforced on all road users, else obedience to it cannot be relied upon. (This is because all road safety has for its basis the possibility for each traffic unit to know in advance what the other unit is to be expected to do: not necessarily by hand signals, but by always obeying a known code of conduct.) Nevertheless, the line of research represented by the work of the National Institute of Industrial Psychology is bound to develop if given the encouragement it deserves, and to produce that foundation of knowledge on which a really valuable scheme for licensing tests could eventually be based. Holding such views and such expectations, I feel that the achievements and studies of the Institute warrant a much more generous recognition by the Minister than a pat and a cheap cliché. He said, "He would certainly watch the future of these experiments with much interest . . . !"

Instead of this detached and platonic watching, the Minister (who had just previously administered a *bonne bouche* of £5,000 to an organisation the function of which is to repeat 'take care' by poster

and by preachment) should have given double this amount to an Institute which is doing the difficult thing: discovering 'how to take care'! In return for the subsidy the Government would no doubt stipulate for access to the information that is being and would be increasingly accumulated.

Be it noted that our information on what constitutes 'taking care', on how to 'take care', on who should 'take care' and when, and on how to provide that people shall be imbued with the instinctive reaction to 'take care' in the right way on the roads, is practically nil.

Let us see what the psychologist—dealing with a totally different class of accidents—those relating to the breakage of crockery in restaurants—has to say about this 'take care' business (see *Human Factor*, July–August).

"Before the importance and the complex nature of this 'human factor' were adequately recognized, factory accidents were attributed mainly to culpable 'carelessness', foolish recklessness, and to dangerous machinery" (p. 267). "The average man . . . is disposed to ascribe breakages, like all other accidents, to 'carelessness', and hence to regard punishment . . . as the most appropriate measure for their reduction. But 'carelessness' has no precise psychological significance, and punishment is now recognized educationally as an inadequate and often ineffective remedy for defective conduct. To allege carelessness, as the cause of an accident, merely implies the fallacy that if sufficient trouble or attention had been given, the accident would not have occurred. Both punishment and the notion of carelessness are merely excuses for not inquiring into the ultimate causes of defective behaviour" (p. 269).

It is remarkable that each word of this quotation as well as the conclusion, albeit a general statement on a widely different subject, applies closely to road accidents, and is an unconscious plea for scientific research on road matters. Moreover, it falls in with Sir Auckland Geddes' plea. The national, economic and social interests that depend on the proper fostering of the industry of road transport and transit require that it shall have a research section of scientific men. It is abundantly clear that to be fruitful this reference to research must on no account be confined to accidents but must be directed to illuminate us on the fullest possible safe development of the manifold beneficial uses of road transport.

It may here be remarked that, in road questions, fatalities—not accidents—are commonly invoked, because in other contexts, for example, railway accidents, a Board of Trade decision provides that casualties are not to be counted until they reach a certain standard of seriousness (such as incapacitation from work for a prescribed number of days). On the other hand, road casualties are to be all reported (since 1930), whether significant or not, under severe penalties. Hence the complete break in the curves of casualty statistics in 1930—whereas the road fatalities give a curve. The introduction of the Road Code in 1930 (at the

same time as the removal of speed limits) reduced the total of fatalities so greatly that despite the increases of vehicles and the increase of exposure in two abnormally fine weather years, the peak of fatalities in 1930 has not yet been touched again.

The scientific method would assuredly require us to relate the number of road fatalities in a place to the amount of traffic flow (pedestrian and other) there. It would establish at an early moment the machinery for measuring and recording increments of safe traffic flow—and thus would enable us to determine to what extent each alteration of, say, police control, or pedestrian behaviour, or of road layout, etc., conduced to it. It would quickly determine for us the vehicular spacing and speed which would give to a bridge or tunnel its maximum safe carrying power. It would restrain a Minister who desired to say he had "no concern with the *accident ratio*, but only with accidents", for it would cause him to realise the fatuousness of such a remark. It could not fail to observe that a year having an abnormally large number of fine, dry summer days (such as had not been known for thirty-eight years previously) must give rise to a manifold increase of the amount of exposure (that is, vehicle, pedestrian and bicyclist hours on the road). It would not allow this to be dismissed as irrelevant when imputing to an increase of misconduct a three or five per cent increase of road deaths during such a year. It would measure instead of guessing the relative merits of 'traffic lights' and 'roundabouts' for road crossings, respectively in town and country. It would follow up the psychological work needed to evolve safe instincts in the pedestrian and driver. It would not permit misleading statistical statements as to causation of accidents to appear unqualified by the necessary scientific reservations. It would bring the noise

nuisance within the range of things measured, and therefore make it controllable without imperilling the industry. Street and vehicle illumination, so far as it affects drivers and walkers, as well as the dazzle problem, would come within its purview, and so would the evaluation in terms of accidents and in terms of cost of non-skid roads, light-coloured road surfaces, proper sign-posting, and street naming—to give only a few examples.

A scientific inquiry would, in addition, lead us to the study of: the effect of alcohol or fatigue on the rapidity of drivers' and pedestrians' reactions, and the amount of slowing of reactions which may be significant. The true distribution of responsibility for causing vibration as between vehicle and road construction. The effect on road wear of various speeds—and of various weights—and of various intensities of pressure at the tyre. The economic advantages, or the reverse, of dispositions of traffic which are to-day left to speculation, the effect of trailers or, say, the values to be got from statistical knowledge of the average vehicle's circular journey in a town. The balance sheet of advantages, safety or road economy obtainable from providing for or prohibiting the *standing* of vehicles. There is no end to the list, for I realise as I am sketching out the services that a research committee could render that a full list would be tantamount to a statement of the essential knowledge which hitherto governments have neglected to obtain. In many instances they have even neglected to seek it.

In England, where, of the sixty-four millions sterling contributed by motorists alone, two thirds are taken away from the service of the road users' urgent needs, there is no warranty whatever for continuing on a course of parsimony which denies us the support of science and is paid for in the flesh and blood of the road users.

Interactions of Gases and Ores during Iron Smelting

FOR some years past, under the auspices of the National Federation of Iron and Steel Manufacturers (now the British Iron and Steel Federation), an experimental inquiry has been carried out at the Imperial College of Science and Technology, London, under the direction of Prof. W. A. Bone, into the interactions of gases and ores during blast-furnace iron smelting. The results of this investigation have been embodied in a series of communications to the Iron and Steel Institute in 1927, 1930 and papers read at its meeting in London on May 31 last. The latest report (Part 4) is of special interest in that it deals comprehensively with (1) equilibria in the systems $Fe_xO_y + yCO = Fe_xO_{y-1} + yCO_2$ between 750° and 1150° C., and $Fe_xO_y + yH_2 = Fe_xO_{y-1} + yH_2O$ between 450° and 850° ; and (2) the relative velocities of ore reduction by the carbonic oxide in blast-furnace gas over a temperature range of 450° – $1,000^\circ$ under the same conditions as regards gas speeds and composition as are met with in the blast-furnace itself.

While equilibria constants in the reversible reactions referred to are independent of the speed of the gas-stream involved, it has been found otherwise with both the absolute and relative velocities of ore reduction at a given temperature. One of the difficulties of the laboratory investigation has been the accurate determination of such velocities under the conditions of high gas speeds (up to 50 ft. per sec.) actually prevailing in blast-furnaces. This difficulty was, however, successfully surmounted, and the subsequent ore reduction velocity measurements were carried out at each of five selected temperatures (450° , 650° , 750° , 850° and 1000° C.) and in each case at each of three gas speeds (4, 16 and 48 ft. per sec.)—corresponding with slow, medium and fast rates of driving in the blast-furnace—in such a manner as enabled relative velocities to be determined precisely under these conditions, not only throughout the whole range of ore deoxidation up to 90 per cent completion, but also for every CO_2 -content of the blast-furnace

gas up to the CO/CO₂ equilibrium ratio at the particular temperature involved. Such conditions comprise all that are likely to be met with (as regards ore reduction) in the blast-furnace between the temperature limits referred to.

The results obtained show, *inter alia*, that (as might be expected) at each temperature the velocity of ore reduction diminishes progressively as the reduction proceeds and the carbon dioxide content of the gases increases. Such rate of decrease is not, however, uniform with the state of deoxidation of the ore, being generally smallest when the ore is about half reduced. While an increase in the gas velocity from 4 ft. to 16 ft. per second invariably resulted in an increase in the relative reduction velocity at all the temperatures investigated, a further increase in the gas speed to 48 ft. per second reduced the ore reduction velocity at 650° but increased it at 850°.

The results have also shown conclusively that there are three definite stages in the ore reduction, corresponding with the three known oxides of iron, namely, Fe₂O₃, Fe₃O₄ and FeO.

The main interest of the research lies, however, in the discovery that, as regards the third stage (that is, FeO → Fe)—which comprises two thirds of the whole deoxidation—the rate of ore reduction for corresponding speeds and compositions of the gas throughout the range 650°–1000° C. in the furnace is at a decided minimum between 750° and 800°–850° C. This applies to all the three gas speeds examined, and points to there being a change in the mechanism of ore reduction by carbonic oxide round about 750°. Thus, the relative velocities at 50 per cent ore reduction, for each of the three gas speeds in question, varied as in the accompanying table with the temperature

Relative Ore Reduction Velocities by Blast Furnace Gas (in terms of units of oxygen removed per unit time)

Temp. °C.	650			750			850			1,000			
Gas velocity ft. per sec.	4	16	48	4	16	48	4	16	48	4	16	48	
Percentage CO ₂ in the Gas	2.5	3.2	3.5	1.75	1.2	1.4	1.05	1.85	2.0	4.55	11.8	13.5	12.0
	5.0	2.1	2.6	1.15	0.9	0.95	0.7	1.1	1.3	4.2	7.0	11.1	7.4

and CO₂-content of a 'blast-furnace gas' originally containing 33.4 per cent of carbonic oxide and 66.6 per cent of nitrogen (that is, CO + 2N₂).

This last-named discovery would seem to be of great importance to blast-furnace practice, especially as 750° is the temperature at which the strongly endothermic decomposition of any limestone (CaCO₃ = CaO + CO₂ - 42.5 k. cal.) in the burden presumably would be beginning to affect the furnace conditions, and therefore the 750°–850° zone may be of considerable extent in the furnace. Moreover, since the research has also shown it to be that in which ore reduction by any impregnated carbon becomes vigorous, its precise location in the furnace would now seem to be an important matter. Indeed it is clear that if the industry is to reap full benefit from the research, a systematic exploration of the temperature, composition of gas, and ore reduction conditions in blast-furnaces smelting typical ores has now become imperative.

This consideration has so strongly forced itself upon the British Iron and Steel Federation that some months ago a sub-committee was set up, with Prof. Bone as chairman, to consider whether (and if so, what) steps can be taken with a view of organising, and afterwards carrying out, systematic investigations on some typical British blast-furnace plants, and to correlate the results so obtained with those of the laboratory research since its inception.

The sub-committee, having completed its preliminary survey of the matter, has unanimously reported that such an investigation on typical blast-furnace plants is both practicable and highly desirable. Also, certain blast-furnace proprietors and managers who have been approached on the subject have expressed their approval of, and willingness to co-operate actively in, the project, and an experimental trial carried out in December last on a blast-furnace at Park Gate Works,

Rotherham, by Mr. F. Clements and his staff, has proved its practicability. So that not only does the time seem ripe, but also the atmosphere is favourable, for putting it into operation, and steps are being taken accordingly. Thus there is now every prospect that the work on

the chemical phenomena of iron-smelting, begun by Lowthian Bell sixty-five years ago, may be carried to completion in the country of its origin.

Obituary

MR. H. GLAUERT, F.R.S.

SCIENCE and aeronautics have suffered a severe loss through the fatal accident to Mr. Hermann Glauert on August 4. Mr. Glauert was walking with his brother and his three children, and stopped to watch the blowing-up of a tree-stump; a large piece of wood, projected nearly 100 yards, struck and killed him instantly.

Born in Sheffield on October 2, 1892, Mr. Glauert

was educated at King Edward VII School and Trinity College, Cambridge. He was a Wrangler with distinction in the Mathematical Tripos in 1913: was awarded the Tyson Medal for 'astronomy and related subjects', the Isaac Newton studentship in 'astronomy and physical optics' (1914), and the Rayleigh Prize for mathematics (1915). He joined the staff of the Royal Aircraft Factory at Farnborough in 1916. In

1920 he was elected a fellow of Trinity, continuing to work at Farnborough. He was a fellow of the Royal Aeronautical Society and he was elected a fellow of the Royal Society in 1931. He married, in 1922, Muriel Barker, a Newnham mathematician and one-time colleague at Farnborough: he leaves two sons and one daughter. He had been for some time a principal scientific officer, and last April he succeeded the retiring head of the Aerodynamics Department of the Royal Aircraft Establishment. He had achieved a world-wide reputation in aerodynamical circles.

Glauert combined, with great mathematical knowledge and ability, a fine physical insight and a talent for approximation, which fitted him peculiarly to satisfy the needs of the aeronautical engineer. His knowledge of German, in addition, placed him in a position to follow the work of the German aerodynamical school. The pioneer work of Mr. F. W. Lanchester, given to the world in his "Aerodynamics" in 1908, received too scant attention in Great Britain, but it inspired Dr. Ludwig Prandtl of Göttingen. The work of Dr. Prandtl and his students spread throughout the world after the War. Glauert was quick to appreciate its value and to introduce it to English readers through his translations.

Glauert concentrated mainly on this line of study and made many original contributions to the theory of aerofoils. Perhaps the most important was a rational theory of the airscrew, which adequately fitted experimental observations and provided a sound basis for practical design and for further study. When the autogiro appeared he successfully turned his attention to an aerodynamic analysis. He also followed up the work of Joukowski and Kutta in deriving the flow round an aerofoil by conformal transformation, extending the method to sections with a finite angle at the trailing edge and originating the later series of R.A.F. sections. He deduced the effect of compressibility of the air on the performance of an aerofoil while streamline motion persists.

Glauert's papers published by the Aeronautical Research Committee were numerous, and he contributed also to the *Proceedings of the Royal Society*. His textbook, "The Elements of Aerofoil and Airscrew Theory" (1926), met a real need and has been widely used; he was awarded a medal for it by the Aero Club de France. More recently, he contributed a part to a more ambitious work undertaken by the Guggenheim Fund under the editorship of Prof. W. F. Durand, of Stanford University. But the full measure of his influence is not to be found in his published papers alone: he was a constant guide and source of inspiration to his colleagues, and he had given enough proof of administrative ability to show that he would make a good head of a research department.

Glauert's habits were tidy, punctual, systematic: his style clear and concise. A rapid worker with great power of concentration, he could turn his mind aside and was ever ready to discuss any subject, a quick and tenacious debater; but he

was always loath to deal seriously with problems in any branch of which he did not feel himself master. Outside his work he mixed freely and joined with zest in games and social activities. He will be keenly missed by his associates both at work and at play.

PROF. W. C. CLINTON

WE regret to record the decease of Prof. Wellesley Curram Clinton, who succeeded Sir Ambrose Fleming as Pender professor of electrical engineering in University College, London, in 1926. He had been prevented for the last three months from attending to his University work by illness, which was not considered to be serious at first, but in August it took an unfavourable turn and to the grief of his relatives, friends and colleagues, he died on August 18. He was sixty-three years of age, having been born in London on October 28, 1871, and he received his early scientific education at Finsbury Technical College under Profs. Ayrton and Perry.

Prof. Clinton had been officially connected with University College for forty-one years. He went as assistant to Prof. Fleming in 1893, when the present Engineering Laboratories were opened, and was appointed successively demonstrator in 1894, assistant professor in 1906, sub-dean of the Faculty in 1919 and Dean in 1934, but did not live to take up that last office. He was elected a fellow of the College in 1920 and fellow of the City and Guilds of London Institute in 1933. He was elected a member of the Institution of Electrical Engineers of London in 1912.

From 1893 until 1926 Clinton assisted Sir Ambrose Fleming in the work of the Electrical Engineering Department of University College with the greatest efficiency and devotion to his duties, and a large number of those now eminent in the electrical engineering profession were his students and will remember with great affection his effective teaching and kindly help. His amiable disposition and efficiency in work made him extremely beloved and appreciated, and his loss will be deeply felt as he was to the front in all that concerned the welfare of the College.

In addition to his College work Clinton found time for some scientific research. He made a speciality of photometry. He translated into English a book on that subject by Dr. L. Bloch, and he published a very useful book on "Electric Wiring" in 1902. He was a contributor to a work on "Modern Electrical Engineering" edited by Sir Magnus MacLean. He also wrote papers on the voltage ratios of the inverted-rotary converter (*Proc. Phys. Soc. Lond.*, 1906), on the efficiency of direct current machines by the Hopkinson method, on a comparison of estimated and observed values of illumination in some lighting installations and on some photometric tests of brightness of radioactive materials. He could have done more research work were it not for his entire devotion to his College duties.

News and Views

Traffic Noise and the Ministry of Transport

THERE is evidence that Great Britain is becoming noise conscious; and we have had occasion during the last few years to refer to the subject of noise measurement and noise control as conducted at the National Physical Laboratory and elsewhere. Certain directions in which traffic noise might well receive the attention of the Government were put before the Anti-Noise League at its recent meeting at Oxford (see NATURE of July 28, p. 149). As from August 27, the Minister of Transport has now decreed a zone of silence for the London area, the hooting of horns being entirely prohibited at night (between 11.30 p.m. and 7 a.m.) within a radius of five miles from King Charles's statue at Charing Cross. London Transport is also instructing its tram drivers not to use gongs in the prescribed area. To judge by the experience of Paris, Brussels and Rome, where no increase in road accidents is reported as the result of similar measures, the experiment is likely to be wholly successful, and relief from, at any rate, one type of noise will be experienced by the area in question. It is understood that similar zones of silence will be set up in other parts of the country.

THE Minister has also set up a new Committee to deal with traffic noises in general, the terms of reference being "to consider and report upon the principal causes of noise in the operation of mechanically-propelled vehicles and the steps which can efficiently be taken to limit the noise so arising". The members of the Committee are: Sir Henry Fowler (chairman), formerly chief mechanical engineer of the London, Midland and Scottish Railway; Mr. Leslie Walton, deputy president of the Society of Motor Manufacturers and Traders; Mr. H. R. Watling, director of the British Cycle and Motor-Cycle Manufacturers' and Traders' Union; Dr. H. J. Gough, superintendent of the Engineering Department, National Physical Laboratory; Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory; Mr. E. S. Perrin, Ministry of Transport; Mr. A. E. N. Taylor (secretary), Ministry of Transport. It is believed that the exhaust silencing of sports cars and motor-cycles, the chief noise offenders on the road to-day, will receive special attention. The Government will place at the disposal of the Committee the full resources of the National Physical Laboratory, where new acoustic laboratories (described in NATURE of August 11, p. 202) were recently completed. Work on the exhaust silencing of motor-vehicles has also been carried out at University College, Southampton. Such questions as the setting up of standards of noise as the basis of legal control, if that should be considered desirable, will clearly have to rest on scientific investigation, but it is evident from the composition of the Committee that the Minister seeks the co-operation of the industry in giving practical and equitable effect to the findings of the Committee in its efforts to secure quieter road transport.

Science and War

THE issue for August of the *Labour Monthly* includes replies to a questionnaire addressed to various people, labour leaders, sympathetic professors and others, on the subject of war. The purpose, of registering strong labour opposition against war, is of course an excellent one, but this presentation of it is unfortunately marred by the intemperance of the language and the obvious intention of linking up any war that might occur, with the continuance of what the editors describe as the "present capitalist and imperialist system". No evidence is offered of the assumed connexion between the two, and any worker who at the call of his country would again consent to fight, is dismissed as a slave of imperialism. The whole great subject of war, especially in relation to science and the future of society, is of intense interest, but one must regret the use of it as a stick to beat our own suffering society, and that of other countries, especially France and the United States, which are obviously intensely and nationally pacifist. No fair-minded person can imagine that our Government or any other Government which we are at all likely to have, would wish for war or do otherwise than make every possible effort to avoid it. Governments may very possibly make mistakes, or miss chances of doing something which might promote a better general spirit. For this they should be watched and criticised, but if, for purposes of another propaganda, we assume that they are dishonest or subservient to unworthy interests, the unfairness of the charge tends to create another division among the naturally pacific forces of the country.

By such means we run a risk of strengthening the very influences which we are most anxious to suppress. Thus the League of Nations is obviously a force for peace. It is not at the moment so strong as the friends of peace would desire, and has certainly missed some important opportunities in recent years. But when Mr. C. H. Norman (quoted in this pamphlet) says, "I noticed that over fifty of them [delegates to a League of Nations Conference] had committed crimes varying from murder, blackmail, sodomy, offences against children, down to all the swindling and fraud that is the second suit of most European and American politicians", the candid reader will shake his head in despair. Indiscriminate mud-slinging can have no result but an occasional murder. The analysis of the social forces at work on such occasions as the outbreak of a great war is as puerile as the tone is spiteful. The same remark would apply to the judgment of Mr. Ernest Henri, also given in the pamphlet, that "the Nazi movement has failed in Germany". That it has great elements of weakness, and that it might end in a grave social upheaval, may well be sustained, but that it "has failed" is so foolish a judgment that it can only spring from a mind determined to see nothing but what it wants to see. Unfortunately, this is the

stamp of all thinking and writing of this character. It is the exact opposite of the scientific frame of mind, and makes one think that the spread of science and the scientific spirit into all realms of thought is one of the two supreme needs of the age.

Inauguration of the Mettur Dam and Reservoir

THE development of irrigation in India has taken another notable step forward with the recent completion of the Mettur Dam in the province of Madras, and the occasion of the official opening on August 21 was marked by an impressive ceremony when Sir George Stanley, the Governor of Madras, made the electrical contact which operated the sluice penstocks and released a huge volume of water from the impounded area. The dam and reservoir, which are to take the designation "Stanley", are located on the Cauvery River, 100 miles north-west of Trichinopoly and 180 miles south-west of Madras. The dam, one of the most massive structures of its kind in the world, contains 1,852,000 cubic yards of masonry weighing 3,200,000 tons; it has an over-all length of 5,300 ft., and a height of 176 ft. The reservoir will extend more than 40 miles north of the river, with a circumference of about 100 miles, and will have a capacity of 90,000,000,000 cub. ft. The catchment area is 15,700 square miles in extent and the total area to be irrigated will be rather more than 1,300,000 acres, including some 300,000 acres at present without any form of irrigation. Pipes have been built into the dam to permit of the utilisation of some of the water for the generation of hydro-electric power in a scheme which is now under consideration by the Secretary of State. The cost of the Cauvery-Mettur undertaking is given as about 5½ million sterling. The idea was conceived about a century ago by Sir Arthur Cotton, but work was not begun until 1925 and benefited by the experience gained during the unprecedented floods of the previous year, which caused a revision and extension of the scheme. For his services in connexion with the work, Mr. Clement T. Mullings, who was chief engineer of the project from 1927 until 1931, has received the honour of knighthood.

Chronology of Scottish Caves

AN examination of the contents of a large cave at Southend, Kintyre, Argyllshire, by Mr. Hamilton Maxwell, on behalf of the Glasgow Archaeological Society, has yielded in the course of digging through 10 ft. of deposit down to bed-rock a number of relics in bone, horn, bronze and iron, mostly belonging to the early iron age. According to a report in the *Times* of August 28, the object of the investigation was to ascertain the probable date of the erosion of the cave; and for this the date of about 4400 B.C. is now suggested. This conclusion is based upon a comparison with the Oban caves of Azilian date and the butt sites at Oronsay, explored by Messrs. Henderson, Bishop and Ludovic McL. Mann. The Oban caves have been taken as dating from about 13000 B.C. This gives, therefore, a dating for the Scottish levels of a raised beach at 27½ ft., 13000 B.C.;

a sunken beach at a depth of 20 ft., about 8700 B.C.; a raised beach at 9½ ft., about 4400 B.C.; and a sunken beach at a depth of about 7 ft. at about 100 B.C.

Meare Lake Village

EXCAVATIONS were resumed on the site of the Meare Lake Village on August 20 and will continue until September 8, or longer, should funds permit. The investigation is being carried on, as usual, under the auspices of the Somersetshire Archaeological and Natural History Society, Dr. A. Bulleid and Mr. St. George Gray again being the field directors. The season's work will be directed to the exploration of two areas in the middle of the group of dwellings of the eastern half of the village. The first of these is a confused area of hummocks and hollows, of which the significance is not clear from surface indications. Apparently the mounds overlap and have been much mutilated superficially. The area is surrounded by a rough lias-stone wall, slight in height, of some 70 ft. in diameter. In a report on the work of the first week which appears in the *Times* of August 28, it is stated two clay floors of dwellings have been found under the stones. On the upper floor was one of the most ornate and best preserved weaving-combs of antler as yet found in the lake village remains. The second site under investigation is a dwelling mound of approximately 35 ft. diameter, which apparently has three floors, the uppermost being paved with small lias-stones. At this level, two much-defaced brass Roman coins of the fourth century were found. At lower levels, pre-Roman objects included pottery with 'late-Celtic' ornament, bronze finger-rings and a buckle and a brooch of La Tène III type. A clear glass bead with yellow spirals was found below the floors. Among the animal remains were bones of two beavers, traces of which are rarely found in Great Britain.

Excavations in Berkshire

FURTHER particulars of the excavations on the Berkshire Downs to which reference was made in *NATURE* of August 18, p. 244, have been received from Mr. H. J. E. Peake. The site on which was discovered the skeleton of a dog was a round barrow on East Lockinge Down, which is mentioned in the bounds of Lakinge in a charter of A.D. 868. The remains were in the upper and larger of two holes in the chalk near the intersection of trenches dug across the barrow with the object of discovering the ditch, which was not visible on the surface. It was found that the highest point of the barrow is not in the centre. A small hole at the central point, about a foot in diameter, contained burnt human remains, but no grave furniture. The date suggested is the end of the Early Bronze or beginning of the Middle Bronze Age. The irregular round barrow in the parish of East Hendred, from which the remains of the two horses were obtained, was found to have no ditch. Beneath the skeletons of the horses were a number of small objects of Roman date, including fragments of an iron knife and the pin of a bronze

fibula hinged to a La Tène coil. Elsewhere in the barrow were numerous fragments of Romano-British pottery and a small bronze hook. The exploration of Cuckhamsley, or Scutchermer Knob, which is known to have been rifled about a hundred years ago, provided no evidence of burial; but a number of fragments of pottery, including finger-tip ware, consistent with a fifth century B.C. dating were turned up, while 2 ft. above were potsherds and a fragment of copper or bronze of foliated design. The mound is evidently not a bronze age barrow nor the burial place of a Saxon king; what the purpose of this remarkable construction may have been has not been revealed.

Quaternary Research in Ireland

EARLY in 1933 a committee entitled "The Committee for Quaternary Research in Ireland" was founded under the chairmanship of Dr. R. Lloyd Praeger, with Prof. H. J. Seymour as treasurer and Mr. A. Farrington as secretary, the personnel of the Committee being representative of all the scientific bodies and universities of Ireland. The Committee succeeded in enlisting the support of Irish scientific societies, the universities and the Free State Government. The object of the research is to establish a chronology for late-glacial and post-glacial deposits in Ireland, and to study the history of the Irish flora and fauna. Prof. K. Jessen of Copenhagen, with his assistant Mr. H. Jonassen, was invited to take charge of the research. One of the most important aspects of the scheme as conceived by the Committee is the training of Irish students from the universities in the methods developed in northern Europe, so that research centres may be permanently established in the country. Work was begun in the present summer, the first site to be examined being the well-known bog at Ballybetagh in south Co. Dublin where many remains of *Megaceros Giganteus* have been found during the last hundred years. An extended tour will also be made for the examination of deposits in many other districts throughout Ireland. A list of well-dated recent archaeological finds from peat bogs, compiled by Dr. A. Mahr, Director, National Museum, Dublin, forms the basis of this tour.

Expeditions of the Smithsonian Institution, 1933

OWING to the period, variable in duration, but usually not inconsiderable, which must elapse before it is possible to publish in full the details of the valuable field-work which is carried out by the Smithsonian Institution in astrophysics, geology, biology and anthropology, the annual exploration pamphlet issued by the Institution is of considerable interest, as giving an early authoritative account of the various expeditions sent out during the year. The latest issue (Publication 3235), for example, which covers the activities of 1933, records the establishment of a new solar observing station on Mount St. Catherine, Sinai (G. C. Abbott), and describes the work of the Norcross-Bartlett Arctic Expedition (Capt. R. A. Bartlett), of a deep-sea expedition to Puerto Rico (Paul Bartsch), a search for extinct marine

mammals in Maryland (Remington Kellogg), particulars of the Hancock expedition to Galapagos (Waldo L. Schmidt), and zoological collecting in Siam (Hugh M. Smith). The greater part of the publication, however, is devoted to the activities of members of the Smithsonian staff in the investigation of the archaeology and ethnology of the American Indian, the former a subject in which great progress has been made in recent years by the systematic application of scientific methods of excavation and correlation of results. Dr. Frank H. Roberts, Jr., has continued his excavations of Pueblo sites in the southwestern United States, in which the development of Pueblo culture and more particularly of the Pueblo dwelling is being revealed. Dr. Walter Hough has also been engaged in studying an important aspect of Pueblo culture by tracing ancient canals in Arizona, while an earlier phase of Indian history has been illuminated by Mr. F. Setzler's cave and mound explorations in Texas and Louisiana. Dr. W. D. Strong has been engaged in the study of the archaeology of Honduras and the Bay islands; while Miss Frances Densmore in her studies of Floridan music and Mr. John Harrington by oral inquiry among ancient members of Californian tribes have recorded material which, but for their activities, would shortly have been lost beyond recovery.

Electrification of the Suburban Railways of Copenhagen

THE population of Copenhagen and its suburbs is about 800,000 and they are served by a number of railways, the most important belonging to the State Railway. The problem of electrification presented special difficulties as Denmark is dependent on imported coal for its electric power supply. During recent years, an appreciable amount of electric power has been transmitted from Sweden by 25,000 volt cables which pass under the Sound. When the problem of supply was first investigated, the choice narrowed down to 3,000 volts or 1,500 volts direct current. The latter was chosen, as, although the cost of the overhead equipment was greater, the cost of equipping the cars was less. Hence, when in the future the number of cars is increased, the cost will be less. An account of the system is given by J. Kristensen in the *Electrical Times* of August 23. He says that all the lattice masts are galvanised, as although it is more expensive than painting it is far more durable. Electrically, the whole system is divided into sections connected through line disconnecting switches. To prevent the electrolysis of neighbouring pipes, extensive precautions are taken. The use of stone ballast keeps the resistance between rail and earth very high, and the resistance of the return system is made as small as possible by joints of heavy copper wire electrically welded to the rails. To prevent interference with telegraph and telephone wires, these have been effectively insulated and placed as far away from the rails as possible. The smallest train is called a 'half-train' and is made up of two motor coaches with a 'trailer' between. It has a seating capacity of 250, and standing room for 200 more. The line Frederiksborg-Klampenborg was opened in April, and the line Copenhagen-Hellerup in May.

Elinvar Hairsprings in Watches

R. E. GOULD has recently published a paper on the comparative performance of watches with the usual cut bimetallic balance wheels and steel hairsprings, and those of the new form having uncut monometallic balance wheels and elinvar hairsprings (*Bureau of Standards J. Res.*, 12, April 1934). Elinvar is a nickel-steel alloy having a temperature coefficient of elasticity which is practically zero from 5° to 35° C. (41° to 95° F.). In the new watches the balance wheel is non-magnetic. The experiments show that the temperature-rate errors of the watches having the new vibrating assembly were smaller than the errors with ordinary watches. Instead of the usual parabolic curve of errors a curve approaching a straight line was obtained. The use of the new assembly ensures a very marked improvement in the performance of the watches. The new arrangement almost entirely overcomes the effects of magnetism, so that after a watch has been subjected to a strong magnetic field the rate is not affected. Very few watches maintain an absolutely uniform rate as the mainspring unwinds. If the number of seconds lost or gained since winding be plotted against time after winding, true 'isochronism' is represented by a straight line. So far as 'isochronism' goes, the new assembly does not give any material advantage over the old. Also various small changes, caused by altering the positions of the watches, are practically the same in both types.

Thames Estuary Fisheries

MR. LAURENCE WELLS, who has from time to time contributed articles to the Southend newspapers based on the notes of the late Mr. James Murie, has recently published two more, the "Whitebait Industry" and the "Spratting Industry" (*Southend Pictorial Telegraph*, April 14 and May 24, 1934). Nearly two hundred years have passed since whitebait was first fished for, and the industry was much more important a hundred years ago than it is to-day. There are, however, signs of revival in the trade, and now there are more whitebait in the river than the merchants can dispose of, although one hundred and fifty years ago it was prophesied that within ten years the river would be denuded of fry. Sprat-fishing is apparently on the decline, and the only salvation for the Thames spratters is the canning industry which is here described. Mr. Wells goes into the history of both fisheries and the methods of capture, giving details of the catches of whitebait, which mainly consists of the fry of herrings and sprats but may contain also about twenty other species of young fishes. He also describes the proper way to cook it, and how to distinguish the herring of whitebait size from that of the sprat.

Rabbits and Traps

THE next Parliamentary session will see a bill introduced in the House of Lords by Lord Tredegar to prohibit the use of the steel trap. This bill is now in the final stages of drafting by the University of London Animal Welfare Society, which, as the result

of a recent questionnaire, claims to be in possession of overwhelming evidence in favour of the abolition of the trap, both on humanitarian grounds and—strange to relate—because it is claimed that trapping results in a *continuance* of the rabbit pest. This claim is founded on the experience of certain landowners, who have abandoned trapping for other methods of extermination simply because they have found that extermination was not to be achieved by means of the trap. Landowners may be deemed to be impartial in a matter of this kind; for, naturally, they desire to keep rabbits down. They are also keenly alive to the dangers of the steel trap to fox-hounds, domestic animals, partridges and other game. Another of their objections to the steel trap is that it kills stoats, ferrets and other natural enemies of the rabbit pest.

Speed of Snakes

THE general notion that snakes attain great speed of movement is not supported by timed observations made in the United States, and described in a paper read by Dr. Walter Mosaner before the American Association for the Advancement of Science at Berkeley, California (Science Service, Washington, D.C.). Of seven typical North American snakes tested, the red racer was the speediest with a record of three and a third miles an hour, while the Californian boa, moving at a rate of only a quarter of a mile an hour, was the slowest. The author considers that the mistaken idea about the speed of snakes arose from the deceptiveness of the smooth, fluent, undulatory movement, but he admitted that his records might possibly be broken by snakes doing sudden bursts under stress of excitement, and by some tropical snakes which may double or treble the American records.

Mosasaurian Skeletons from Manitoba

ACCORDING to the *Times*, the National Museum at Ottawa, Canada, has lately received two nearly complete Mosasaurian skeletons from an Upper Cretaceous clay in southern Manitoba. They measure respectively 33 ft. and 15 ft. in length, but both lack the end of the tail. Only fragments of these fossil marine reptiles have hitherto been found in Canada, and our knowledge of the group depends chiefly on well-preserved skeletons from the yellow chalk of Kansas, U.S.A. The new specimens were collected, and are now being prepared for study, by Mr. Charles M. Sternberg, son of Mr. Charles H. Sternberg, who collected most of the specimens from Kansas.

A New Platinum Mineral

PROF. O. ZVJAGINSTSEV, of the Russian Platinum Institute, Moscow, has reported, according to the *Prager Presse* of August 18, that a new mineral has been found associated with platinum ores. It contains iridium, osmium, gold and ruthenium as well as platinum. The mineral has a silver-white appearance, is very hard but brittle and has a high specific gravity. Considerable development has recently taken place in the mining of precious metals in Russia.

Last year, for example, as much as 87,000 kgm. of pure gold was extracted, and this exceeded the Canadian production. It also represented an increase of forty per cent over the amount obtained in 1932. More still is expected to be obtained in the present year.

Grassland Research in Australia

It is not often that research workers are able to review the whole field of their particular investigation in their own country, but grassland agronomists in Australia are placed in this fortunate position by the appearance of Bulletin No. 14 of the Herbage Publication Series of the Institute of Agricultural Botany ("Grassland Research in Australia", Imperial Bureau of Plant Genetics, Aberystwyth, Great Britain, 3s., February 1934). The bulletin contains a comprehensive survey of Australian research work on pasture management and improvement, the genetics, pests and diseases of grass crops, poisonous plants, the introduction of new species and plant physiology as it relates to grasses. For each research centre, the names of the investigators, the scope of the work, experimental procedure and references to published results are given. Two original papers on "The Technique of Pasture Investigations" by J. Griffiths Davies and H. C. Trumble, and "Botanical Analysis of Irrigated Pasture" by E. S. Beruldsen and A. Morgan are also included in the bulletin.

Physics in National Planning

In an article on this subject which Prof. Karl T. Compton, of the Massachusetts Institute of Technology, contributes to the July issue of the *Review of Scientific Instruments*, he points out that physics has given birth to nearly all those ideas which have led to the understanding and use of the forces of Nature; that almost every branch of industry has benefited from it, and that the pace at which it is developing at the present time assures us of its increasing power to help in the future. A nation which, by anti-educational policy or by inadequate provision for research, puts itself industrially at the mercy of more progressive nations, is courting economic distress and unemployment for the next generation. He considers that the United States Government, in spending only one half of one per cent of its annual budget on its scientific bureaux, is showing a lamentable lack of vision. He urges re-consideration of the place of science in national planning and policy, and better provision for it in the future.

The U.S. National Research Council

In several issues of *Science* during 1933, articles by various authors have appeared surveying the organisation of, and suggestions for needed changes in, the United States National Research Council. These articles have now been issued in pamphlet form as a partial record of the accomplishments of the National Research Council ("A History of the National Research Council, 1919-1933". Washington, D.C. 1933. 50 cents). A survey of the organisation and activities of the Council is contributed by Dr.

Albert L. Barrows, its assistant secretary. The Council originated in an offer made by the National Academy of Sciences of its services to President Wilson in 1916, when it was seen that the United States would become involved in the War. The Council was finally established as a perpetual body on May 18, 1918. The organisation and activities of the following divisions are described by their respective chairmen: Physical Sciences, Prof. F. K. Richtmeyer; Engineering and Industrial Research, Prof. Dugald C. Jackson; Chemistry and Chemical Technology, Prof. Charles A. Kraus; Geology and Geography, Prof. W. H. Twenhofel; Medical Sciences, Prof. Stanhope Bayne-Jones; Biology and Agriculture, Prof. Fernandus Payne; Anthropology and Psychology, Prof. A. T. Poffenberger. An account of the Research Information Service is contributed by its director, Dr. Clarence J. West, and the assistant secretary of the Council describes the various divisions of general relations (federal, foreign, States and educational). A list of publications is appended.

History of Medicine Congress

This year's Congress of the German Society of the History of Medicine will form part of the ninety-third Congress of the Society of German Men of Science and Physicians, which will be held at Hanover on September 18-19. The following subjects, among others, will be considered: bone finds in the Alamannic graves, by Prof. Georg Sticker; racial ideas in India, by R. F. G. Möller; Velasquez and the doctrine of heredity by Prof. Haberling; a contribution to the study of medicinal plants, by Edith Heischkel; Cæsarean section by midwives, by Elsaluise Haberling; Novalis and Romanticism, by Prof. Paul Dieppen; Urso, the last doctor, philosopher and theologian at Salerno, by Dr. Rudolf Creutz; the medical faculty at the University of Tyrnau, by Prof. T. von Györgi; the correspondence of Drs. Zimmermann and Espenburg with Kotzebue, by Dr. W. Leibbrand; Kestren, the Frankfort municipal doctor, by Dr. Kallmorgen; national and political tendencies in the congresses for natural science 1822-48, by Dr. Ludwig Englert, and Caspar Friedrich Wolff, by Dr. Julius Schuster. Further information can be obtained from Dr. W. Artelt, Universitätsstrasse 3b, Berlin, N.W.7.

Sixth International Congress for Scientific Management

At the Sixth International Congress for Scientific Management to be held in July of next year, arrangements have been made for the discussion of many papers giving accounts of management in relation to a variety of problems. These include business forecasting, budgetary control, the inculcation of best methods of management, production control and technique, standardisation, the distribution problems of manufacturers, wholesalers and retailers, selective education and training for high administrative positions. Many international and national problems would be affected by the greater use of scientific method. The management of

industrial and agricultural undertakings is gradually being based on more precise data and on improved techniques of management independent of the many and specific points on which scientific workers of different kinds—chemists, physicists, geologists and many others—are qualified to advise. Management consists in taking decisions with due regard to the multifarious factors of the organisation either within or without the control of the manager. The Congress is well supported by a large number of professional bodies and by eminent industrialists. H.R.H. the Prince of Wales is the patron; the chairman is Sir George Beharrell. Dr. E. F. Armstrong and Sir Henry Fowler are among the chairmen of committees. The fuller programmes and membership forms will be available from Mr. H. Ward, 21 Tothill Street, London, S.W.1, at the end of October. The papers to be discussed will be printed in six volumes and be available to members before the Congress.

Announcements

THE next meeting of the General Assembly of the International Astronomical Union will take place in Paris on July 10–17, 1935.

ON October 13, Sir E. Hilton Young, the Minister of Health, will open the Stenhouse Williams Memorial Library at the National Institute for Research in Dairying, Shinfield, near Reading. The Library was founded in memory of Dr. Stenhouse Williams, the first director of the Institute, who died on February 2, 1932.

THE Sixth International Botanical Congress will be held at Amsterdam on September 2–7, 1935 (see NATURE, 132, 780, Nov. 18, 1933). The Congress will be divided into the following sections: (1) Agronomy, (2) Cytology, (3) Genetics, (4) Geobotany, Ecology and Phytogeography, (5) Morphology and Anatomy, (6) Mycology and Bacteriology, (7) Phytopathology, (8) Palæobotany, (9) Plant Physiology, (10) Taxonomy and Nomenclature. The principal topics for discussion have been selected. Further information can be obtained from the Secretary, Dr. M. J. Sirks, Wageningen, Holland.

THE twenty-fifth edition of Messrs. Becker and Co.'s (17–29 Hatton Wall, London, E.C.1) catalogue of chemical apparatus, chemicals and general laboratory equipment has recently been issued. It contains 856 pages, and describes a wide field of apparatus and equipment. Recent advances in chemical apparatus are represented by the increasing number of electrically heated units, and the use of special materials such as silica and monel metal for the construction of apparatus. We also note the low-pressure apparatus, including the Kaye steel mercury diffusion pump; thermoelectric equipment and pyrometers; pyrex apparatus with interchangeable standard ground joints; biological apparatus, including microscopes; and projection apparatus. The catalogue will be useful in any laboratory.

MESSRS. WILLIAMS AND NORGATE, LTD., announce that they will shortly issue on behalf of the Herbert

Spencer Trustees a volume by Prof. John Garstang, professor of sociology in the University of Liverpool, on "The Kingdom of Solomon" as one of the volumes of the Descriptive Sociology Series.

A COMPREHENSIVE treatise on the principles and practice of the production and refining of mineral oils entitled "The Science of Petroleum" is in preparation for publication by the Oxford University Press. The British editors are Dr. A. E. Dunstan, chief chemist of the Anglo Persian Oil Company, Prof. A. W. Nash, Department of Oil Engineering, University of Birmingham; and Mr. H. T. Tizard, rector of the Imperial College of Science. The chief editor in America is Dr. B. T. Brooks. The work will contain articles by nearly three hundred authorities from all parts of the world; every aspect of the science of petroleum is being discussed in articles which, it is hoped, will be authoritative and definitive.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A technical officer in the Admiralty Technical Pool chiefly for work in connexion with small precision mechanical and electrical apparatus—Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Sept. 4). A teacher (evening) of heat engines and hydraulics at the Central Polytechnic, Scarbrook Road, Croydon—Principal (Sept. 10). An assistant curator in the Royal Albert Memorial Museum, Exeter—Town Clerk, endorsed "Assistant Curator" (Sept. 12). A chief inspector of aircraft in the Civil Aviation Directorate of the Government of India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Sept. 12). An assistant at the Fuel Research Station, East Greenwich, for work on the preparation of reports and abstracting of technical papers in connexion with the Fuel Research Coal Survey—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Sept. 15). Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty—Civil Engineer-in-Chief (Sept. 15). A junior technical examiner (male), formerly known as draughtsman, in the Lands Branch of the War Department—Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Sept. 20). An engineering chemist, Public Works Department, Gold Coast—Director of Recruitment (Colonial Service), 2 Richmond Terrace, London, S.W.1 (Sept. 30). A professor of pure mathematics in the University of Sydney, Australia, particulars obtainable from the Universities Bureau of the British Empire, 88A Gower Street, London, W.C.1—Registrar, University of Sydney (Oct. 15). An assistant (Grade III) for work on general aircraft instrument design and test in the Directorate of Technical Development, Air Ministry—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting reference No. A.617). A laboratory assistant (male) at the War Department's Experimental Station, Porton—Commandant, Experimental Station, Porton, near Salisbury.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Crystallisation of Metals from Sparse Assemblages

In the course of an extended investigation into the properties of thin metal films, of the order of 50 atoms in thickness, we have observed an early stage in the crystallisation which presents peculiar properties. The films, of gold and of silver, were prepared by cathodic sputtering on various carefully cleaned surfaces—optical glass, quartz glass and the natural face of a diamond crystal. The nature of the surface has no effect on the phenomena to be described.

The films, as prepared, appear completely homogeneous under various types of illumination, and with magnifications up to 1,000 times, obtained with a $\frac{1}{2}$ in. oil immersion apochromatic objective, N.A. 1.30. After the film has been heated *in vacuo* for two or three hours at a temperature of about 280° C., small specks, about 0.5–1 μ across, can be observed on it, which, in transmitted light, at a magnification of 1,000, appear a golden brown colour. Examined in a polarising microscope, the illumination being plane polarised light, and the nicols being crossed, each particle appears on the dark ground as white, with a black cross imposed. In all particles, the arms of the cross are parallel to the analysing and polarising nicols respectively. This figure is characteristic not of a uniaxial crystal, which shows the familiar 'rings and cross' in convergent light, but of a spherulite, and is, in fact, called the 'spherulitic figure' by Morse, Warren and Donnay¹ in their paper on artificial spherulites. Such spherulites are made up of crystalline fibres, closely packed, and radiating from a centre, each



FIG. 1. Spherulitic particles on a silver film, and a large cubic crystal with birefringent edges. The spherulitic particles on the top of this crystal itself are due to a second sputtering, and subsequent heating. ($\times 2,000$.)

fibre behaving as a uniaxial crystal with its axis along a radius. The appearance shown by the small particles in Fig. 1, which represents a heated silver film under a magnification of 2,000, exactly resembles that of the artificial spherulites of mercuric oxide, about 3 μ across, shown in the paper just quoted.

Prolonged heat treatment at temperatures up to 340° C. leads to the growth of the particles, but they lose their spherulitic nature, and become well-formed crystals of cubic type, which appear black between crossed nicols, only the edge remaining doubly refracting, as shown by the large crystals in Fig. 1. Interesting results have been obtained as to the faces of preferential growth of the cubic crystals, and their relation to the plane of the surface on which the film is deposited.



FIG. 2. Spherulitic particles of gold formed by reduction in silicic acid gel. ($\times 2,000$.)

It appears then, that, when gold or silver crystals grow very slowly from a film, in which the amount of material available for incorporation at any moment is small, the first stage of crystallisation is an aggregate of a spherulitic nature, in which the individual crystalline fibres behave as if uniaxial, although the normal crystalline form of the metals in question is cubic, that is, optically isotropic. This may be qualitatively explained by supposing that, in a film only 50 atoms across, the cubic lattice is not a stable arrangement when the upper layers are mobile, as, from evidence obtained by us, they are in gold and silver films at 300° or so. It is suggested that particles from these upper layers form a small local cluster, which is largely isotropic in the early stages of growth, but soon begins to form small regions, or facets, in which a crystalline regularity is established. From these facets grow out the crystalline fibres, possibly with regions of unordered atoms between them. The spherulites are some 2,000 atoms across, so that if the number of fibres is of the order 100, the fibres will be about 30 atoms across and 1,000 atoms long. In such a fibre the crystalline structure may well be sufficiently disturbed by the smallness of the transverse dimension, expressed in number of atoms, to behave as uniaxial. It is, of course, possible that the aggregates are not complete spherulites, but are conical segments of a spherulitic nature, as is a single 'set' in a smectic liquid-crystal layer. The highest possible optical resolution is not sufficient to show the difference between the figure to be expected with a complete spherical aggregate, and with a portion, so long as the angle of the cone is wide.

It seemed possible that a spherulitic aggregate might be the first stage in other methods by which crystals of pure metals are grown from sparse assemblages. Crystals of gold were therefore grown by reduction from gold chloride in a silicic acid gel. After the formation of so-called colloidal particles

the gel was washed away, and the particles, about 1μ across, collected on a glass plate. They proved to show the spherulitic figure, and were practically indistinguishable from the particles slowly grown in the gold and silver films (Fig. 2). Well-formed crystals with birefringent edges were also observed, and can be seen in the photograph.

This appears to be the first occasion on which spherulites of pure metals have been observed. They may have an important bearing on the question of the stability of the crystal lattice.

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July 27.

¹ H. W. Morse, C. H. Warren and J. D. H. Donnay, *Amer. J. Sci.*, **23**, 421; 1932.

The New Field Theory

In a recent series of articles¹ Born has developed, with Infeld, a new theory of the electromagnetic field that solves the difficulties connected with the self-energy of the electron. In II an elegant form is given for the Lagrangian of the electromagnetic field, but the Lagrangian alone does not completely specify the electromagnetic field since one must add the assumption² that f_{kl} is the curl of a potential vector φ_k . The method suggested³ for including the Einstein gravitational equations within the theory would further mar the elegance of the Lagrangian.

It seems possible to give a Lagrangian function based upon the projective theory of relativity⁴ which will not only lead to the Born field equations in the Galilean case, but will at the same time automatically make f_{kl} the curl of φ_k , and will also contain ten further 'gravitational' equations. The Lagrangian lacks the elegance of that proposed in II, and the field equations derived from it are extremely complicated.

In the projective theory of relativity the gravitational potential g_{ab} and the electromagnetic potential φ_a enter the projective metric $\gamma_{a\beta}$ in such a way that the projective curvature scalar has the value

$$B = R - \varphi_a^c \varphi_b^d = R + g^{ac} g^{bd} \varphi_{bc} \varphi_{da},$$

where R is the Riemannian curvature scalar of the g_{ab} , and φ_{ab} is, apart from a factor, the curl of φ_a . If we define field equations as the conditions that the variation with respect to the $\gamma_{a\beta}$ of the invariant integral

$$\int (\sqrt{1 + \alpha B} - 1) \sqrt{-g} dx^1 dx^2 dx^3 dx^4 \quad (\alpha \text{ a constant})$$

shall vanish, the four field equations corresponding to the variation of φ_a will, in the Galilean case, reduce to those of I⁵ and will therefore lead to the static field obtained in both I and II.

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July 19.

¹ For example, *Proc. Roy. Soc.*, **143**, 410; 1934; referred to as I, and **144**, 425; 1934; referred to as II.

² II, p. 433, Eq. (3.1).

³ II, p. 435.

⁴ See "Projektive Relativitätstheorie", O. Veblen, *Ergebnisse der Math.*, Berlin, 1933.

⁵ With the constant subtracted as in I, p. 432, Eq. (7.10).

Further Band Systems of Aluminium Hydride

SOME new band systems of aluminium hydride at 2700 Å. and 4950 Å. have already been reported¹. Using a new construction for the aluminium electrode which permitted large energies in the arc at a high pressure of hydrogen, we have obtained the band system at 4950 Å. in the first order of our 6.5 m. concave grating. The band system has been analysed and is found to belong to a ${}^1\Sigma^{***} \rightarrow {}^1\pi$ transition, where the lower term ${}^1\pi$ is in common with the well-known band system ${}^1\pi \rightarrow {}^1\Sigma$. Of the three branches expected (P, Q, R) only the Q and P branch has been found, owing to the strong overlapping from the AlO bands. The following constants have been evaluated.

${}^1\Sigma^{***}$	B_0	D_0	J_0	r_0	ω_0 , cm. ⁻¹	ν_0 , cm. ⁻¹
	6.120	-11.33×10^{-4}	4.53×10^{-10}	1.68 Å.	900	20277-16

From the combination rule of R. de L. Kronig and ground state ${}^1\Sigma^+$ of AlH predicted by Mulliken, it is found that the term is ${}^1\Sigma^-$.

Like most of the band systems of aluminium hydride, the band at 4950 Å. shows a remarkable 'cut off' of the series. The P and Q branches are both cut off at $j=19$. Accordingly, the predissociation originates from the ${}^1\pi$ term.

E. Hulthén and R. Rydberg² consider that the predissociation and the pressure effect in the lowest ${}^1\pi$ term of aluminium hydride is due to a 'barrier' 400 cm.⁻¹ above the dissociation limit. Owing to a leak past this barrier, the terms higher than $j=20$ in ν_0 are diffuse. Perhaps this explains the predissociation in the new ${}^1\Sigma^{***} \rightarrow {}^1\pi$ system.

Details will be published elsewhere.

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July 2.

¹ *Z. Phys.*, **89**, 40; 1934.

² *NATURE*, **131**, 470, April 1, 1933.

Situation of the A (${}^3\Sigma$) Level in the Nitrogen Molecule

HERZBERG and Sponer¹ have recently reported that the A (${}^3\Sigma$) level of N_2 lies 6.14 volts above the X (ground) level. They have assumed in deriving this value that Kaplan's new band system² is indeed the intercombination $A - X$. For this hypothesis the spacing of Kaplan's upper vibrational levels affords some support. On the other hand, direct estimates of the position of this level by the method of electron collision, including Sponer's³ original determination, agree in placing it at least two volts higher than the above value.

A careful repetition of Sponer's determination employing many technical refinements has recently been completed in this laboratory. We obtain 8.34 ± 0.05 volts for the interval $A - X$, in substantial agreement with previous results, but with an accuracy much greater than that claimed by any previous worker. A detailed account of this work will appear elsewhere.

If Herzberg and Sponer's assignment is to be accepted, this discrepancy must be explained. Their suggestion that in all electron collision measurements the excitation of the Second Positive Bands is due to a secondary collision process does not appear to us adequate. First, at the pressures used in our experiments (3×10^{-3} mm.) such collisions are

unlikely to occur with sufficient frequency, and secondly (what is much more important), we find that bands starting from different upper vibrational levels give excitation potentials differing from each other by amounts corresponding to the difference of these levels as given by spectroscopic data. It seems to us impossible that any secondary process could leave these differences intact.

Herzberg and Sporer's assignment is based upon a few combinations differing by several wave-numbers from the accepted spacing for the vibrational states of the *A* level, and though the agreement is suggestive, it is scarcely sufficient to establish the identity of Kaplan's upper level in the face of conflicting evidence. In any case, even if the disagreement in the combination differences should turn out to be experimental error, and if the bands are really due to an *A* - *X* transition, several other points remain to be explained:—(1) The extremely low value for the dissociation energy of the normal state (7.34 volts) as compared with that obtained by extrapolation of the vibrational levels (11.75 volts). (2) The presence of the bands only under special conditions of excitation, though the *A* level is being rapidly populated by cascade from both ³Π levels in any kind of discharge tube. Spectrograms of our electron beam at low pressures (1 × 10⁻³ mm.) show no trace of Kaplan's bands. This implies that their intensity even at these low pressures must be less than 1/100 the intensity of the Second Positive Bands. (3) Their non-appearance in absorption.

We therefore believe that the weight of evidence is still in favour of the higher value of the interval *A* - *X*.

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July 18.

¹ Herzberg and Sporer, *Z. Phys. Chem.*, B, 26, 1; 1934.
² Kaplan, *Phys. Rev.*, 45, 675; 1934. Kaplan, *Phys. Rev.*, 45, 898; 1934.
³ Sporer, *Z. Phys.*, 34, 622; 1925.

Relative Toxicity at High Percentages of Insect Mortality*

DOSAGES of toxic materials sufficient to ensure complete mortality of a given population have not been determined very precisely in the past, because of the nature of the *S*-shaped toxicity curve. Numerous estimates of relative toxicity, based on dosages to kill only 50 per cent of a population, have been published. Precision thus obtained is often of distinct advantage in theoretical studies of various factors which influence toxicity. It is obvious, however, that, depending upon the percentage of mortality taken as a basis for comparison, the toxicity relations of two compounds may vary. For example, 50 per cent of a population of rice weevils (*Sitophilus oryzae* L.) are killed by a dosage of 23 mgm. per litre of carbon disulphide or by one of 35 mgm. of ethylene dichloride. If comparisons are made at 75 per cent mortality, the curves are found to be sharply divergent, the respective dosages being 27 and 62 mgm. per litre. No simple factor, therefore, can be

* Paper No. 1,273 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.

used with which to multiply the 'median lethal dose', and to obtain the amount to kill approximately 100 per cent.

In fields such as those of insecticides, fungicides and bactericides, it is important to have some reliable means of estimating dosages at high mortalities. Bliss¹ has suggested a method of estimation of points approaching complete mortality. Investigators, such as Langmuir, working with adsorption equilibria, Robertson with growth, and Hecht with visual acuity, have fitted *S*-shaped curves to their data,

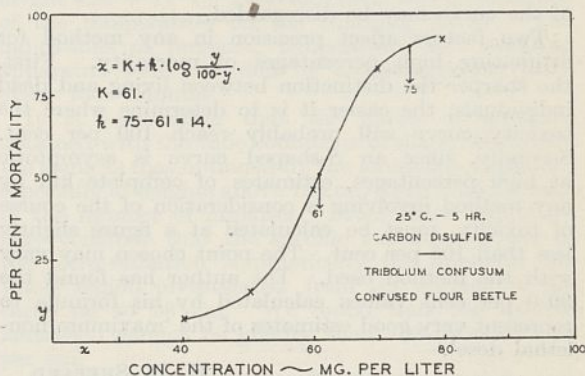


FIG. 1. Curve drawn through weighted means of original data.

although not primarily for the determination of the 100 per cent effect. A simple form of their formula has been used rather successfully by the author to fit curves in about 75 cases in a study of the action of fumigants on stored product insects. The formula used,

$$x = K + k \times \log \frac{y}{100 - y}$$

is based on that applied to hydrogen ion concentration by W. M. Clark. *K* is the point of 50 per cent

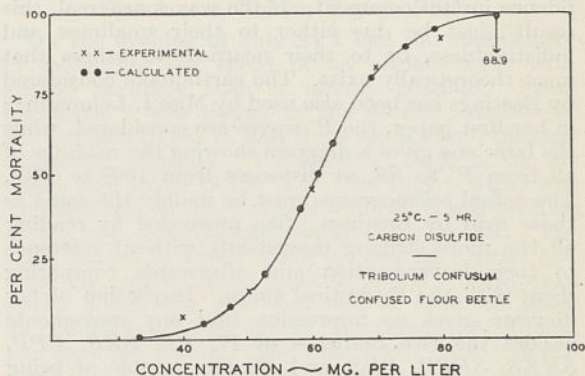


FIG. 2. Calculated curve superimposed upon the same means.

mortality and fixes the position of the curve on the horizontal axis, whereas *k* is the difference between the 90 and 50 per cent points and fixes the slope; *x* and *y* are dosage and percentage mortality respectively. It is possible to determine the 90 per cent point with nearly the precision of the 50 per cent. Data at only 4 or 5 points are necessary, the highest one between 90 and 95 per cent kill and the lowest one or two points between 20 and 45 per cent. It is very important to use a large population in a number of smaller groups to obtain data for each point. 1,472 beetles were used to obtain the data

shown in Figs. 1 and 2, from 207 to 430 individuals to each point.

The curve calculated by the formula is perfectly symmetrical whereas the experimental one may or may not be. It is not necessarily a natural attribute of the population to produce a skew curve. The degree of skewness can be shown to vary from none to considerable when the temperature is varied at which a population of beetles is fumigated. Skewness of the experimental data is of little consequence in the present connexion; if the fit is good between 50 and 100 per cent the skewness at the lower end of the curve may be disregarded.

Two factors affect precision in any method for estimating high percentages of mortality. First, the sharper the distinction between living and dead individuals, the easier it is to determine where the toxicity curve will probably reach 100 per cent. Secondly, since an *S*-shaped curve is asymptotic at high percentages, estimates of complete kill by any method involving a consideration of the course of toxicity, must be calculated at a figure slightly less than 100 per cent. The point chosen may vary with the method used. The author has found the 99.0 per cent values calculated by his formula to represent very good estimates of the 'maximum non-lethal dose'.

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July 12.

¹ Bliss, C. I., *Science*, **79**, 38-39, 409-410; 1934.

State of the Earth's Central Core

It would be premature to discuss at length the identification of *S* waves through the earth's core, announced by L. Bastings¹, until the complete paper is available. Nevertheless, the failure of previous investigators to detect these waves with any confidence invites comment. If the waves are real, this result must be due either to their smallness and indistinctness, or to their nearness to others that must theoretically exist. The earthquake considered by Bastings has been also used by Miss I. Lehmann²; in her first paper, the *P'* waves are considered, while the later one gives a diagram showing the readings of all from *P'* to *SS*, at distances from 160° to 170°. The actual seismograms must be mainly the same as those read by Bastings. She proceeded by reading all the more striking movements without reference to their interpretation and afterwards comparing them with the theoretical times. Inspection of her diagram gives no impression that any movements besides the two branches of *P'*, *PP*, *SKS*, *PPP*, *SKKS*, *SKSP*, *PPS*, and *SS* are capable of being traced over this range of distance, and even of these, *SKS* and *SKSP* show such a scatter from any smooth curve as to make the identifications doubtful. Presumably they are real but small or with indefinite commencements. She finds *PPS* early in comparison with Gutenberg's times, and this may be what Bastings has identified as *S*₁'. The difference between the observed times of this pulse and Gutenberg's calculated times for *PPS* may, however, arise from the errors of Gutenberg's times, which are reasonably good but still require some correction, and at present I am inclined to think that the pulse read is really *PPS*.

It appears that the existence or otherwise of *S*

waves through the core will have to depend on the possibility of separating them from *PPS*, and must await more definite information about the latter. In our recent revision of the tables, Mr. K. E. Bullen and I found anomalies in *PS* that have not yet received interpretation, and these will probably be intensified in *PPS*.

The lack of rigidity in the core does not rest wholly on the past failure of seismologists to identify *S* waves through it. If the rigidity of the core stood in the same ratio to the bulk modulus as holds for the shell, the earth's tidal yielding would be much less than it is, but the actual bodily tide is consistent with fluidity of the core³. If Bastings's interpretation is correct, it will be necessary to suppose that the core is elasticoviscous, behaving as a solid for stresses with periods of a few seconds but as a liquid for a period of 12 hours; and it remains to be seen whether such a constitution would not give an impossible amount of tidal friction.

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¹ *NATURE*, **134**, 216, Aug. 11, 1934.
² *Gerlands Beiträge z. Geophysik*, **26**, 402-412; 1930. *Verhandl. d. 5. Tagung d. Balt. Geodät. Komm.*, 192-212; 1931.
³ "The Earth", 239; 1929. *Mon. Not. Roy. Ast. Soc., Geoph. Suppl.*, **1**, 371-383; 1926.

Magnetron Oscillations

In a recent issue of *NATURE*¹, Dr. K. Posthumus has reported the production, by means of the split anode magnetron, of short-wave oscillations, which he suggests are of a new type. The oscillations occurred when the magnetic field strength exceeded the critical cut-off value and were characterised by an inverse relationship between frequency and optimum magnetic field strength.

It would appear that these oscillations are identical with the so-called 'dynatron' oscillations which I have discussed in a recent paper². For relatively low frequencies it has been shown that the performance of such an oscillator can be predicted from the observed static characteristics, at least in the case of a two-segment anode. At high frequencies (corresponding to wave-lengths of the order of 1 metre) the dynamic characteristics differ from the static 'dynatron' characteristics due to electron inertia. At such frequencies two important effects occur: (1) the bombardment of the cathode³ by some of the electrons the energy of which is increased by the change of electric field during their transit; and (2) the time of transit can be controlled by adjusting the ratio of V_a to H as described by Dr. Posthumus, so that many of the electrons reach the anode with radial velocities less than those corresponding to static conditions. Due to these effects, the anode current and the efficiency may both exceed the values predicted from the static characteristics.

The equation for a two-segment magnetron given by Dr. Posthumus becomes, in terms of wave-length instead of frequency,

$$\lambda = 300 \pi r_a^2 H / V_a \text{ (practical units).}$$

Combining this with the equation

$$H = \sqrt{181 V_a / 2r_a}$$

defining the critical magnetic field strength, we obtain

$$\lambda_0 = 6.4 \times 10^3 r_a / V_a^{\frac{1}{2}} = 3.2 \times 10^3 d_a / V_a^{\frac{1}{2}}$$

for the minimum wave-length in terms of anode

diameter and voltage. The similarity between this result and my empirical equation³

$$\lambda_0 = 3.6 \times 10^3 d_a / V a^{\frac{1}{2}}$$

leaves little doubt as to the identity of the two 'types' of oscillation.

In an attempt to carry the multiple-segment anode construction to its logical conclusion, a 'squirrel-cage' anode system was tried some time ago in these Laboratories. In this, successive bars were connected to opposite sides of the oscillatory circuit. The performance was, however, much less encouraging than that quoted by Dr. Posthumus for his four-segment valves, possibly due to the filament being too well centred in the anode.

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Aug. 7.

¹ NATURE, 134, 179, Aug. 4, 1934.

² J. Inst. Elec. Eng., 72, 326; 1933.

³ Megaw, NATURE, 132, 854, Dec. 2, 1933.

Rôle of Insulin in Peripheral Metabolism

PREVIOUS efforts to ascertain the mechanism of insulin have indicated that it is in the peripheral metabolism. We have been investigating its focal point in the respiratory cycle of the cell and the peripheral metabolism of the carbohydrates.

The method employed was to utilise the effect of substances which have been previously used as inhibitors of respiration (ethyl urethane and cyanides) and sodium fluoride and iodoacetic acid, which latter affect the carbohydrate metabolism and have been used in the study of glycolysis in yeast and muscle extracts. Maximum tolerated doses of these compounds have been administered to rabbits, and their relative effect studied upon the action of insulin in doses of 1 unit per 2 kgm. weight of the animal.

The hyperglycaemic effect of narcotics, cyanides and iodoacetic acid have been reported by others. We have found that sodium fluoride likewise produces a hyperglycaemia, and we have based our conclusions on the assumption that the hyperglycaemia in these cases is largely due to their antagonistic action at the periphery rather than solely to the deglycogenation of the liver. In confirmation of this view, we have found that the standard unit of insulin used will render an animal hypoglycaemic to the point of convulsions if the hyperglycaemia is due to deglycogenation of the liver, where the peripheral metabolism is intact.

Our results indicate that the insulin mechanism is largely concerned with the reaction between α -glycero-phosphoric acid and pyruvic acid, resulting in the formation of lactic acid. Embden's scheme¹ has been used as the basis of the intermediary metabolism in the tissues.

This communication is in the nature of a preliminary report, and we are applying these results to the study of insulin action in muscle strips.

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July 30.

¹ Ann. Rep. Chem. Soc., 30, 331.

Intensity of the Cosmic Ultra-Radiation in the Stratosphere with the Tube-Counter

ON July 24 we succeeded in sending up a Geiger-Müller tube counter by registering balloons into the stratosphere to a height of 28 km. The sensitivity of the tube counter was the same for rays from all directions. The apparatus was protected against the low air temperature in the stratosphere in the same way as previously described¹ by a case of 'Cellophane', so well that the lowest temperature at the greatest height was + 17° C. Therefore there was no influence of the temperature on the counting device. The indications of pressure, temperature and counting apparatus were recorded by a photographic plate every four minutes.

It is remarkable that the curve of impulses obtained with the tube counter is in shape identically the same as that obtained by the ionisation chamber; especially at heights above 18 km., there is no increase of the number of impulses. From these results we may conclude that the specific ionisation power of the ultra-radiation is practically the same for the whole region investigated from the surface of the earth up to 28 km. We found that the specific ionisation cannot be greater than 103 pairs of ions per cm.

A more detailed report of the investigations will be published shortly in *Physikalische Zeitschrift*. We wish to thank the Notgemeinschaft der deutschen Wissenschaft for providing the means that enabled us to make these investigations.

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¹ NATURE, 133, 364, Sept. 3, 1933.

Speed of a Golden Eagle's Flight

ON the evening of July 24 I had the opportunity of measuring the speed of an eagle's flight with greater accuracy than is usually possible. From my house I was gazing at the several summits of An Teallach (3,483 ft. and three miles away) through a stalking telescope. I noticed an eagle in the air above Sàil Liath (3,150 ft.). The eagle's flight was irregular and on more careful scrutiny it was possible to see two peregrine falcons stooping at her. The eagle soared to about 5,000 ft., coming nearer, and from an undetermined position made a downward sweep across the glen and out of sight on Meall an Duibha behind my house. The peregrines followed but were left behind. The time taken on this downward flight was about one minute and the distance approximately three miles.

This observation is almost worthless in itself, but half an hour afterwards I was walking to my weather station at 1,000 ft. on Meall an Duibha, immediately behind the house. At this altitude, the eagle rose from the ground about three hundred yards in front of me and the peregrines followed. I glanced at my watch, taking the position of the seconds and minutes hands. The eagle soared and I focused my glass. She reached a height which I could not estimate with certainty, but was probably 4,000 ft. The peregrines were still stooping but never actually struck. Having reached her height, the eagle made another sweep and I was able to see her land on one

of the buttress cliffs of Sàil Liath at an altitude of 2,000 ft. The time taken on the whole of this return flight was 1 min. 45 sec.

I measured the distance on the 1-in. Ordnance Survey map between the points of the eagle's rising and landing and found it to be exactly $3\frac{1}{2}$ miles. This makes the rate of flight 120 miles an hour with a net gain in altitude of 1,000 ft. There was a very slight cross wind from the west. The peregrines were left far behind on the downward sweep. We have, therefore, a timed flight in a straight line (in plan) between two known points, the flight being made with, presumably, some urge towards maximum speed.

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Dundonnell,
Wester Ross.
July 31.

F. FRASER DARLING.

Causes of Suppression of Crossing-Over in Males of *Drosophila melanogaster*

THE possibility of artificially inducing crossing-over in males of *Drosophila melanogaster*¹ has enabled us to attempt by genetic methods the study of the direct causes of the suppression of crossing-over in *Drosophila* males. Investigations on the effect of inversions on crossing-over evoked by subjecting *Drosophila* males to X-ray treatment may apparently throw light on this problem.

The experiments carried out by me in the winter of 1933-34 have shown that inversions in males throughout regions of chromosomes not touched by them, inhibit crossing-over in a much feebleness degree than in the case of females, and this means that inversions in spermatogenesis cause a smaller 'conflict of forces' than in oogenesis.

These data point to a diminution of forces of attraction between homologous loci of chromosomes in spermatogenesis, which does not affect the degree of proximity of homologous chromosomes indispensable to crossing-over, nor does it gainsay in principle the possibility of crossing-over: it is necessary only to X-ray the males when, as also with females, a closer junction of the long autosome's central parts during conjugation is brought about and the potential possibilities of crossing-over in the male are thereby accomplished.

A feebleness effect of the forces of attraction between homologous loci of the chromosome ought not to hinder chromosome conjugation by the regions of attachment of the spindle fibre. Here, most likely, crossing-over normally occurs in males. This is Darlington's opinion². However, this point of view is not confirmed genetically, as the regions here indicated are genetically inert and crossing-over in the long two-armed autosomes of *D. melanogaster* is usually accomplished in each of the limbs, and is in this case always a double one.

It is noteworthy that these data and deductions fully coincide with cytological data of Koller and Townson³, which deal with the same subject.

A detailed account of this work will be published shortly.

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July 20.

¹ Friesen, H., *Science*, **78**, No. 2031; 1933; and Friesen, H., *Biol. Z.*, **54**, H. 1/2; 1934.

² *J. Genetics*, **24**, 65-96; 1931.

³ *Proc. Roy. Soc. Edin.*, **53**, 130-146; 1932-33.

Inland Water Survey

THE leading article in *NATURE* of August 4 and Admiral Sir Percy Douglas's letter in the following issue referring to it deal with a subject of very real importance.

That the public supply of good water to every individual of the whole of the inhabitants of Great Britain should be the first consideration of a Government would no doubt be accepted by most people without much argument, for it is the basis of the good health of the community. But this is by no means the case, singular as it may seem. We have a completely interlinked and co-ordinated supply system for electricity for the whole country but in water supply the Victorian ways persist. Almost complete individualism is still the practice both within and without the Ministry. Any development, however remotely akin to that of electricity, is anathema. Thus it is that in some districts you can turn on the light but not the water.

In any development for a national water supply, the first great work would be the ascertainment of all our water resources, a hydrogeological survey, and it is to be hoped that the Minister of Health will give thorough consideration to the request of Admiral Douglas's deputation for this.

For myself, being interested in the whole subject, I cannot help but wonder even if we got our survey, unless something more is to follow we should not again be held up, possessing all the information but no power to use it or make others do so. So many definite recommendations to deal with this part of the question have been made by commissions and committees in the past, for example, the interim report in 1920 of the Board of Trade Committee presided over by Sir John Snell, that it ought not to be necessary to quote, requote and add any further reasons in support. Of works of urgent public importance involving in their carrying out much employment, the bringing up to date of our water supply is the first.

ALAN CHORLTON.

Le Zoute.

Free Alumina in Soils

IN the literature of soil science, the assumption is frequently made that, because a soil or product of rock weathering yields, when chemically analysed by acid digestion and fusion methods, a high proportion of alumina, it must therefore contain at least a part of its aluminous components in the uncombined state. That this is not necessarily the case has been indicated¹ by the application of an alizarin adsorption method, devised by me, to a series of laterites, bauxites, kaolins, subsoils and surface soils, including some that are red in colour, collected mainly in the West Indies. The alizarin method depends on the fact (apparently first discovered in 1928 by Schmelev) that gibbsite ($Al_2O_3 \cdot 3H_2O$) and diaspore ($Al_2O_3 \cdot H_2O$) after heating to temperatures around 800° C., but not before heating, develop the ability to adsorb in suitable circumstances appreciable quantities of alizarin. The amount adsorbed may be determined colorimetrically by extracting the stained washed material with acidified sodium oxalate solution.

The procedure was afterwards applied in a study of rock-weathering in British Guiana². Some of the materials tested were nearly identical with those previously exhaustively examined chemically and petrographically by the late Sir John Harrison³. Comparison between the results obtained and

Harrison's petrographical determinations demonstrated that, among the various products of weathering of igneous rocks (comprising bauxite, primary laterite, red earths, quartzose sands and kaolins), only those that contained identified gibbsite gave positive evidence of the presence of free alumina by the alizarin test. Hence it is concluded that gibbsite is the chief and perhaps the only form in which free alumina occurs in certain of these products. Being crystalline, gibbsitic alumina presumably cannot contribute to the colloidal attributes exhibited by certain tropical soils, although hydrous iron oxides that usually accompany it may so contribute.

Further evidence of the presence of free gibbsitic alumina in bauxites, laterites and lateritic soils, and its absence from most tropical red earths and kaolinitic earths, has been since obtained by determinations of heats of wetting. Whilst most natural soils yield heat of wetting values commensurate with their degree of colloidal, the values given by the ignited soils are small or negligible. Exceptions to this generalisation are presented by gibbsite, bauxites, laterites and lateritic earths containing gibbsite, and by various types of hydrous alumina, all of which exhibit relatively large heat of wetting values after ignition, though not necessarily before ignition. Thus, values ranging from 15 to 20 cal. per gm. have been obtained for ignited gibbsite and highly aluminous bauxites and laterites, whilst many red soils, usually designated 'lateritic', gave very much lower values, and most kaolinitic and bentonitic types of soil gave negligible values after ignition. Thus the heat of wetting test may furnish a simpler and more rapid alternative method than the alizarin test for detecting free alumina in the products of rock weathering and soils. Detailed results for a series of selected soils and other materials are being compiled for publication. F. HARDY.

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July 12.

¹ Studies in Tropical Soils. (1). Identification and Approximate Estimation of Sesquioxide Components by Adsorption of Alizarin. F. Hardy, *J. Agric. Sci.*, 31, 150-166; 1931.

² Studies in Tropical Soils. (2). Some Characteristic Igneous Rock Soil Profiles in British Guiana, South America. F. Hardy and R. R. Follett-Smith, *ibid.*, pp. 739-761.

³ The Katamorphism of Igneous Rocks under Humid Tropical Conditions. Sir John Harrison, *Imp. Bur. Soil Sci.*, Rothamsted Expt. Sta., June 1934, pp. 1-79.

Crystal Structure of the Alums

We have been able to determine the complete crystal structure of the alums.

The magnitudes of the F 's corresponding to the various (hko) planes we found from X-ray rotation photographs, using the measured F 's of Cork¹ as a guide. The signs of the F 's were found from a photographic comparison of reflections from $KAl(SO_4)_2 \cdot 12H_2O$, $KCr(SO_4)_2 \cdot 12H_2O$ and $KAl(SeO_4)_2 \cdot 12H_2O$, and on carrying out a double Fourier synthesis, we were able to arrive at a structure which satisfies all intensity considerations, and at the same time all requirements of distances.

The structure is a very beautiful one. Half the waters are grouped round the potassium atoms in such a manner that they also have contacts with two oxygens and one of the aluminium waters. These four contacts are arranged approximately tetrahedrally. The remaining half of the waters form regular octahedra around the aluminiums, and each of these waters makes external bonds with one oxygen and one potassium water. We find that these

two bonds and the one from the water to aluminium itself are almost exactly coplanar.

The behaviour of the waters in alum is, therefore, in accordance with the behaviour of water in other hydrated crystals, and with the theoretical model of Bernal and Fowler².

The details of the structure are as follows:

Al on (000), etc., K on ($\frac{1}{2}\frac{1}{2}\frac{1}{2}$), etc.,

S on (.31 .31 .31), etc., O on (.24 .24 .24), etc.

O on (.30 .27 .43), etc.

H_2O on (.04 .13 .30), etc., and ($\overline{.02} \overline{.02} \overline{.16}$), etc.

These parameters mean that the large peak in the Fourier projection in planes parallel to (111) obtained by Cork is due to the coincidence of a number of oxygens and waters, and the real sulphur peak is the smaller one at $\theta = 80^\circ$ in his diagram³.

We hope to publish a more complete account of the structure elsewhere.

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¹ Cork, *Phil. Mag.*, 4, 688; 1927.

² Bernal and Fowler, *J. Chem. Phys.*, 1, 515; 1933.

³ *Loc. cit.*, p. 694.

Some Experiments on Heavy Water

THE following results have been obtained with water containing 4-5 per cent H_2O .

(1) By crystallising sodium sulphate, normal and heavy water are divided practically equally in the water of crystallisation and the solution.

(2) Diethyl ether dissolves, within this range of concentration, at equilibrium, normal and heavy water in equal quantities. On the other hand, if ether drops are allowed to rise through such water and to dissolve in this manner mainly water out of the interfaces water-ether, then the interfaces prove to be enriched in heavy water.

(3) The compound KH_2PO_4 does not interchange its hydrogen atoms in this solution.

(4) The compound $[Co(NH_3)_6] \cdot (NO_3)_3$ (stable to concentrated nitric acid) interchanges all its 18 hydrogen atoms in this solution. Crystals of the compound in equilibrium with the solution at $0^\circ C$. do not interchange their hydrogen atoms.

Full descriptions of these experiments will be published in *Helvetica Chimica Acta*.

Chemical Institute,
University,
Basle.
Aug. 2.

H. ERLÉNMEYER.
H. GÄRTNER.

Lost Fragrance of Musk

APROPOS the statement made in NATURE of July 14, p. 54, that the lost scent of musk (*Mimulus moschatus*) was first noticed in Britain in 1909—an oft-quoted statement—I think the following reference ought to be put on more permanent record. Mr. Thomas Wilkinson, a native of Lancashire, now a Fifeshire farmer, some sixty years ago began growing musk for the Liverpool market. He soon had a monopoly of the trade and sold 5,000 plants a week during the months of May. In 1898, he stated, he noticed the plants began to acquire a rank, leafy smell, and at the end of the summer he sold his business. Four years later he returned to Liverpool and found the musk plants then on sale scentless.

ERIC HARDY
(Librarian).

Liverpool Naturalists' Field Club.

Research Items

Mountain Tribes of New Guinea. Some hitherto undescribed tribes of New Guinea are the subject of a communication from Mr. E. W. P. Chinnery (*Man*, August). They inhabit the great central mountain ranges which are now being examined by administrative officers. Along the Papuan border from Mt. Joseph to Mt. Hagen, and on a wide expanse of grass-covered plateau between the Western Kratke Mountains and Mt. Hagen, are groups of people with methods of garden culture and certain customs not found elsewhere in New Guinea. Of the three groups of these peoples, the western half of the second group and the whole of the third or north-western group have only recently been examined. The so-called Kukukuku groups usually live in small family houses near their gardens; but in the western Tauri there are many large stockaded villages of round houses with conical roofs. Both men and women dress alike. The men are usually clean-shaven and the hair is cut short with a tuft on the top to hold a loop from which is suspended a long cape of tapa cloth for protection against cold and rain. The men use a short bow and arrows, and carry a stone-headed club. They chew betel nut, but do not smoke tobacco. Cannibalism has been reported of the people between the Garfuku River and Kratke Mountains. During inter-tribal warfare the women accompany the men with spare arrows. On the Bena Bena tributary there is a cane-swallowing ritual not previously observed in New Guinea. Some of the adult men wear a long length of thin cane doubled and looped round their necks. They send the women and children away and then push the bent part of the cane down the gullet for several inches, leaving the two ends protruding from the mouth. It is said that a man may have three canes down his throat at the same time. At one performance two important men grasped the ends of the cane and danced around the performer, who still had the rest of the cane down his throat.

Feeding of Trout in Tasmania. The study of the more important insects which serve as food for trout is an indispensable preliminary to a full understanding of the methods by which a successful and permanent trout fishery may be maintained. Dr. R. J. Tillyard begins this study with reference to Tasmania with a description of the life-history and contacts of the mayfly genus, *Atalophlebia* (*Papers and Proc. Roy. Soc. Tasmania for 1933, 1934*, p. 1). He makes the interesting suggestion that the supply of these mayflies in the Macquarie River might be augmented by the judicious placing of more or less decayed timber in the stream. If old willows or gum-trees which are being cleared away near the river are cut into convenient lengths and submerged (in places where they would not interfere with angling), the mayfly nymphs find their way to these logs in vast numbers, and hiding in the crevices obtain a rich living from the vegetable material which collects on them and from the products of their decay. In the experience of the writer of this note, success on similar lines has followed upon the introduction of cut grass to a pond in the lowlands of Scotland.

Littoral Fauna of Hong Kong. In the *Hong Kong Naturalist* (Supp. No. 3, February 1934) there are four interesting papers dealing with the local fauna,

namely: echinoderms by Th. Mortensen; holothurians by S. Heding; fishes collected in October-December 1931 by Albert W. Herre; and crabs (Part 4) by Chia-Jui Shen. A number (30 species in all) of Asteroids, Ophiuroids, Echinoidea, Holothuroids and Crinoids are recorded. This is the first time the echinoderm fauna of the vicinity of Hong Kong has been specially investigated, but the present collection only represents a small fraction of what is present in the area. Prof. Mortensen states that it is beyond doubt that more extensive shore collecting and dredging both in the littoral regions and in deeper waters will yield a very rich harvest. Three new species (one asteroid and two ophiuroids) are represented in the collections sent to him by Dr. Herklots, reader in biology in the University of Hong Kong, besides seven species new to the area, and included in the new species is a magnificent *Euryale* (*E. purpurea*, Mrtsn.) about 50 mm. in disc diameter. Among the holothurians are two new species and one new variety.

Iso-electric Points of Bacterial Suspensions. It has been shown in a number of cases that the presence of a salt affects the physical properties of proteins when these are studied in relation to changing hydrogen ion concentration. It is now found by G. Yamaha and S. Abe (*Sci. Reports Tokyo Bunrika Daigaku*, 1, 221; 1934), that similar effects may exist for suspensions of bacteria, of which nine species were used. The bacteria were suspended in a 0.9 per cent sodium chloride solution and the hydrogen ion concentration changed by the addition of hydrochloric acid. In these circumstances, the apparent iso-electric point as measured by precipitation was consistently at a much lower pH value than that found by cataphoresis. There is some evidence that this effect varies with the nature of the acid employed.

Genetics at Cold Spring Harbor. The Year Book, No. 32, of the Carnegie Institution of Washington for 1933 contains a report of the Department of Genetics by the director, Dr. C. B. Davenport. It refers to work done mainly at the Cold Spring Harbor Laboratory. By intensive investigation of the ten known allelomorphs of the miniature wing locus in *Drosophila virilis* and the eleven allelomorphs of white eye in *D. melanogaster*, Demerec is further analysing the nature of the gene. He has devised a method for testing whether a lethal factor at a particular locus is due to the elimination (deficiency) of the corresponding gene, and finds that 56 per cent of all lethals are cell lethals, the individual cell failing to survive in their absence. In *Datura*, Blakeslee has obtained several haploids with an extra chromosome, the extra being identified by the characters of the plant. He finds that segmental interchange has accompanied the production of new species in this genus. A mutation has been found which produces pollen dyads having $2n$ chromosomes. When selfed, the offspring are tetraploids and again form dyad pollen grains. Other extensive fields of investigation are leukemia in mice, another hormone of the anterior pituitary by Riddle, the inheritance of racing capacity and a general formula of heredity by Laughlin. Human genetics is represented by the studies of Steggerda and others on racial differences between Indians, Negroes and Dutch, the

papillary patterns of various races, growth studies of children, and the inheritance of sporadic goitre. Dr. T. Kemp suggests that this is due to a dominant gene in the X-chromosome which also causes non-disjunction of the two X-chromosomes in the female.

Polynesian Mosses. Edwin B. Bartram has recently published a report of a representative series of mosses collected by various travellers during the past ten years in the Society Islands, Austral Islands, Tuamotu Archipelago, Marquesas Islands, Cook Island, and Tonga (Bernice P. Bishop Museum Occasional Papers, 10, (10), 1-28; 1933). A considerable extension of the known range of several is noted and the following twelve new species are described and figured, the types being deposited at the Museum: *Dicranoloma plicatum*, *Calymperes tuamotuense*, *Calymperes pseudopodianum*, *Trichosteleum pygmaeum*, *Dicranella rufiseta*, *Dicranoloma brevifolium*, *Taxithelium falci-folium*, *Calymperes Quaylei*, *Thuidium ramosissimum*, Dixon and Bartram, *Raphidorrhynchium Quaylei*, *Glossadelphus tahitensis*, *Spiridens armatus*.

Treatment of Light Soils. Conference Report No. 17 from the Rothamsted Experimental Station, Harpenden, Herts (34 pages, price 2s., obtainable from the Secretary), deals with the difficult problem of the cultivation of the light soils of England. Successful methods of farming light hill arable and downland in Wiltshire are described by Mr. A. J. Hosier (Marlborough). Hoof cultivation and manuring the grass through dairy cows and poultry is the key to the improvement of his downland pastures. Improved grassland may then have its fertility cashed by a few years under arable cultivation. The results following the deep ploughing of thin acid sand resting on the chalk are set out by Mr. W. Parker (King's Lynn). Sugar beet growing becomes possible and the whole level of the rotation is raised. The utilisation of this land for the large-scale production of dried lucerne meal is a novel feature of Mr. Parker's system. Methods adopted by Mr. A. W. Oldershaw with much success in handling the acid sand at Tunstall, Suffolk, are fully discussed in his paper. They include deep cultivation, chalking and the use of suitable artificials. Finally, some of the scientific problems arising in the cropping of light soils are dealt with by Dr. H. H. Mann in the light of the classical field experiments conducted on the sandy soils of Woburn. The report shows that the difficulties of the management of the light soils can be met by capable and resourceful cultivators making full use of the scientific and technical methods now available.

Seismometric Reports on Tokyo Earthquakes. Since the great Japanese earthquake of 1923, nine seismograph stations have been established in the district round Tokyo, in addition to eight local meteorological observatories also provided with instruments. During the last three years, quarterly lists of the earthquakes sensible in Tokyo have been issued by the Earthquake Research Institute, each illustrated by a map showing the positions of the epicentres. Early this year, the lists for the years 1924-30 have been published in a special *Seismometrical Report*. In these seven years, the number of earthquakes felt in Tokyo is 413, or an average of 59 a year. In addition to the usual elements of the motion, the position of the epicentre is given for each earthquake and, in about three fourths of the total number, the depth of the focus.

This ranges from 10 km. to 140 km., with an average of 42 km. or 26 miles. For each year, a map is added showing the distribution of the epicentres.

Electric and Photometric Units. Volume 15 of the *Procès-Verbaux* of the Comité International des Poids et Mesures contains the Report for 1933 of the Advisory Committee on Electricity and Photometry. With regard to electrical units, the Advisory Committee recommends that so soon as the results of the comparisons of the current international units with the absolute units have been made by all the national laboratories, the absolute units be substituted for the international. The question of adopting platinum instead of manganin as the material for standard resistances was left undecided. Some uncertainty as to the stability of the 12.5 per cent cadmium amalgum of the standard cell, and as to the utility of acidifying the cell, having arisen, the two questions were submitted to the national laboratories for investigation. Both resistance and electromotive force standards are to be determined to one part in a million. The primary unit of light intensity is ultimately to be based on the radiation from a perfectly black body, and in the opinion of the Advisory Committee, photometry of coloured lights can only be secured by fixing *a priori* a curve of visibility throughout the spectrum such as that recommended by the International Committee on Lighting in 1924.

Evaporated Metal Mirrors. R. C. Williams in a letter (*Phys. Rev.*, July 15) has described the advantages of making mirrors by evaporating on to glass first a thin film of chromium and then a layer of aluminium. The film is at first fairly soft, but it is hardened by washing in water or alcohol and may then be rubbed hard with cotton cloth without appreciable change. Even rubbing with steel wool affects the film only slightly. The reflectivity of the films is similar to that of pure aluminium. The aluminium may be dissolved off without affecting the chromium, and the author says he has found a method of removing the chromium layer if required.

Indium. A considerable amount of attention has been given in recent years to the so-called 'rare elements', several of which could be made available in quantity if a demand arose. A large field of chemical investigation is awaiting attention in this direction, and the old-fashioned attitude towards inorganic chemistry is rapidly passing away. An element which has in the past provided some important results from the point of view of chemical theory is indium. Its three chlorides, InCl , InCl_2 and InCl_3 , disposed of the cherished doctrine of perissads and artiads, the very name of which is now practically unknown. The correct choice of the atomic weight of the element was one of the first services rendered to chemistry by the periodic law of Mendeléeff. A "Bibliography of Indium", drawn up by Potratz and Ekeley, has just been published by the University of Colorado (*Studies*, 21, No. 3; 1934), in which communications to the literature from the date of the discovery of the metal in 1863 to 1933 are listed in a classified system. Most of the work on indium appears to have been published in Germany and the United States, although England is represented by the work of Carpenter and Tamura on twinned metallic crystals, older work of Roberts-Austin and Carnelly, and an investigation of indium acetylacetonate by Morgan and Drew.

Measuring Rate of Evaporation

By DR. J. S. OWENS

A NEW apparatus for measuring evaporation is shown in Fig. 1. A pan *A* contains the material from which evaporation is to be measured; this may be sand, soil, grass, water or other material. The pan *A* is supplied with water through a per-

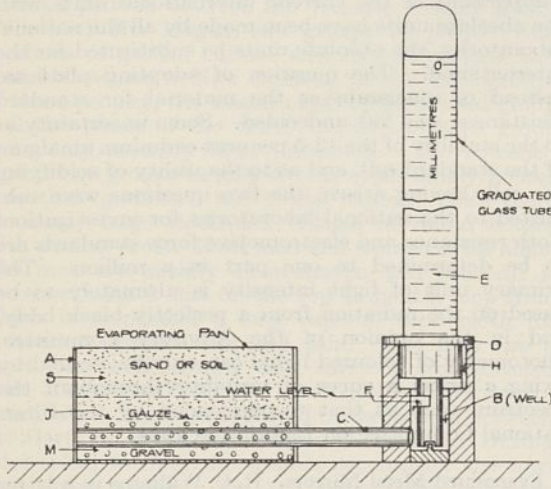


FIG. 1. Evaporating pan *A*, sand in pan *S*, gauze *J*, gravel *M*, connecting tube *C*, well *B*, port for air and water *F*, air channels *H*, socket of glass tube *D*, graduated tube *E*.

forated tube *C* from a graduated glass tube *E*, which acts as a reservoir. The supply is so arranged that the level of the water table in the pan *A* is maintained constant, while the water required to do this is measured on the glass tube *E*, in millimetres of depth over the pan *A*. Thus, if the pan has a diameter of 10 cm. and the tube *E*, 2 cm., 1 mm. over the area of the pan will mean 25 mm. change of level in the tube. The pan may be of any convenient size to suit the desired conditions, and the bore of the tube *E* will then determine the magnification.

This is the basic principle of the apparatus and it is put into operation thus: the tube *E* is fixed in a socket *D* which fits into the top of the well *B* widened for the purpose. The socket *D* is prolonged downwards into the well *B* by a smaller tube, about 1 cm. bore. This prolongation is formed of two thin-walled tubes, one of which fits outside the other. The outer of these is closed at the bottom and has a slot, like in a wood screw, across its bottom.

The inner tube is open below. A port *F* is cut through the walls of both these, so that if the outer tube be turned round over the inner, the port *F* can be opened or closed. A projection on the floor of the well which engages in the slot in the bottom of the outer tube permits *F* to be opened or closed, while the graduated tube *E* is in position on the well.

Starting now with no water in the instrument and the pan *A* full of sand, the graduated tube is lifted out of the well. The outer tube or sleeve on the bottom projection is drawn off and the glass tube filled through the open end of the inner tube. The outer tube is pushed on over the inner and turned to close *F*, after which the glass tube is replaced in the well, turned to open *F*, when the water will run out and into the pan, bubbles of air entering through *F*. Air is admitted to the well by three vertical channels *H* round socket *D*. As soon as the water level reaches the top of *F*, no air can enter and the level remains fixed at this. If evaporation from the pan lowers the water in the well *B*, air is allowed to enter through *F* until the level is restored; thus a constant level is maintained. When starting, water may be put direct into the well until the sand is saturated and the water just covers the mouth of tube *C* in the well; the rest can be added as above.

After evaporation has gone on for some time and the tube *E* is nearly empty, it may be refilled by turning in its socket through 180° to close *F*, lifting out, removing outer sleeve and filling the tube. *F* is again closed by turning the outer sleeve, the tube *E* replaced gently in well, turned through 180° to open *F*, when the measurement can be continued without interruption. When measuring evaporation, the instrument should be on a level base and must not be moved, or if this is necessary, the opening *F* must first be closed and not opened until after moving and placing on a level bed. If this is not done, water may run from well to pan and admit air to the tube *E*.

Fig. 2 shows results obtained with this apparatus.

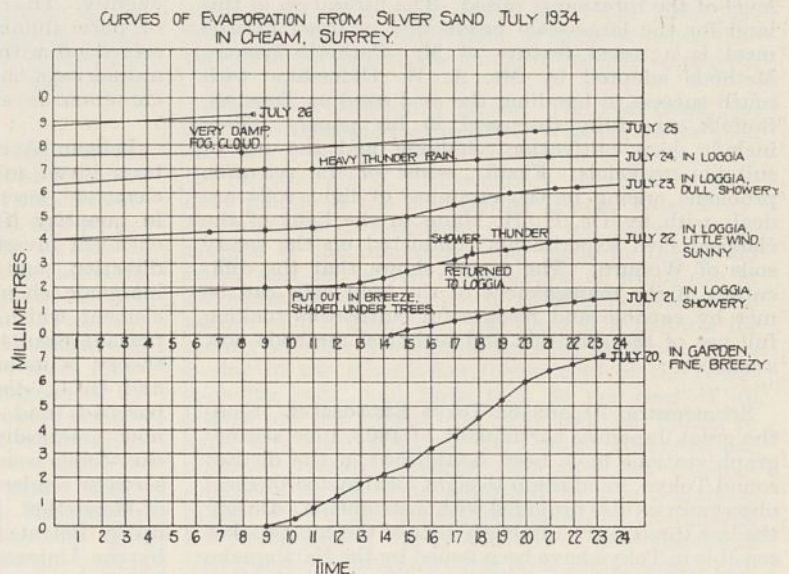


Fig. 2.

Evaporation, when rapid, can be measured over very short periods. The nature of the surface can be varied, also the material may be loose or compact. The effect of depth of water table from surface can be investigated by raising the pan or by adding loose rings; much other useful information, not hitherto easily obtainable, may be gained.

Chemistry of Photosynthesis

IN his presidential address to the tenth annual general meeting of the Indian Chemical Society held at Bombay, Prof. N. R. Dhar discussed some aspects of the chemistry of photosynthesis ("Chemical Aspects of Carbon Assimilation", *J. Indian Chem. Soc.*, 11, 145; 1934). Numerous experiments carried on in his laboratory during the past ten years show that formaldehyde is synthesised and detected when dilute solutions (5 per cent) of bicarbonates of the alkali metals are exposed to sunlight for about four hours in thin layers (0.5 cm. thick) either in open dishes or covered with silica plates at temperatures up to 30°; higher temperatures are prejudicial to formaldehyde formation. The amount of formaldehyde photosynthesised per 100 c.c. of solution exposed is 0.00007-0.0001 gm. Schryver's reagent is most sensitive for the detection of formaldehyde in small quantities. The amount of formaldehyde obtained by exposing the bicarbonate solutions in the same dishes placed in a bath at 40° is about one third of that obtained at 30° under identical conditions.

It is interesting to note that in Nature the amount of carbon assimilation is less at 40° than at 30°. Moreover, the amount of formaldehyde in rain-water obtained after a succession of bright days is practically the same as is photosynthesised by exposing potassium bicarbonate solutions to sunlight. Larger amounts of formaldehyde are produced by the reduction of bicarbonate or carbonic acid solutions by metallic cerium, tungsten, iron, etc. This reduction is accelerated by light. These results have been confirmed by Mezzadrolì and his collaborators (1927-29) and very recently by Yoe and Wingard (*J. Chem. Phys.*, 1, 886; 1933).

Reducing sugars have been obtained by exposing formaldehyde solutions to sunlight mixed with ferric chloride. The temperature coefficient for this reaction for a 10° rise of temperature is of the same order as that of the photosynthesis with *Elodea* or *Hydrilla*.

When solutions of glycol and potassium nitrate are exposed to sunlight for 8 hours in presence of titanium oxide as a photocatalyst, glycine is produced. Similarly, a solution containing glucose and potassium nitrate with titanium oxide, when exposed to sunlight for the same period, appears to produce arginine amongst other substances. Longer exposure to light causes the disappearance of the amino acids photosynthesised, probably due to their photo-oxidation. Solutions of ammonium lactate also form amino acids on exposure to light. The amino acids thus obtained can be readily detected by the valuable 'ninhydrin' test.

The temperature coefficients of photosynthesis in plants do not obey the Arrhenius relation connecting the temperature and the velocity of a reaction. In photosynthesis, the observed values of temperature coefficients are always smaller than the calculated ones. The phenomenon of 'solarisation', or the

adverse effect of strong light on photosynthesis, and the fact that the compensation point, that is, the light intensity at which the photosynthetic and respiratory activities of the plant compensate each other, decreases with fall of temperature. The non-applicability of the Arrhenius relation to photosynthesis has been explained on the following considerations:—

(a) Photosynthesis is proportional to the light intensity.

(b) Respiration takes place in the dark but is appreciably accelerated by light.

(c) An increase of temperature enhances respiration more markedly than photosynthesis.

Moreover, the smaller temperature coefficient of photosynthesis in feeble than in intense light and the lower temperature coefficient in chlorophyll-poor leaves in comparison with chlorophyll-rich leaves have also been explained from the same viewpoint.

A new theory of carbon assimilation is also advanced in which the following are the main points:

(1) Partial activation of carbon dioxide and water at the leaf surface due to their adsorption by chlorophyll and other pigments. It seems that chlorophyll and carotinoids act as photo-sensitisers, and as reducing agents in the photo-reduction of carbon dioxide.

(2) Further activation of the adsorbed carbon dioxide and water by absorption of a part of the energy available from respiration and oxidation of carotin, and the formation of activated carbon dioxide and water as products of respiration.

(3) Absorption of light by chlorophyll and other pigments and the dissociation of the activated water molecules, on the leaf surface, into H and OH₁, and the reduction of activated carbon dioxide into formaldehyde by the atomic hydrogen produced from the sensitised photolysis of water. The amount of energy required to decompose a gm. mol. of water into H and OH is practically the same as that necessary for the formation of a gm. mol. of formaldehyde from carbon dioxide and water.

(4) Polymerisation of formaldehyde to reducing sugars.

(5) The formation of hydrogen peroxide from OH and the rapid decomposition of hydrogen peroxide into water and oxygen on the leaf surface. Formaldehyde is obtained more readily by the photo-oxidation of energy-rich compounds than by exposing bicarbonate solutions to light.

There is an intimate relation between respiration and photosynthesis in the plant kingdom. It seems that photosynthesis cannot proceed without the energy available from respiration for the partial activation of carbon dioxide and water. The need of oxygen in photosynthesis is also easily explained. Experimental evidence in support of this theory of carbon assimilation was given.

Botanical Work in the University of Lucknow

THE University of Lucknow Department of Botany issues a small pamphlet which contains abstracts of the published work of the Department in the quinquennium 1928-32. This report makes it clear that the contributions of this Department, under the guidance of Prof. Birbal Sahni, have been

very valuable in nature and cover such a wide field of botanical activity that the senior students of the Department should readily find both inspiration and guidance whatever special interest may determine the approach to their botanical problems.

Prof. Sahni himself is represented by a long series

of papers most of which deal with palaeobotanical problems, often of very wide general interest. Several papers deal with petioles and rhizomes of zygopterid affinity which tend to the conclusion that the "old and once extensive genus *Zygopteris*, after many vicissitudes, will probably emerge once more as the largest and most important of the *Zygopterideae*". A solitary block of secondary wood found long ago at an unknown locality in the Rajmahal Hills, Bihar, has aroused Prof. Sahni's interest in the vessel-less Dicotyledons, as this wood, undoubtedly of Jurassic age, shows definite affinities with these plants. The block is put in a new genus *Homoxyton* and the wood of the living genus *Tetracentron* has been re-examined.

Dr. S. K. Mukerji has interesting papers upon salt distribution in soil (which leads to a re-examination of Liesegang rings) and upon ecological questions, together with a very forceful statement of the need for the compilation of an Indian pharmacopœia and

of increased interest in the commercial plantation and exploitation of Indian medicinal plants. He has also several interesting papers upon the conditions governing the distribution of water plants in Indian freshwater areas.

Dr. H. P. Chowdhury has several papers upon the factors affecting respiration and transpiration in apple fruits, which record several attempts to determine cell size and the comparative extent of inter-cellular space systems, very difficult variables to measure in such fleshy tissues. He has also papers on the algal and fungal vegetation, whilst Dr. S. K. Pande has several papers upon Indian liverworts. There are other contributions and other fields of work but this brief review of the contents of this pamphlet, published by the University of Lucknow (1933), shows what signal progress the Indian universities, guided by Indian investigators, are making in biological fields of work.

Photoelectric Theory and Applications

LIKE the thermionic valve, the photoelectric cell has evolved during recent years from an interesting scientific novelty into an instrument of everyday commercial application. In such circumstances a large amount of scientific and technical information is published, and the assimilation of this information presents some difficulty to those not actively engaged in the particular field concerned. A useful paper in this connexion was presented to the Television Society on February 14, entitled "Review of the Theory and Applications of Photoelectric Effects" by G. Windred. This paper constitutes a summary of our present knowledge of photoelectric phenomena, with a brief outline of the relevant theory and an indication of some of the applications of modern photoelectric cells.

Treating the subject in historical order, reference is made to the photo-conductivity effect exhibited particularly by selenium. It is shown that the change in conductivity of this substance is proportional to the square root of the energy in the incident light. By suitable construction, a selenium cell may be made to give a current change of 100 milliamperes between dark and light conditions, and in this form it is used to operate relays for a variety of purposes. The selenium bridge has also played an important

part in the transmission of sound by light as in the photophone. For many purposes, however, the selenium cell has been eclipsed by the photoelectric cell, which incorporates a substance which liberates electrons under the influence of incident light. The energy of the emitted electrons is proportional to that of the incident light, and the phenomenon is thus exhibited particularly at short wave-lengths.

One form of the modern photoelectric cell employs a cathode with a monomolecular film of potassium or cesium on oxidised silver in an atmosphere of argon. An alternative form of photoelectric cell has been developed from the copper oxide rectifier; this cell consists of a layer of cuprous oxide on a copper plate forming one electrode, while a conducting gauze is placed in contact with the oxide to form the second electrode. In the latter case, illumination of the oxide surface through the gauze results in the production of electrons which flow from the oxide to copper and produce a current in the external circuit without the aid of a battery or other source of electromotive force. Both these types of photoelectric cell are in widespread use for many scientific and technical purposes, such as photometry, sound films and television.

Radio Research in Great Britain

SINCE its establishment in 1920 under the Department of Scientific and Industrial Research, the Radio Research Board has contributed notably to the study of many problems which have arisen in connexion with the science and practice of radio communication. At suitable stages in the course of each investigation, the results are made available either by the issue of special reports through H.M. Stationery Office or by the publication of papers in the proceedings of scientific and technical societies. In addition, summaries of the work are published periodically in the form of Reports of the Radio Research Board, the latest of which covers the period January 1, 1932, to September 30, 1933.*

The date at which an account of the work for the year 1932 would normally have been submitted

found the organisation of the Radio Research Board in a state of transition, and the publication of the report under review was therefore intentionally delayed in order that the introduction and first results of two notable improvements in organisation might be dealt with in some detail. These relate to the complete re-organisation of the Committees generally supervising the work of the Board, and the amalgamation of the Wireless Division of the National Physical Laboratory and the Radio Research Station, Slough, into a new Radio Department of the Laboratory. An additional advantage of the delay is that substantial progress is reported in several investigations which had reached only a very preliminary stage at the end of 1932.

A considerable portion of the report is devoted to investigations on the propagation of electric waves, and particular attention is given to the development and utilisation of new methods of 'echo-sounding'

* Department of Scientific and Industrial Research. Report of the Radio Research Board for the period 1st January 1932 to 30th September 1933. Pp. iv+137. (London: H.M. Stationery Office, 1934.) 2s. 6d. net.

of the ionosphere, by which observers on the ground can explore the electrical condition of the atmosphere at heights of 60–150 miles. A preliminary account is given also of the results obtained from the special work carried out during the Second International Polar Year, which covered the thirteen months ended in August 1932. Closely associated with the research on wave propagation has been the study of the angle of incidence and of the varying intensity and polarisation of waves received from distant transmitting stations; while, in another sphere of activity, the development of a practical radio direction-finder which shall be immune from the effects of these varying electric waves, has been continued with considerable success. Attention has also been devoted to the production and study of short electric waves down to wave-lengths of about 15 cm., and to their mode of propagation over the earth's surface. Work which is more of a laboratory rather than field nature has included the maintenance and development of the radio frequency standards at the National Physical Laboratory, and of the methods of measuring various electrical quantities used in radio technique. A new wireless transmitter of somewhat unique design has been installed at the Laboratory during the period under review; while a special investigation was conducted into the problem of interference and receiver selectivity. Finally, the report describes the latest developments made at the Radio Research Station in connexion with the cathode ray oscillograph.

The serious student and expert worker in radio research problems will find much to interest him in the report, while access to more detailed information on the subject is facilitated by the list given in an appendix of publications describing the work of the Radio Research Board during the period under review.

Science News a Century Ago

Death of Telford

Thomas Telford, the first president of the Institution of Civil Engineers, died at his house, 24 Abingdon Street, Westminster, on September 2, 1834, at the age of seventy-seven years. In an obituary of him published in the *Annual Register* for 1834, it is said that "he was inclined to set a higher value on the success which attended his exertions for improving the great communication from London to Holyhead, the alterations of the line of the road, its smoothness, and the excellence of its bridges, than on the success of any other work he executed. . . . He understood algebra well, but held mathematical investigation rather cheap, and always resorted to experiment when practicable, to determine the relative value of any plans on which it was his business to decide. . . . Mr. Telford's will was sworn under £35,000. The testator bequeaths about £3,000 to divers charitable institutions, and legacies to several persons of mechanical and literary genius, amounting altogether to £16,000. Among these is a bequest of 500 guineas to Robert Southey, esq., the poet laureate."

Botanical and Horticultural Shows

It was the custom of J. C. Loudon, the editor of the *Gardener's Magazine*, to collect and print in his journal, after midsummer, a comprehensive series of reports and notices of the provincial flower shows and kindred exhibitions held in England and in Scottish centres. These were of special importance at the period to cultivators of new plants and shrubs, as

well as of great benefit to gardeners and the community in regard to displays of fruit and vegetables. The Beverley Floral and Horticultural Society promoted a gathering of this kind on September 3, 1834, the details of which appeared in the *Hull Advertiser*. Reference was made to a "brilliant assortment of georginas", the latter term being then in common use. It seems that the president of the Beverley Exhibition took occasion to protest against the adoption of the name *Georgina* in place of *Dahlia*. This led Loudon to write as follows: "The genus was named Dahlia in honour of Prof. Dahl a Swedish botanist. Objections were at first made to this name under the erroneous impression that it had already been appropriated to another genus, and this induced Prof. Willdenow in his 'Species Plantarum' to apply a new name, that of *Georgina*, after Georgi, an eminent Russian traveller and botanist. Mr. David Don has proved to us that the name *Dahlia* was applied one year before that of *Georgina*, and that therefore, although the latter name has been adopted in the 'Dictionnaire d'Histoire Naturelle', the former ought to be retained." Loudon then states that it is his intention to use the name *Dahlia* in all future issues of his publication. (*Gardener's Magazine*, 1834.)

The Post Office Steam Packet Service

In the 'twenties of last century, the old sailing packets between England and Ireland and the Continent were superseded by steam vessels, but the mail steamers still continued to be run directly by the Post Office. In a note in the *Mechanic's Magazine* of September 6, 1834, it is stated that "The Post Office has now twenty-four steam vessels regularly employed in its service; four between Liverpool and Dublin, of about 300 tons each, and 140 horses' power; six between Holyhead and Dublin, of 235 tons and 100 horses' power; four between Milford and Waterford of from 189 to 237 tons, and 80 horses' power; two between Port Patrick and Donaghadee of 110 and 130 tons, and 40 horses' power; three between Weymouth and Guernsey and Jersey of from 154 to 165 tons and 60 horses' power; and five from Dover to Calais and Ostend, of 110 tons each and 40 and 50 horses' power. They perform 2,293 voyages annually."

The Pulkova Observatory

The suggestion for the construction of an observatory near St. Petersburg was made by the Emperor Nicholas I (1796–1855) in 1830. In the *Athenæum* of September 6, 1834, it was said: "A new observatory, far surpassing in magnitude every similar establishment is about to be built at St. Petersburg by command of the Emperor. The observatory itself will consist of three towers with moveable cupolas. Two of these towers are to be appropriated to the Königsberg heliometer and the Dorpat refractor, but the centre tower is destined for the reception of an instrument exceeding in size all others of its kind. In the lower part of the towers the meridian and transportable instruments will be placed. Spacious habitations for five astronomers will be connected by corridors with these towers so that the whole will form a continuous building 510 ft. in length. Smaller subordinate buildings, for various purposes, will increase the establishment, for the site of which an eminence between six and seven miles from St. Petersburg has been selected." The foundation stone of the famous observatory was laid on June 21, 1835, and the building was completed on August 19, 1839.

Societies and Academies

DUBLIN

Royal Dublin Society, June 26. J. CARROLL: Potato eelworm (*Heterodera Schachtii*) investigations. Work on the potato eelworm has established the fact that the root excretion of potatoes growing in recently sterilised soil does not possess the power of inducing hatching of eelworm eggs in the normal manner. J. REILLY and DENIS F. KELLY: A note on fatty oil production. Consideration is given to the possibilities of the economic production of various vegetable oils from seeds such as flax, hemp, rape, sunflower, soya bean, poppy, mustard and mercuriales, in the Irish Free State. J. J. RYAN and G. T. PYNE: Investigations on the cryoscopy of milk. A cryoscopic constant is developed for milk based on estimations of refractive index, chlorides and soluble phosphates, which allows of close approximation to the freezing point. Results of tests on some 40 samples of (mainly) individual milks showed close agreement between the two. It is suggested that the determination may prove useful for the detection of watering, particularly where the refractive index is already in use for sorting purposes. J. LYONS and M. O'SHEA: The influence of the stage of lactation on fat estimations by the Gerber method. Because of the increase in the proportion of small fat globules in milk as lactation advances, a modification of the Gerber method of determining fat percentage is necessary. M. J. GORMAN and D. SLATTERY: Some observations on the influence of lime on the growth of red clover in an acid soil. Red clover (broad, late flowering and wild) was grown in pots in an acid (pH5) soil to which sufficient lime was added to raise the pH to 6.5. Compared with controls which received no lime, the plants in the limed series at the end of eighteen weeks were smaller and yielded less dry matter; their fibrous roots were poorly developed and nodules were few or absent. In the unlimed pots, fibrous roots were well developed and nodules were abundant.

PARIS

Academy of Sciences, July 9 (*C.R.*, 199, 105-172). The president announced the deaths of Mme. Curie and of Benjamin Baillaud. K. BOTSUK and S. MAZURKIEWICZ: Absolute *rétractes*, not admitting decomposition. GEORGES KUREPA: Branched tables of ensembles. MIRON NICOLESCO: The representation of continued functions of several variables by uniformly convergent series of polyharmonic functions. A. KULAKOFF: Burnside's problem. ROBERT LÉVI: Rolling with slipping. F. E. MYARD: A gearing with inclined axes. JEAN BAURAND: The propagation of a train of periodic waves at the surface of water. HENRI SUBRA: A method of measuring static voltages such as the voltage of charge of a condenser, in the case of voltages higher than 0.1 volt and with the aid of a transportable apparatus utilising a voltmeter as the only measuring instrument. STEPHEN PROCOPIU: The ideal magnetisation of a crystal of iron. MAURICE FALLOT: The iron-platinum alloys. The Curie point and magnetic moments. GEORGES LIANDRAT: The photoelectric emission of the boundary layers and Einstein's relation. R. BOSSUET: Researches on the alkaline metals in natural waters. Results of the application of spectrographic methods. Waters from the primitive formations are characterised by

the presence of the five alkaline metals and those from superficial strata by the absence of lithium. The wide distribution of rubidium is noteworthy. HERSZFINKIEL and A. WRONCBERG: The radio-activity of samarium. Employing the method of direct measurement of the ionisation current, and taking special precautions to reduce the amount of possible radioactive impurities, the range of particles observed was slightly higher than the 1.5 cm. found by Curie and Joliot. JULES GUÉRON: Variation of the light diffusing power and of the viscosity of solutions of stannic chloride in the course of their evolution. MARCEL GUICHARD: The study of chemical systems by variation of weight with regularly varying temperature. Discussion of the interpretation of weight-time curves obtained by the method previously described by the author. HENRI MURAUOUR and W. SCHUMACHER: The study of the propagation of explosive decomposition in a mercury pump vacuum. Details of experiments with iodide of nitrogen, hexamethylenetetramine peroxide and hexogen. E. ARENDT: The internal corrosion of zinc. JAMES BASSET: The preparation of crystallised carbon under very high pressure. Under very varied physical and chemical conditions and under pressures reaching 25,000 kgm./cm.², the carbon is always obtained as graphite. PAUL LAFFITTE and J. BRETON: The detonation limits of some gaseous mixtures. The inflammation limits of a large number of gas mixtures have been determined, but very few determinations have been made of the detonation limits, that is, the limits between which a gas mixture can give an explosive wave. Details of experiments with hydrogen-air, hydrogen-oxygen, hydrogen and carbon monoxide-air, hydrogen and carbon monoxide-oxygen mixtures are given. JEAN DESMAROUX: The fixation of acetone by nitro-cellulose. RAYMOND QUELET: A method of synthetic preparation of α -chloroethyl derivatives of the phenol oxide ethers: application to the synthesis of some vinylanisols. M^{lle}. BLANCHE GRÉDY: The preparation of some acetylene compounds of the cyclane series. P. P. AREND: Relations between the original structure of the disperse phase of natural soils and the crystalline and metasomatic transformation of the sediments. JEAN GOGUEL: The tectonic of the region situated to the north of Grasse. CH. POISSON: The polar front and the formation of typhoons. M. DOUGUET and R. BUREAU: The diurnal variation of atmospherics during the polar night. Discussion of records of atmospherics obtained at the French station at Scoresby Sound. PIERRE CHOUARD: A singular case of the transformation of bulbs into rhizomes throwing up shoots. M^{lle}. N. CHOUCROUN and HARRY PLOTZ: The differences between the electrifications of various varieties of the tubercle bacillus. The experiments described point to a greater electrification when the virulence is greater. IWO LOMINSKI: The action at a distance of the staphylococci bacteriophage on the staphylococcus. EM^{lle} ROUBAUD and JEAN MEZGER: The sensibility to bird malaria (*Plasmodium relictum*) of various racial swarms of the common mosquito, *Culex pipiens*.

CAPE TOWN

Royal Society of South Africa, March 21. E. C. CHUBB, G. BURNHAM KING and A. O. D. MOGG: A new variation of Smithfield culture from a cave on the Pondoland Coast. A description of the excavation of a cave at the mouth of the Umgazana River,

some ten miles south-west of Port St. John's. Pottery was found in the later layers, and stone implements in all the occupational strata. There can be no doubt that the congeries is assignable to the Smithfield culture, but shows a variation from the typical congeries of this division from open sites. T. F. DREYER: The stratification of the superficial deposits at Mossel Bay and the age of the Mossel Bay and other lithic industries. A. P. GOOSSENS: An anatomical study of the roots of grasses. The development of the root and its tissues is discussed. Root hairs occur all over the whole length of the root, and usually become cemented to the soil particles, to form a sheath. A perforated cortex is a characteristic feature of grass roots, and seems to be associated with a better oxygen supply. The stele of grass roots varies very little. The pith is important in that reserve food is stored in it during the resting period. MARGARET ORFORD: Neolithic stone implements found at Regina in the western Transvaal. The two specimens described afford additional evidence of the presence of a highly developed Neolithic culture in South Africa. The association of Smithfield rings and Neolithic daggers proves the existence of a definite link between these industries. A tentative suggestion as to the contemporaneity of the Neolithic and Bronze Ages in South Africa has before been put forward. The style and finish which these objects present suggests the possibility of their being copies of Bronze objects. The material of which they are composed was used in the construction of ornamental objects from the Zimbabwe culture. We may say, therefore, that these specimens form a link between the Neolithic, Smithfield and Zimbabwe industries. J. M. WINTERBOTTOM: Bird population studies (5). An analysis of the avifauna of the Jeans School Station, Mazabuka, Northern Rhodesia. M. A. KEAY: Water absorption by leaves of *Crassula*.

LENINGRAD

Academy of Sciences, C.R., n.s., 2, No. 2. A. WALTER and L. INGE: The influence of the concentration of electrons on the dielectric resistance of crystals. I. KIKOIN: A new photoelectric effect in cuprous oxide. Supplementary data to the communication published in NATURE of May 20, 1933, p. 725. D. BLOKHINTSEV: Contribution to the theory of phosphorescence. I. N. NAZAROV: Dehydration of the tertiary-butyl-tertiary-heptyl-carbinols. R. I. BELKIN: Studies on the regeneration in Amphibia (2). Influence of the temperature on regeneration in the axolotl (3). Regeneration of parts of extremities implanted into the tail of the axolotl. G. A. NADSON and E. A. STERN: New observations on the biological action of metals at a distance. Metals, acting at a distance, can retard the development not only of micro-organisms, but also of germinating seeds, the energy of the action being in proportion to the atomic weight of the metal. E. HASRATIAN: The influence of extraneous and conditioned stimuli upon an unconditioned food reflex. M. SHKOLNIK: The effect of boron upon the development of flax in water and soil cultures. The author's experiments proved the complete inability of flax to develop in the absence of boron. In soil cultures a substantial increase of yield was obtained by fertilising the soil with boron. I. KOLOMIEC: On drought resistance and its outward signs in different varieties of spring wheat. The water content and

the degree of drought resistance in each variety is not constant, but depends on the stage of growth. A. I. OPARIN: Metabolism in sugar beet at low temperatures and the storage of beet in a frozen state. In a root killed by frost, the biochemical processes connected with the disintegration of sucrose ceased immediately, and such roots may be preserved for any length of time, provided the temperature remains below -3.5°C . The method has been applied on a commercial scale. V. FOMITCHEV: Devonian deposits of the periphery of the Kuznetsk Basin. N. KUZNETSOV-UGAMSKIJ: Movements of the coast-line of the Issyk-Kul lake. G. VERESCHAGIN, A. GORBOV and I. MENDELEJEV: Contribution to the problem of the occurrence in Nature of water with anomalous density. It is suggested that the preservation of the ancient fauna in Lakes Baikal and Tanganyika may be due to their exceptional depths and the presence of 'heavy' water. The necessity of studying the properties of various natural waters is pointed out. K. K. FLEROV: Geographical distribution and systematics of the elk or moose (*Alces*, Gray). Two species are recognised, namely, *Alces alces*, L., occurring in Europe and in Western Siberia, and *A. americanus*, Clinton, of which three subspecies occur in North America, one in the Yakutsk region and one in the Ussuri region of Siberia.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 221-249, April 15, 1934). L. F. AUDRIETH and M. T. SCHMIDT: Fused 'onium' salts as acids. (1) Reactions in fused ammonium nitrate. Fused ammonium nitrate is a good conductor and contains the 'onium' ion, which in certain circumstances may lose a proton, giving the fused salt the properties of an acid. Similar 'onium' salts (ammonium, hydrazine, hydroxylamine, pyridine, aniline and phenylhydrazine compounds) can all act as acids in the fused and the dry states. This view has important applications in considering (1) the use of ammonium sulphate and fluoride as fluxes for ores, (2) certain reactions of metals, oxides and carbonates with ammonium salts, etc. It is based on Brønsted's view that acidity is a matter of competition between the solvent and the acid anion for the proton. E. M. EAST: Norms of pollen-tube growth in incompatible matings of self-sterile plants. The extent of the pollen-tube growth is regarded as conditioned by a type of chemical reaction similar to the specific protein reactions of immunology. L. C. DUNN: A new gene affecting behaviour and skeleton in the house mouse. Characters of the new type are shortened tail, erratic circuit movements and complete deafness and sterility. It acts as a simple recessive to normal and is termed 'shaker-short' (*st*). J. W. GIVENS, JR.: Projective differentiation of spinors. B. F. SKINNER: The extinction of chained reflexes. In a chain of reflexes not ultimately reinforced, only the members actually elicited undergo extinction when the chain is interrupted. SELIG HECHT and AURIN M. CHASE: Anomalies in the absorption spectrum of visual purple. Certain workers have found evidence of the appearance of a yellow intermediate body in the bleaching of visual purple. The density of visual purple solutions obtained from the eyes of frogs kept in cold storage decreased steadily during bleaching when measured with light of wave-length $550\text{ m}\mu$; measured with light of wave-length $450\text{ m}\mu$, it first

rose and then fell, indicating formation of an intermediate compound. A solution of visual purple from active frogs in summer shows no such preliminary increase of absorption during bleaching. It is suggested that 'winter' and 'summer' frogs' visual purple contain different quantities of coloured or colourless substances which combine with decomposition products of visual purple to form a yellow substance. G. A. MILLER: Groups involving three and only three squares. W. M. ROGERS: Heterotopic spinal cord grafts in salamander embryos. Co-ordinated movements of the fore-limbs resulted only when the implanted graft included the normal brachial region of the cord, thus confirming earlier investigators' results. In addition, it was shown that the co-ordinating mechanism can develop in brachial cords isolated from the central nervous system previous to the outgrowth of nerves. Co-ordination reflexes are independent of the number of nerves which grow into a limb during development.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
(ABERDEEN MEETING)

Wednesday, September 5

At 8.30 p.m.—Sir James Jeans: "The New World-Picture of Modern Physics" (Presidential Address in the Capital Cinema, Union Street).

Thursday, September 6

At 10 a.m.—Prof. T. M. Lowry: "Physical Methods in Chemistry" (Presidential Address to Section B).

Dr. E. S. Russell: "The Study of Behaviour" (Presidential Address to Section D).

Prof. A. G. Ogilvie: "Co-operative Research in Geography and an African Example" (Presidential Address to Section E).

Prof. F. G. Baily: "Sources of Cheap Electric Power" (Presidential Address to Section G).

Prof. A. W. Borthwick: "Some Aspects of Forest Biology" (Presidential Address to Section K).

Mr. H. T. Tizard: "Science at the Universities: Some Problems of the Present and Future" (Presidential Address to Section L).

At 2 p.m.—Conference of Delegates of Corresponding Societies. Sir Henry Lyons: "Scientific Societies and Museums" (Presidential Address).

Friday, September 7

At 10 a.m.—Prof. H. M. MacDonald: "Theories of Light" (Presidential Address to Section A).

Prof. W. T. Gordon: "Plant Life and the Philosophy of Geology" (Presidential Address to Section C).

Prof. H. M. Hallsworth: "The Future of Rail Transport" (Presidential Address to Section F).

Dr. Shepherd Dawson: "Psychology and Social Problems" (Presidential Address to Section J).

At 8.30 p.m.—Sir Frank Smith: "Storage and Transport of Food" (Sir William Hardy Memorial Lecture) (MacRobert Hall, Gordon's College).

INSTITUTE OF METALS, September 3-6. Annual Autumn Meeting to be held at Manchester.

Sept. 3.—Dr. J. L. Haughton: "The Work of Walter Rosenhain" (Annual Autumn Lecture).

Official Publications Received

GREAT BRITAIN AND IRELAND

Ministry of Agriculture and Fisheries. Economic Series No. 40: Abattoir Design; Report of Technical Committee. Pp. 46+xii. (London: H.M. Stationery Office.) 1s. net.

The Strangeways Research Laboratory, Cambridge. Report for 1933. Pp. 24. (Cambridge.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1577 (T.3202 and S. and C. 543): Westland-Hill Pterodactyl Mark IV. Part 1: Experiments on One-fifth Scale Model, by A. S. Batson; Part 2: Full Scale Tests, by J. E. Serby. Pp. 19+16 plates. 1s. 6d. net. No. 1582 (S. and C. 565): Aileron Angles in High Speed Manœuvres with Single Seater Fighters. By B. V. Williams and J. H. Hartley. Pp. 8+6 plates. 6d. net. (London: H.M. Stationery Office.)

City of Leicester Museum and Art Gallery. Thirtieth Report to the City Council, 1st April 1933 to 31st March 1934. Pp. 30. (Leicester.)

The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor (John W. Cobb) for the Session 1932-33. Pp. 12. (Leeds.)

Mines Department. Twelfth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1933. Pp. 129+19 plates. (London: H.M. Stationery Office.) 2s. net.

Fifteenth Annual Report of the Ministry of Health, 1933-1934. (Cmd. 4664.) Pp. xii+388. (London: H.M. Stationery Office.) 6s. net.

Proceedings of the Royal Society of Edinburgh, Session 1933-1934. Vol. 54, Part 2, No. 14: Fifty Years Ago, in the Royal Society of Edinburgh. An Address delivered, at the request of the Council, on May 7, 1934, in commemoration of the 150th Year of the Society. By Prof. D'Arcy Wentworth Thompson. Pp. 145-157+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s. 6d.

OTHER COUNTRIES

Canada: Department of Mines: Geological Survey. Summary Report 1933, Part B. (No. 2353.) Pp. 176B+2 plates. 50 cents. Summary Report 1933, Part D. (No. 2351.) Pp. 162D+5 plates. 50 cents. Economic Geology Series, No. 13: Platinum and Allied Metal Deposits of Canada. By J. J. O'Neill and H. C. Gunning. (No. 2346.) Pp. 165. 50 cents. Memoir 172: Geology and Mineral Deposits of Salmo Map-area, British Columbia. By J. F. Walker. (No. 2345.) Pp. 102. 25 cents. (Ottawa: King's Printer.)

Canada: Department of Mines: National Museum of Canada. Bulletin No. 73: Annual Report for 1933. Pp. 30. (Ottawa: King's Printer.) 25 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 107: A Development of the Michell's Theory of Lubrication. By Torao Kobayashi. Pp. 385-414. 25 sen. No. 108: On the Effect of Pipe Bores on the Cut-off of Fuel Spray in Injection Systems with Open Nozzles. By Fujio Nakanishi, Masaharu Itô and Kikuo Kitamura. Pp. 415-435. 25 sen. (Tôkyô: Koseikai Publishing House.)

Entomological Investigations on the Spike Disease of Sandal. (23) Anthicidae (Col.). By Dr. Rudolf F. Heberdy. Pp. 14+1 plate. (Delhi: Manager of Publications.) 7 annas; 9d.

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 15, No. 3: Nematode Parasites of Mammals, from Specimens collected in the New York Zoological Park, 1932. By Gervase W. McClure. Pp. 49-60. (New York City.)

Harvard Meteorological Studies. No. 1: Daytime Radiation at Blue Hill Observatory in 1933, with Application to Turbidity in American Air Masses. By Bernhard Hauritz. Pp. 31. (Cambridge, Mass.: Harvard University.) 50 cents.

Bulletin of the American Museum of Natural History. Vol. 66, Art 3: The Diptera of Kartabo, Bartica District, British Guiana. By C. H. Curran. Pp. 287-532. (New York City.)

The Cawthron Institute, Nelson, New Zealand. Thomas Cawthron Centenary Lecture, October 10th, 1933: The Achievements of the Cawthron Institute. By Dr. T. H. Easterfield. Pp. 19+5 plates. (Nelson.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1933. Pp. 27. (Batavia.)

Carnegie Institution of Washington. Publication No. 450: Diametral Changes in Tree Trunks. By Ferdinand W. Haasis. Pp. iii+103+4 plates. Publication No. 423: The Building of the Roman Aqueeducts. By Esther Boise Van Deman. Pp. xi+440+60 plates. (Washington, D.C.: Carnegie Institution.)

Proceedings of the First Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry held at New Delhi from the 20th to the 23rd February 1933, with Appendices. Pp. iii+297. (Delhi: Manager of Publications.) 5-14 rupees; 9s. 6d.

U.S. Department of the Interior: Office of Education. Pamphlet No. 48: Residence and Migration of College Students. By Frederick J. Kelly and Betty A. Patterson. Pp. 22. (Washington, D.C.: Government Printing Office.) 5 cents.

Memoirs of the Geological Survey of India. Vol. 65, Part 1: The Dhuli Earthquake of the 3rd July 1930. By E. R. Gee. Pp. vi+106+vi+11 plates. (Calcutta: Geological Survey of India; Delhi: Manager of Publications.) 4.6 rupees; 7s. 3d.

Forest Bulletin No. 83: Provisional Field Table for *Quercus incana* Roxb. (Banj or Ban Oak.) By H. G. Champion and I. D. Mahendru. Pp. iv+13+3 plates. (Delhi: Manager of Publications.) 14 annas; 1s. 6d.

CATALOGUES

Shell Wild Barfield Quenching Oils. Pp. 16. (London: G. W. B. Electric Furnaces, Ltd.)

Zeiss Nachrichten. Heft 7, Juli. Pp. 43. (Jena and London: Carl Zeiss.)