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Pride and Prejudice in Africa

DESPITE the obligations which, in common with France and the Union Government of South Africa, Great Britain has incurred in accepting the trusteeship of some four millions of Africans under mandate from the League of Nations, a rather vague pride in past achievements in suppressing the slave trade, and a careless prejudice against any claims of the native races to be more than hewers of wood and drawers of water, colour much of such public opinion as is from time to time called into existence by affairs in Kenya Colony and Tshekedi or similar incidents. The situation is all the more deplorable in that during recent years there has been available a wealth of material which can assist the intelligent layman to pass accurate judgment on African affairs, such as the reports of the East African Commission of 1924, under Mr. W. G. A. Ormsby-Gore, and of the Hilton Young Commission in 1929, Lord Lugard's studies of the principles of administration of backward races, and so on.

The most disturbing forces in the life of Africa at the present time arise from the insistent demand of the rest of the world for the products of tropical Africa. This demand has set in motion economic forces which are producing revolutionary changes in vast areas where European settlement is impossible. They are disintegrating the fabric of tribal life and creating problems of administration which cannot be left alone, above all in the light of the calamitous experience of South Africa. Apart altogether from the new standard of administration to which we are committed in Tanganyika Territory, and which has been accepted as the standard of administration elsewhere in our African territories, industrial conditions are poising problems which make a policy of *laissez faire* as dangerous from an economic point of view as it is morally indefensible.

Of these problems the study of conditions in the copper belt of Northern Rhodesia, with particular reference to the effect of the mines upon native society and upon the work of missions, carried out in 1932 under the auspices of the Department of Social and Industrial Research of the International Missionary Council*, provides many striking illustrations. The copper belt of Northern Rhodesia was chosen as the chief field of study because its

* Modern Industry and the African: an Enquiry into the Effect of the Copper Mines of Central Africa upon Native Society and the Work of Christian Missions made under the auspices of the Department of Social and Industrial Research of the International Missionary Council. By J. Merle Davis. Pp. xviii+425. (London: Macmillan and Co., Ltd., 1933.) 12*s.* 6*d.* net.

mines are among the latest that have been opened in Africa, and they have been developed with a vigour and on a scale that have attracted a large native working population. In addition, the position of these mines between those of the Belgian Congo and the Union of South Africa, with their widely contrasted labour policies, gives Northern Rhodesia an opportunity to profit from the experience of its neighbours. Many of the acutest difficulties in Africa to-day are unfortunately the direct result of neglect, sometimes deliberate, of the lessons of history.

This study makes it abundantly plain that the working of the copper mines is raising problems which go far beyond the immediate social and economic problems in the vicinity of the mines. The withdrawal of labour from the native areas, with a consequent shortage of man power for cultivation of essential food crops, is threatening the whole economy of native life, quite apart from the disintegrating influence of the new outlook and new needs acquired by natives working on the mines. The structure of native society is being knit with our own in ways which it is now well-nigh impossible to disentangle.

It is, of course, clear that, at the mines themselves, problems of social welfare present an important field for scientific study and one in which co-operation between the mines, missions and Government is highly important. Such co-operation based on a careful study of the actual conditions might make a contribution to a better understanding between the natives and Europeans, to the education of native society and the enrichment of the community at the mines, and through it and through the network of native interests created, to the foundation of an urban native society.

Economic conditions present a particularly strong challenge. Co-operation of the type just visualised is fully as important in relation to the building of permanent communities round agriculture through the rotation of crops, use of fertilisers, soil conservation, etc., in place of the semi-nomadic native methods, which are inadequate to avert the continual threat of famine. Much might be done by co-operative methods to supplement the present training and experience of the native employed on the copper belt, so as to increase his economic power on returning to rural life. Agriculture in Africa to-day in all its aspects —technical, social and economic—provides a field in which intensive scientific study is urgently needed, and it is a sore reproach to the administration in Northern Rhodesia and elsewhere that funds for demonstration and experimental work under the Department of Agriculture have been cut to the bone.

However, just when science is affording growing support to the administration in its efforts to develop self-government in accordance with native law and custom, economic conditions and the impact of modern industry are strengthening the disturbing or opposing forces. Discontent with the tribal system and its inadequate adaptation to the industrial revolution in Africa was a prime factor in the unrest which led to the Tshekedi incident. An important paper by Dr. R. S. Rattray at the Leicester meeting of the British Association directed attention to some of the doubts and misgivings regarding this system which are arising in spite of its promise for the preservation of the African national genius.

The attack on the system of indirect rule comes partly from its tendency, in the absence of adequate anthropological knowledge or experience on the part of those administrating it, to build up centralised African autocracies out of harmony with African institutions and traditions. It comes partly from the growing class of educated tribesmen, who can find no place in a system which seems to discount Western education and Western lines of progress. This element is being strongly and continuously reinforced by the wage-earning class, who have similarly been detribalised by their employment at the mines and have equal difficulty in finding a place in tribal society.

These factors are shaking the existing system to its foundations. There is widespread belief among the educated Africans, which was encouraged by the reports of the Phelps-Stokes commission, that indirect rule and anthropology are veiled attempts to keep the African in his place. Without the co-operation of the educated native, the whole structure of indirect rule must crumble, and the fruits of anthropological research must be lost. Only a determined attempt to develop an intelligent native leadership and a sound public opinion are likely to save the situation, and here once again success will depend on adequate co-operation and harmony between industry, missions, and Government. In each sphere there is need of fuller sympathy depending on accurate knowledge of native religious beliefs and old customs.

The absence of that sympathy accounts directly

for much native unrest, as well as for recent mistakes in administration which have augmented such unrest. Unrest is strongly reinforced, moreover, by the disproportion between the sums collected from natives and Europeans in taxation and the expenditure of those sums on social welfare and educational work among the natives. From an industrial point of view, the importance of sympathy and understanding of native customs and beliefs is already being recognised, but the significant contribution of scientific work in these fields in establishing a relation of mutual confidence and respect is imperfectly apprehended by industry.

From whichever aspect we survey them, however, African problems provide a surpassing field for scientific investigation and endeavour, and the report before us indicates yet again some of the more important lines of work—the study of the various problems affecting public health whether in the mines or in the agricultural communities; the improvement of the standard and quality of native agriculture both in respect of food and of economic crops; provision of adequate transport in regard to the marketing of African produce and the mobility and efficiency of labour; and the development of education so as to assist the native, whether as a producer or as a wage-earner, to advance in the scale of civilisation and assimilate such moral controls as will enable him to resist the dangers and yet to utilise the advantages of increasing wealth.

Here is a programme in which scientific work must play a decisive part, but there is an even more important contribution which science may yet make. In a brilliant criticism of the Rhodes lectures of General Smuts, Mr. J. H. Oldham has pointed out that just because Africa is only at the beginning of its development, it may offer one of the most fruitful fields of experiment in regard to the place of expert knowledge in political affairs. What is needed is a far-sighted policy directed towards the economic development of the great resources of Africa on scientific lines in the interests of the native inhabitants, the immigrant European and Indian communities, and the world at large, and at the same time promoting the physical, intellectual, moral and social advance of the African peoples. Missions, no less than Government and industry, must have a clearly defined policy, and there is no room in such a policy for prejudice.

The new possibilities of service which science has opened up in dealing with the problems of dependencies are as yet largely unappreciated. To urge that the scientific outlook and method should become an increasing factor in government is not to advocate the rule of a bureaucracy. It offers much greater assurance that the human factors will be fully considered, that account will be taken of the prejudices and beliefs of all parties and not merely of those of one section, and that an honest attempt will be made to sort out the real cause of unrest. The possibilities of mastery which science has given us in problems of government propound moral questions the answers to which depend on our scale of values, and the application of scientific thought and method to African problems will, in the end, be justified by the ability of science to keep those who use it loyal to the conceptions of disinterested service implicit in the spirit of science itself.

The Complete Guide to Astrophysics

Handbuch der Astrophysik. Herausgegeben von G. Eberhard, A. Kohlschütter und H. Ludendorff. Band 1: *Grundlagen der Astrophysik.* Teil 1. Pp. xii+564. 99 gold marks. Band 2, Hälfte 1: *Grundlagen der Astrophysik.* Teil 2/1. Pp. xi+430. 69 gold marks. Band 2, Hälfte 2: *Grundlagen der Astrophysik.* Teil 2/2. Pp. vii+431–752. 57.20 gold marks. Band 3, Hälfte 1: *Grundlagen der Astrophysik.* Teil 3/1. Pp. x+474. 77 gold marks. Band 3, Hälfte 2: *Grundlagen der Astrophysik.* Teil 3/2. Pp. viii+475–832. 62 gold marks. Band 4: *Das Sonnensystem.* Pp. viii+501. 78.80 gold marks. Band 5, Hälfte 1: *Das Sternsystem.* Teil 1/1. Pp. x+574. 99 gold marks. Band 5, Hälfte 2: *Das Sternsystem.* Teil 1/2. Pp. x+575–1156+2 plates. 99 gold marks. Band 6: *Das Sternsystem.* Teil 2. Pp. ix+474. 68.70 gold marks. (Berlin: Julius Springer, 1928–1933.)

THE need for such a work of reference as is supplied by the "Handbuch der Astrophysik" has become growingly obvious as successive volumes have appeared. The reviewer can speak from personal experience of its extreme usefulness in the observatory library and of its general completeness, within its own scope, as a work of reference. The articles contained in the different volumes may be divided into three groups—the theoretical, the instrumental or optical and the observational. It must not, however, be supposed

that there is any rigid division between these groups. The articles necessarily and rightly overlap. Thus an instrumental article on photometry quite properly has special reference to the astronomical applications and may well trench upon the domain of the article on the luminosities and colours of the stars. The fact that the two overlapping articles approach the same subject from two different points of view may lead to slight confusion here and there, but is probably more of a help than a hindrance to the student of the subject.

The theoretical articles may be subdivided into two sets, one of which belongs rather to the domain of pure physics, though headed in the direction of astrophysics and to some extent limited to the requirements of the astrophysicist: such articles as those on optical theory, theoretical photometry, radiation, the principles of the quantum theory, laws in series spectra, multiplet spectra and band spectra, all come under this head. The more astronomical articles of a theoretical type are those on the thermodynamics of stars, the theory of pulsating stars and the ionisation of stellar atmospheres. In these articles gaps in the existing literature on stellar atmospheres are well filled in, up to the date when the articles were written.

The optical or instrumental articles include an account of the construction and testing of telescopes and a discussion of the problems of practical spectroscopy. Full details are given of the instruments used and of the methods to be employed in astrophysical work, in photographic and photoelectric photometry, also in visual photometry, spectrophotometry and colorimetry. Special attention is paid to work on solar radiation. The reduction of photographic plates is a subject that one might scarcely expect to find in an astrophysical "Handbuch", but its presence as a separate article indicates how widely the editors have cast their net.

The third group of articles deals with the results of observation and gathers together a great wealth of scattered data, often difficult of access. They give in general a very readable, if at times somewhat uncritical, account of the special subjects under discussion. Naturally a wide range of topics calls for mention: stellar spectroscopy (classification and radial velocities), variable stars, novæ, binary stars (visual and spectroscopic), solar radiation, solar physics, eclipses, comets and meteors, photometry of planets, stellar photometry, stellar temperatures, stellar luminosities and masses, nebulæ, the Milky Way, stellar clusters and stellar statistics, are among the subjects treated in separate articles of very varying length. It will give an idea of the general scale of the work to mention that, in the article on variable stars, 74 pages are devoted to stars of the Mira Ceti class and 41 pages to Cepheids.

The articles are written in English or German, at the choice of the various authors. Half of the thirty-three contributors are German, but articles have been contributed from eight other countries; the whole work may be regarded as one more example of that international co-operation which has always been so valuable in the world of astronomy. The appearance of successive volumes has extended over a period of five years. This is reflected in two ways: on one hand, where theory has been rapidly developing, as in the quantum theory, or the study of stellar atmospheres, it is almost possible to date the articles by the outlook they represent, and different articles may approach the same question from very diverse viewpoints; on the other hand, where fresh observations have been accumulating, as in the study of line contours and intensities, there are already obvious gaps in those articles which were published several years ago. It is a pity, for the sake of their use as sources of reference, that the articles are not dated, but a supplementary volume is intended, and that may remove this difficulty. It will be a great help if the supplementary volume could contain a complete subject index for all ten volumes; at present, it is not as easy as it might be to trace a subject back to the one or two overlapping articles in which it is discussed, or to find exactly where a subject is treated on the particular side in which a reader may be for the moment most interested.

With regard to the form of publication of the volumes, we may note that the printing is clear and very readable, this including the numerous valuable tables; the text is also very free from misprints. Illustrations are lavish and well reproduced—perhaps the article on solar physics is best served in this particular. For volumes that are likely to be well used the binding is not as good as it might be and the lettering on the backs is liable to be somewhat easily obliterated.

Passing from the general to the particular, it is impossible within the limited range of a short review to discuss seriously 36 articles extending over 4,000 pages, but it may be possible to give an indication of their character by selecting a few,

frankly recognising that they represent a purely personal choice on the part of the reviewer. Prof. Abetti in his well-illustrated article on solar physics discusses solar spectrographic instruments of various types, visual photographic and spectroscopic observations of the sun's surface and the deduced results, also theories of the constitution of the sun. Dr. Graff in his discussion of the planets examines the evidence as to their atmospheres, rotations, spectra and such allied questions as the nature of the zodiacal light. Prof. H. D. Curtis in his article on the nebulæ discusses the different types—diffuse, planetary and spiral—with the various theories as to their origin and structure—also such closely allied questions as the expanding universe; useful bibliographical information is added. Under variable stars, Prof. Ludendorff classifies the various types, showing the links between them, and gives a full account of the literature and of the many theories put forward especially with regard to the Cepheid variables. The subject of pulsating stars is discussed mathematically in a separate article by Prof. E. A. Milne, whose article on the thermodynamics of the stars comes naturally alongside one by Prof. A. Pannekoek on the ionisation in the atmospheres of the stars.

Linking these theoretical articles to observational astronomy, with due emphasis on the difficulties underlying work in this sphere, comes the article by Prof. Brill on spectrophotometry. A discussion of sources of error in dealing with the continuous spectrum and line intensities makes clear that existing discrepancies between theory and observation may still be in part due to difficulties on the observational side. In this connexion one may express the hope that in the supplementary volume some attention will be paid in any additions to the articles on multiplet spectra and band spectra to the astrophysical interest of the subject. The articles by Prof. Laporte and Dr. Wurm respectively, though useful and complete, partake rather of the nature of textbooks on the subject and are not obviously what might be expected in a volume of primarily astrophysical interest.

In conclusion, a word of gratitude is due to the editors of the "Handbuch" for the laborious task that they have undertaken and carried through so successfully. They have placed all workers in the subject under a heavy debt and they have gathered together within easy reach much information that may be valuable to those researching in allied fields.

F. J. M. STRATTON.

Himalayan Poppies

An Account of the Genus Meconopsis. By George Taylor. With Notes on the Cultivation of the Introduced Species by E. H. M. Cox. Pp. xiii + 130 + 29 plates. (London: New Flora and Silva, Ltd., 1934.) 20*s.* net.

THE Natural History Museum is happy in possessing a band of young field botanists who bid fair to bring botanical science, lately overshadowed by the romantic march of the physical sciences, once more into high repute. Of this band, Mr. Taylor is not the least. *Meconopsis* is one of those select genera dear to horticulturists. But for them it might long have languished in darkness, unhonoured and unsung. British horticulturists have stimulated discovery, cultivation, and study; and Mr. Taylor, with a wealth of material, living and dead, before him, collected primarily in the interests of horticulture, has presented them with a new classification, and brought our knowledge of the genus up to date.

It is, however, botanists rather than horticulturists who will be interested in what Mr. Taylor has to say. The author has a wide acquaintance with his subject, and is both lucid and provocative; he is not the worse botanist for that. Old mistakes are resolved; tangles untangled; new ideas infused. It would be no compliment to say that all taxonomists will accept his rearrangement of the genus; but his opponents will need to be well equipped before joining issue with him.

Mr. Taylor takes up the position that species are distinguished by fixed morphological characters, not connected by intermediate forms; conversely, if there are intermediate forms, they embrace one (Linnæan) species, no matter how extreme the divergence. He has applied this principle ruthlessly to *Meconopsis*; other taxonomists have not applied it to, for example, *Rhododendron*. There seems to be no relationship between the age of a genus, and its degree of stabilisation; and *Meconopsis* is not more polymorphic than *Rhododendron*. Stabilisation is probably more a function of space than of time. Cytology may help in the delimitation of species; but as Bruun has insisted in his "Cytological Studies in Primula" (Uppsala, 1931), chromosome differences constitute only *one* character, comparable to a morphological character, though perhaps more fundamental. Nevertheless, the results are sometimes surprisingly at variance with visible differentiation; for example, in section

Sikkimensis of the genus *Primula*. Mr. Taylor faces the difficulty boldly, and takes his own line. He may be right in attaching more importance to stylar than to epidermal structures, though both are probably artificial in the sense that we cannot link them to any function, or trace their evolution. Indeed the author expressly denies any relationship between his subgenus *Discogyne* and *Papaver*. Then, when he comes to *Meconopsis integrifolia*, he waxes a little impatient over the synonymy, based on styles, and helps the lame dogs over theirs with a flying leap. Nor is he quite consistent; since he advances the same argument for unity here that he advocates for separation between *M. venusta* and *M. impedita*. It is surprising, too, to find him upholding, even provisionally, *M. argemonantha* on the woefully imperfect material available. The fate of *M. Baileyi* should have warned him.

No really satisfactory system of representing distribution has yet been devised. To enclose all recorded areas for a taxonomic unit has its uses; but the method is apt to obscure more than it reveals. Some adaptation of the layer system might be employed. Mr. Taylor gives us several maps; but we are left with an empty feeling that they convey no more than meets the eye. We should have preferred distribution maps of the more comprehensive species, such as *M. horridula* and *M. impedita*, especially in combination with larger taxonomic units. The statement (p. 94) that "all forms [of *M. horridula*] may be found growing in association in the field" is surprising; though its correct interpretation depends upon the scope of "in association". The reviewer's experience is that *all* varieties, even colour varieties, of *Meconopsis* definitely tend to segregate. Again, the statement (p. 33) on the authority of a collector, that *M. superba* grows "above the snow line" is equally surprising—if true.

Mr. Taylor does not mention latex, though the colour of this is sometimes a useful diagnostic character. Nor does he mention that the seeds of *M. betonicifolia* are eaten by the natives in lieu of *Papaver somniferum*, and so may be assumed to possess narcotic properties.

But the mantle of Sir David Prain, whose last revision of the genus was published nearly twenty years ago, has fallen on worthy shoulders. At the prohibitive price, the format might have been better. Some of the photographs are excellent; we should have preferred some line drawings of capsules, in the text, for others.

Social Values

The Conflict of Values. By J. R. Bellerby. (Published by Education Services.) Pp. xi+204. (London: Richard Clay and Sons, Ltd., 1933.) 6*s*. net.

AN encouraging sign of the times is the clearer recognition of the need for experiment in economics and sociology. The difficulties in the way of practical work in this field are of course sufficiently obvious, but they are surely not insuperable, and the need for overcoming them was never greater than now.

As Mr. Bellerby shows in his new book, the first step for a nation as for an individual is to have some definite aim and purpose, an architect's plan, an ideal State shining as a star ahead, never actually attainable, but inspiring our best efforts in the search for real values. This would appear to be the first law both in individual and social psychology. Mr. Bellerby endeavours in a philosophical discussion, somewhat after the Platonic manner, to discover these values, combine them into a complex 'web of purpose', and relate them to an economic or industrial structure leading as nearly as possible in the direction of the ideal state. He brings to his task a highly interesting and attractive style, original and courageous thought, and above all a keen sense of practical difficulties as illustrated by actual test and experiment.

The book is a sequel to a previous work entitled "A Contributive Society", and, in the author's own words, is "the logical completion of that work, giving point to its main theme by describing the life values, or the scheme of values, which may be achieved through contribution".

This first chapter marks the end of the first phase of theory, after which the experiment is described, from which useful criticisms have been drawn. The attempt is made to illustrate a 'contributive' society, in contrast apparently with Mr. Tawney's 'acquisitive' society. Inspired by a new estimate of life values, which, however, in themselves are not new since they go back to Plato and Christ, the members of this social group endeavour to contribute a maximum both of service and worldly goods or money to the common fund, on the principle of the 'average wage'. The group is established on a purely voluntary basis, without compulsion of any sort; and the life values which are re-stated in relation to modern economics are those concerned with beauty, truth

(or knowledge), and love. For the individual the aim is to develop personality to the utmost, and in doing this in the right way the greatest advance will be made towards attaining the ideal State or community.

This question of values in social philosophy has exercised the greatest minds in all ages, and has led to visions of many Utopias, those of Plato, More, Morris, Bacon, and others, most of them being here briefly outlined and discussed by Mr. Bellerby, including a note on the inner meaning and implications of progress, and the contrasts between the Western mind of breathless activity and the Oriental mind of calm meditation. The theory of social evolution is apparently accepted by the author; but this somewhat complicates matters, tending as it must do to a fatalistic outlook, especially if one goes so far as Keller and Sumner (in "Societal Evolution"), wherein there is not necessarily any progress, and human destiny is determined by the operation of blind, impersonal, yet invincible forces.

The 'web of purpose', and the setting up of an economic system must before all things be purposive, and contribute to the development of personality. "Its processes must be such as to challenge and demand character, and its product must aid men to strong growth." This view of one of the aims of industry has already been outlined in the columns of NATURE by the present reviewer; as also was another important point, referred to by Mr. Bellerby as the central problem of his book. This is the question of what best constitutes the 'web of purpose' and ideal to be aimed at. Is it the militaristic ideal of the Vikings, the bustling activity and obsession for business of the western nations of Europe, the meditative philosophy of the Oriental, or religious piety, or scientific attainment? The answer given long ago, and now given again by Mr. Bellerby in almost the same words, is that the ideal State, embodying the ideal industrial system, so far as this is conceivable, will not be one fixed or static and stereotyped system, based on one single ideal, like that of large-scale mechanised industry for example (if this is really an ideal). Certainly it does seem that this is the inevitable outcome of present tendencies, but these tendencies are not necessarily right or inevitable, especially when viewed in the light of a philosophical analysis of values.

Mr. Bellerby particularly emphasises the need, as has already been done before in these columns, for elasticity and variety, for both breadth and depth, in the contributive society, so that not one ideal only but probably many ideals may find inspiration and scope. So far as the industrial structure is concerned, it was long ago pointed out by some of us that room should be found for many different forms of industry, both large scale and small, both mechanised and handicraft, competitive and co-operative, individualistic and communal. That there may be incompatibility and even conflict between the various ideals is realised by Mr. Bellerby in the very title of his book; but this need not deter the far-sighted statesman and an intelligent and educated people from attempting a nice balance between all the various elements which should go to make up a great industrial and agricultural nation.

W. G. L. C.

Short Reviews

Müller-Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer und E. Waetzmann. In 5 Bänden. Band 4: *Elektrizität und Magnetismus.* Teil 4: *Elektrische Eigenschaften der Metalle und Elektrolyte; magnetische Eigenschaften der Materie.* Herausgegeben von Arnold Eucken. Pp. xx + 906. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1934.) 62 gold marks.

THERE is no doubt that this final portion of the fourth volume of the eleventh edition of such a well-known treatise on physics is bound to be of interest to all who teach modern physics or who are interested in research on the conduction of electricity by solids and liquids. The book gives an excellent treatment of the experimental aspects of the electrical properties of metals, including an important section on thermo-electric effects. It also includes an adequate discussion of thermionic phenomena, and a very satisfactory statement of modern statistical and kinetic theory of the metallic state is contributed by Nordheim.

Coehn of Göttingen is responsible for the account of electrolytic processes, including an important section on the modern theory of strong electrolytes, while Jost of Hanover appends an account of the electrical conductivity of non-metallic crystals. O. v. Auwers, whose recent work on hysteresis cycles of the perminvars aroused much interest, gives a very concise treatment of magnetic phenomena, and a survey of the quantum theory of magnetism, by Nordheim, completes a very fine work.

It is almost unnecessary to add that the standard of the production is in all respects equal to that of the first three parts of the volume.

Meteorology for Masters and Mates. By Charles H. Brown. Seventh edition. Pp. ix+234. (Glasgow: Brown, Son and Ferguson, Ltd., 1933.) 7*s.* 6*d.* net.

THE object of this book appears to be mainly to assist those taking the master's and mate's examination to answer questions in meteorology which demand a greater knowledge than seems to be required according to regulations. It should, however, also help to stimulate interest in the subject, and assist in producing a generation of seamen able to take full advantage of the help in navigation that can be obtained from the exchange by wireless of weather information between ships at sea and shore stations. The author goes more into the physical causes underlying meteorological phenomena than he did in the earlier editions of the same work. From the point of view of the examinee, the arrangement of the subject matter appears excellent; the syllabus for the first mate's as well as for the master's examination is given at the beginning, and examination papers are set at the end, with references to the parts of the work dealing with the subject matter of each question.

Under "Velocity of Gales" (p. 86) it is stated that "It is to be understood that the direction and force of the wind depends on the part of the depression that the observer is situated in, but that the speed of a gale is really the rate of travel of the system", which has the implication that a gale never occurs in a stationary depression. On the same page there is the further statement that "the force and frequency of the squalls of wind depend not on the gradient alone but also on the distance from the centre of low pressure". It would be interesting to know what evidence there is in support of this statement. E. V. N.

Santiago de los Caballeros de Guatemala. By Dorothy H. Popenoe. Pp. xvi+74+7 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1933.) 6*s.* 6*d.* net.

THE Spanish city well described and illustrated in this volume was begun towards the middle of the sixteenth century as the third capital of the colony of Guatemala, after the second one, Almolonga, built by Alvarado, had been destroyed by earthquake. Much of the city known to-day as Antigua Guatemala still stands, but it lies in a volcanic area and suffered repeated earthquake shocks until in 1773 it was so badly devastated that Spain ordered its abandonment and the removal of the capital to a new site, the modern Nueva Guatemala. Mrs. Popenoe had made a wide study of Central American archæology and written this book shortly before her untimely death. She has succeeded in reconstructing the life of the city and much of the beautiful architecture of the early Renaissance which characterised the first buildings. The work is based on old documentary records.

Kohlensäure und Kalk: Einführung in das Verständnis ihres Verhaltens in den Binnengewässern. Von Prof. Dr. Julius Pia. (Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten, herausgegeben von Prof. Dr. August Thienemann, Band 13.) Pp. vii+183+3 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1933.) 21 gold marks.

THE present volume of "Die Binnengewässer" is a treatise on carbonic acid and chalk in fresh waters. It is a comprehensive work and, like all the previous parts, covers much ground, and the subject is considered from many different aspects. The three parts into which it is divided deal respectively with chemical constants and theories of solubility, inorganic and organic precipitation, and the most important chalk deposits. Compared with the condition in the sea, the part played by living organisms in connexion with the precipitation of chalk is small; the various chemical and physical factors are much more important in fresh waters. The research of the various specialists in these subjects is fully described, and there is a bibliography of 26 pages, making this volume a most satisfactory work of reference.

La France méditerranéenne. Par Prof. Jules Sion. (Collection Armand Colin: Section de géographie, No. 164.) Pp. 222. (Paris: Armand Colin, 1934.) 10.50 francs.

PROBABLY no region of France has more distinctive physical conditions and human characteristics than the Mediterranean border. The difficulty in discussing this region lies in fixing its limits. Prof. Sion has wisely confined his attention to the plains, the delta of the Rhone and the coastal ranges of hills. After briefly explaining the structure he goes on to discuss human relationships, historical, economic and demographic, tracing with a sure knowledge the reasons for the various changes that the region has undergone, of which none is more interesting than the decline of wheat and the development of viticulture, and the rise of the various seaports. No student of geography can afford to miss this important though small work on the geography of France. R. N. R. B.

Plant Life Through the Ages: a Geological and Botanical Retrospect. By Prof. A. C. Seward. Second edition. Pp. xxi+603. (Cambridge: At the University Press, 1933.) 30*s.* net.

IT is unnecessary to emphasise the authoritative nature of this geological and botanical retrospect; the name of the author, who is professor of botany in the University of Cambridge, carries sufficient guarantee. The fact that within two years a second edition of a specialised work has been called for speaks well for its success. The first edition was reviewed at length in NATURE of October 3, 1931, p. 559. A few alterations and corrections have been made and more references added in the present edition.

Twenty-One Years of Fruit Research at East Malling

THE Fruit Research Station at East Malling, in the heart of the Kent fruit area, which was established in 1913, at the request, and with the active and continued assistance, of fruit growers, celebrates its coming-of-age at the annual meeting of its supporters on May 24. The occasion is being graced by the presence of His Royal Highness the Duke of York, who has consented to honour the Station by visiting its plantations and laboratories on that date, when the Institute's subscribing members, now numbering 1,000, will have their annual opportunity of making a closer acquaintance with the results of the experimental work, special demonstrations of which will be staged.

A prime essential for the successful prosecution of research on fruit plants is continuity of policy. If more than fragmentary information is to be obtained, experiments must cover a reasonable proportion of the useful life of the subject, so that an investigation even of strawberries may last four or five seasons, whilst the full value of trials of tree fruits may not be obtained in less than twenty years.

Since 1913, in spite of the necessary restriction of its activities during the War years, the Station, by adherence to a clear-cut programme of long-distance research in the field and in the laboratory, has obtained results of fundamental importance to fruit growers. The annual total of 2,000 interested inquirers who visit the Station is an indication of the confidence placed in its work by the industry, which recognises that the best fruit must be grown before the best marketing methods can be applied.

Important contributions have been made to the practice of the culture of small fruits such as black currants and raspberries, first by systematic botanical studies of varieties, which made possible accurate identification and consequently the accumulation and maintenance of races and strains true to type. Only when this had been effected was it possible to begin field trials to determine the cropping capacity, manurial requirements, disease resistance and market value of the multitude of varieties available in commerce. Such investigations, coupled with the elaboration of methods of control of pests and diseases, have been the main factor in lifting black currant culture from a haphazard gamble to its present condition of an organised system of operations which can be undertaken with a reasonable certainty of success.

Similar methods, linked up with the evolution of a scheme of nursery hygiene, have been applied to raspberry growing, and a large measure of success has already been obtained, whilst problems of the propagation and control of diseases and pests of the strawberry, loganberry and blackberry are under investigation.

Fruits such as apples, pears, plums and cherries, the trees of which are budded or grafted on root systems other than their own, present problems similar to those of the small fruits; but, in addition, further complications are introduced by the presence of the foreign root system. The first step was the collection of examples of these rootstocks from a wide range of commercial sources, and after meticulous botanical examination it was possible to construct a very necessary system of classification for identification purposes and to avoid future confusion. The next stage was the multiplication of the different rootstock types, and for this purpose vegetative methods were resorted to in order to preserve to each its own genetic constitution. This process alone involved a prolonged intensive investigation, since many varieties did not propagate easily and special methods had to be evolved to apply to different cases. Trials have been made with hardwood and softwood cuttings, root cuttings, layers and stools, and thus was found the most suitable method for each variety. The next process was the raising of series of trees of commercial scion varieties budded or grafted on each type of rootstock, and these were then planted out, grown under a recognised commercial system of culture, and intensive records of individual tree performance were taken over several years. The records include annual measurements of the total length of new shoots, the girth of the trunk, the height and spread of the branches, leaf area, the number of blossom trusses formed and the number, size, colour and quality of fruits.

In parallel with field trials of this type, experiments have been carried out in which similar trees are subjected to different degrees of winter stem pruning, the effect on subsequent performance being measured by a series of routine records as in the rootstock trials.

Manurial investigations have been conducted, both in the field and in pot culture, and valuable information relative to this subject has also been obtained by work on the spatial distribution and time of growth of roots. A number of trees up to ten years old on different soils have been excavated piecemeal and then reconstructed, giving a picture of the spread and depth of the roots to which manurial substances have to be supplied. The time and rate of root growth are determined by direct measurement of growing roots through glass windows in the sides of underground observation posts.

These and other converging lines of research have now made it possible to classify the rootstocks on the basis of the influence which they exert on the scion; and the trees growing in the plantations of the institute, each coupled with its own particular record of past performance, demonstrate the fundamental importance of using standardised rootstocks, chosen with full regard for their potentialities, which are now known with considerable accuracy.

It has, of course, long been known vaguely that the rootstock has some influence on the performance of a tree but the accumulated results of the Station's experiments have shown just what this influence may achieve and how advantage may be taken of it, though it is not yet clear what physiological and chemical mechanism is involved in the translation of rootstock potentialities into scion performance. It is, however, now certain that choice of rootstock may mean the difference between the economic success and failure of a plantation, since such factors as the vigour and disease-resistance of the tree, the age at which fruit-production begins, the amount of crop and the size, colour and quality of the fruit may all be affected by the rootstock.

Some control of these factors may, of course, be achieved by such cultural treatments as pruning and manuring, but since tree fruit plantations are planned in relation to a future of 30–50 years, the importance of obtaining control of the trees by selecting at the outset the correct rootstock in relation to its purpose need scarcely be emphasised. The extent of this control is such that it is now possible by rootstock selection to choose in advance whether a tree shall become a dwarf bush for the garden or a large 'standard' with a spread of 40 ft., and in fact to produce at will trees suitable each for its particular purpose.

The natural corollary of these investigations was not only to make them known to the fruit-growing industry but also to make available the material with the aid of which the principles could be applied. Consequently in order to ensure that growers and nurserymen shall be able to procure in quantity suitable rootstocks and desirable and healthy varieties of small fruits all true to type, the Station has established a considerable acreage of nurseries where material is raised and distributed through commercial sources. The number of plants thus made available now amounts to 250,000 annually. The area now under experiments amounts to 130 acres and in the course of the investigations problems have arisen which have necessitated co-operation of pomologists, physiologists, mycologists, bacteriologists, entomologists, statisticians and chemists; their publications appear in the Station's Annual Reports and in biological journals, chiefly the *Journal of Pomology and Horticultural Science*.

The Imperial Bureau of Fruit Production, founded in 1929, is housed at the Station and acts as a clearing house of information concerning research on fruit plants, which is made available through *Horticultural Abstracts*.

Canadian Water Power Developments during 1933

By Dr. Brysson Cunningham

THE recent issue by the Dominion Water Power and Hydrometric Bureau of the Canadian Department of the Interior of two reports[1] relating to hydro-electric developments during the year 1933 enables a fresh survey to be made of the remarkable progress which continues to be achieved in the Dominion in the exploitation of its natural water power resources.

It was scarcely to be expected that the rate of development which, from 1924 until the end of 1932, was fairly constant at the high figure of nearly 440,000 additional horse power per annum, could be maintained during the present period of economic depression. In the circumstances, it is satisfactory to record that the net increase during 1933 was no less than 270,210 horse power, bringing (with a previously untabled item of 16,600 horse power in 1932) the total development at the beginning of this year up to 7,332,070. It is conservatively estimated that this represents a capital investment of 1,675,000,000 dollars and that it is capable of effecting a saving of about 36,000,000 tons of coal per annum. The actual saving for the year 1933 is computed at 14,775,000 tons. As projects require several years to materialise, the annual increment of power is, of course, mainly due to installations the inception of which dates back a corresponding period. During 1934 and thereafter, there will be further increments on the completion of undertakings now under way, but, from the point of view of the maintenance of the rate of progress, it is significant and unfortunate that no undertakings of magnitude were initiated during 1933.

The distribution of the present realised total of 7,332,070 horse power among the various provinces of the Dominion is shown in the accompanying

AVAILABLE AND DEVELOPED WATER POWER IN CANADA, January 1, 1934.

Province	Available 24-hour power at 80 per cent Efficiency		Turbine Installation (h.p.)
	At Ordinary Min. Flow (h.p.)	At Ordinary Six Months' Flow (h.p.)	
British Columbia	1,931,000	5,103,500	717,602
Alberta	390,000	1,049,500	71,597
Saskatchewan	542,000	1,082,000	42,035
Manitoba	3,309,000	5,344,500	390,925
Ontario	5,330,000	6,940,000	2,355,105
Quebec	8,459,000	13,064,000	3,493,320
New Brunswick	68,600	169,100	133,681
Nova Scotia	20,800	128,300	112,167
Prince Edward Island ..	3,000	5,300	2,439
Yukon and Northwest Terr.	294,000	731,000	13,199
Total	20,347,400	33,617,200	7,332,070

table, which also exhibits a statement of the estimated total power available. It would not be correct, however, to deduct the realised horse power in column 4 from either of the totals of available power in columns 2 and 3, for the purpose of arriving at the balance still awaiting development, because experience in the matter of turbine

installation demonstrates the realisation of an excess of some 30 per cent over the ordinary six months' flow power. On this basis, it is a legitimate conclusion that the recorded water power resources of the Dominion will permit of a turbine installation of about 43,700,000 horse power, of which the present realised total is rather less than 17 per cent. Even so, the per capita development for the Dominion, namely, 686 horse power per 1,000 of the population, places Canada in an outstanding position among countries of the world using water power.

Of the 270,210 horse power brought into operation during 1933, rather more than a moiety (136,000 horse power) is due to the completion of the Masson Development of the MacLaren-Quebec Company, situated at the mouth of the Lievre River in Quebec Province, of which a view is given in Fig. 1. It comprises four turbine units, each of 34,000 horse power, and has a dam and intake 1,050 ft. long with a tunnel 6,060 ft. long leading to the power house. There is an effective head of 185 ft.

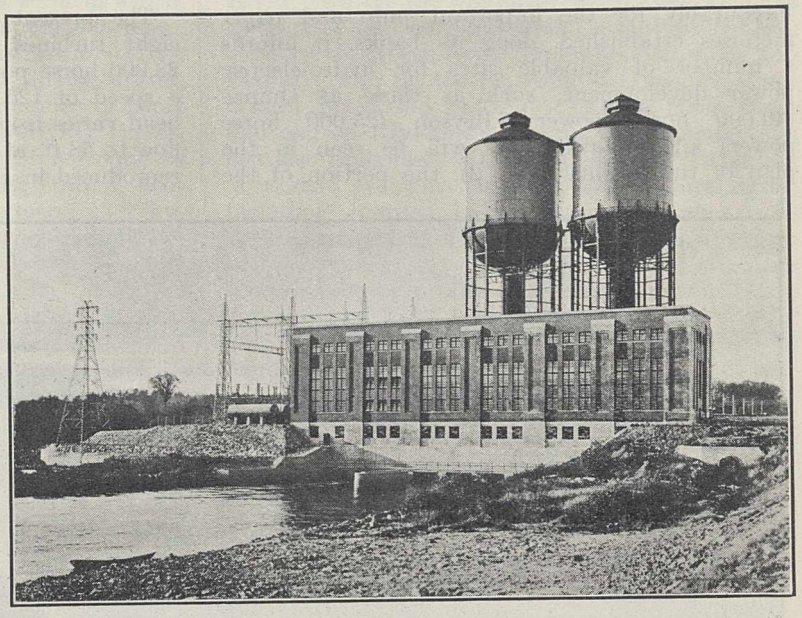

FIG. 1. Masson Development, Lievre River, Quebec, 136,000 h.p., of the MacLaren-Quebec Power Company. By courtesy of the Dominion Water Power and Hydrometric Bureau, Ottawa.

Another important enterprise, now in hand, is the Canyon Development on the Lower Abitibi River in Ontario, which has been acquired by the Provincial Government and its operation placed in the hands of the Hydro-electric Power Commission of Ontario. Ultimately, the installation will comprise five turbine units of 66,000 horse power each. Two of these are complete and in operation, the first having been put into commission in May 1933 and the second in August last. A cable line at a voltage of 132,000 transmits current from the Canyon to the Sudbury mining district, 246 miles distant. Under an agreement recently concluded between the Hydro-electric Power Commission and the Canadian Northern Power Corporation, current from the Canyon will be an important factor in mining development in Northern Ontario.

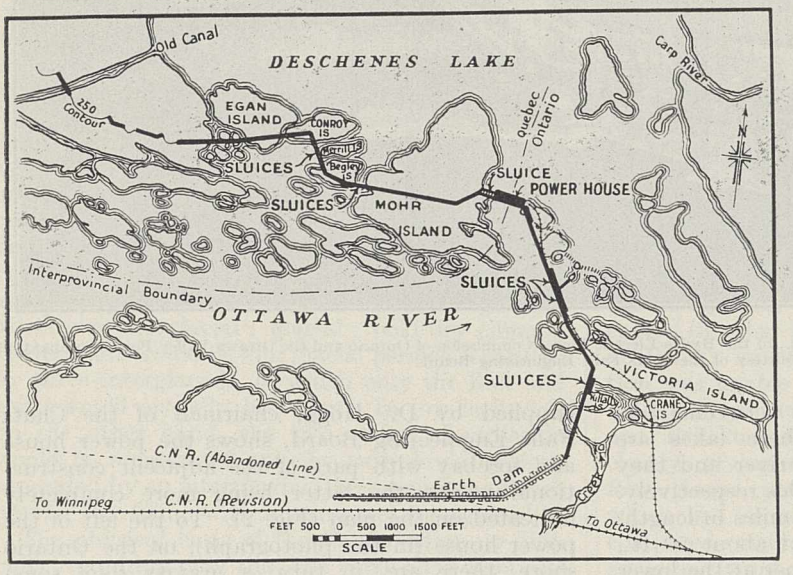

FIG. 2. Site plan of the Chats Falls Development.

The Beauharnois installation, described in NATURE of June 3, 1933, continues to expand. During 1933, contracts were placed for the balance of the equipment (turbines, generators, transformers and switching equipment) necessary to produce the full 500,000 horse power development, and this is expected to be realised in 1936. The present capacity is 133,000 horse power, exclusive of that required for constructional purposes.

Although not coming precisely within the limits of the period under review, the Chats Falls Development[2], completed in September 1932, is an undertaking the magnitude of which merits some notice; and, moreover, apart from its outstanding capacity of nearly a quarter of a million horse power, it is the first major power development in the inter-provincial section of the Ottawa River which constitutes a complete

exploitation of the whole flow at any site. The Ottawa River is the boundary between the Provinces of Ontario and Quebec for a length of 300 miles from Lake Timiskaming to Carillon, a point 25 miles from the junction with the St. Lawrence. Favourably for the important pulp and paper factories established along its banks, it affords a number of valuable sites for hydro-electric power development, such as those at Quinze (40,000 horse power), Bryson (25,000 horse power) and Ottawa. As will be seen in the plan of the locality (Fig. 2), the portion of the river developed at Chats Falls lies between Chats Lake and Lake Deschenes. These lakes are really broadened expanses of the river and they have areas of 27 and 36 square miles respectively. Uniting them is a channel about 3 miles in length, in which there is a natural fall of about 50 ft., 38 ft. of which are in the falls proper at the lower end of the channel, and the remainder in the rapids above the falls. The rapids and the falls are separated by a sheet of water, one square mile in area, known as the Fishery Pool, and this forms the forebay of the development. From records taken over a period of seventeen years, it has been ascertained that the mean flow at Chats Falls is 45,000 cusecs, with a dependable minimum of 22,000 cusecs, which by the enlargement of certain storage facilities on the main stream and its tributaries is susceptible of an increase to 28,000 cusecs.

The present hydraulic installation consists of eight turbines, each with a rated capacity of 28,000 horse power under a head of 53 ft. and at a speed of 125 rev. per minute. The operating head varies from 38 ft. at times of very high river flow to 58 ft. at low flows. The photographic view reproduced in Fig. 3, which has been courteously supplied by Dr. Hogg, chairman of the Chats Falls Engineering Board, shows the power house and forebay with part of the adjacent constructional works, the latter being more completely indicated on the plan (Fig. 2). To the left of the power house (in the photograph), on the Ontario shore, there are, in turn, a gravity dam some 1,200 ft. in length ; 32 sluices, known as the Ragged Chute sluices, each with a clear opening of 18 ft. ; a gravity dam, 1,350 ft. long ; the Victoria sluices, 10 in number, also with 18 ft. openings, and a further gravity dam of 1,450 ft. length. Beyond this, there is a low earthen dyke, or embankment, parallel with the river edge, extending for nearly

FIG. 3. Chats Falls Development, 224,000 h.p., of the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company. By courtesy of the Chats Falls Engineering Board.

a mile upstream. On account of these works, a section of the Canadian Railway, two miles in length, had to be re-laid farther inshore. On the Quebec, or western side, immediately adjacent to the power house are 4 sluices, each 40 ft. in width, and a log slide ; then a gravity dam, 2,000 ft. long ; the 10 Wolverine sluices ; another dam, 650 ft. long ; 22 Merrill Island sluices and, finally, a dam, 2,600 ft. long, terminating in a number of short disconnected lengths closing low-lying areas. Alongside the power house, in the foreground of Fig. 3, can be seen the transformer station, consisting of 13 single phase transformers, 13·2 kv. to 220 kv., while 800 ft. farther along is the 220 kv. switching station occupying an area of about 300 ft. by 360 ft.

Not the least important feature of hydro-electrical exploitation on a national or provincial scale is the regulation of water supplies, and in this connexion the work of the Quebec Streams Commission is worthy of notice. The Commission continues to maintain with every success the desired regulation of flow on all the controlled rivers through its extensive system of storage reservoirs in various parts of the province. It controls seventeen reservoirs, five of which are on the St. Maurice River, two on the St. François River, two on the Gatineau River, one at Lake Kenogami for the Sable and Chicoutimi Rivers ; three on the North River (Lakes Masson, Long and Bedini) ; two on the St. Anne de Beaupré River (Lakes Brulé and Savane) ; one on Mitis River and one on Rivière du Lievre. The Commission has also proceeded with the further investigation of storage problems on the Upper Ottawa River, including Jourdan Lake. Numerous lakes have been examined to determine whether they are to be considered as navigable waters, and river profiles have been taken. Studies of ice formation have been made and also sundry investigations of back water and drainage, besides the execution of bank protection work.

[1] "Hydro-electric Progress in 1933". By the Hon. Thos. G. Murphy, Minister of the Interior, Ottawa. "Water Power Resources of Canada". Paper No. 1733. Dominion Water Power and Hydrometric Bureau, Ottawa.

[2] The Chats Falls Development. Papers by various writers, reprinted from the *Engineering Journal, Canada*, February and March, 1933.

World Climate during the Quaternary Period

AT the Royal Meteorological Society on May 16, Dr. G. C. Simpson read an important paper on his theory of the climatic variations during the Quaternary Ice Age, with especial reference to its geological implications. Briefly, the theory states that the effect of an increase in the solar radiation intercepted by the earth is a relatively small increase in the earth's temperature, but a large increase in the evaporation, cloudiness and precipitation. In high latitudes or on high mountains, where the precipitation is mainly in the form of snow, the first result is an extension of the ice-sheets and glaciers, but as the radiation increases still further, the rise of temperature becomes great enough to melt away the ice. If the solar radiation, starting from a minimum, goes through two complete cycles, the climatic succession would be : cold dry climate ; glacial ; warm wet interglacial ; glacial ; cold dry interglacial ; glacial ; warm wet interglacial ; glacial ; cold dry climate. Hence there would be four glacial periods separated by three interglacials, of which only the first and third would actually be warm. In low latitudes, on the other hand, the two cycles of radiation would be represented only by two pluvial periods separated by an interpluvial, the maximum of each pluvial coinciding with a warm wet interglacial.

The physical basis of the theory offers no difficulty, requiring only that the earth shall fluctuate in the unstable zone between insufficient snowfall and too great heat. The real test is whether the theory fits the geological facts, and in his latest paper Dr. Simpson arrays an impressive mass of evidence that the fit is very good indeed. Two primary difficulties are first attacked ; the centre of glaciation in the northern hemisphere was not the north pole, but lay somewhere in Greenland, while careful analysis by Penck and Brückner has shown that, in the Alps, glaciation was not due to increased snowfall but to decreased temperature. Both these difficulties are explained by the geographical fact that the North Atlantic is open to the Arctic, while the North Pacific is not. During the oncoming of a glacial period there was a great accumulation of floating ice in the Arctic Ocean, and the only outlet through which this could escape led into the Atlantic, which was covered by ice floes down to comparatively low latitudes, while the Pacific was ice-free. This floating ice greatly lowered the temperature of eastern North America and still more of western Europe, and led to the great extension of glaciation in countries bordering on the Atlantic. In the early stages of the Quaternary, however, communication between the Arctic and Atlantic was more or less interrupted by a bar between Greenland and Norway or Scotland ; until this bar was submerged, glaciation was unable to develop over the British Isles.

In another respect the classical work of Penck and Brückner in the Alps fits the theory very closely, giving exactly the required sequence of four glacial periods and three interglacials, of which the second was known to be very long compared with the third, while the latter was exceedingly wet and warm. The theory is supported also by recent discoveries in tropical Africa of two great pluvial periods separated by a very dry interpluvial. Archæologically, the third interglacial is dated in Europe by the Acheulean, which is everywhere associated with a warm fauna. From the geological record, Dr. Simpson estimates that at the maximum of the solar radiation the

temperature was between 5° C. and 10° C. higher than at present, and the cloud amount about two tenths greater; from these data he calculated that the sun is a variable star with a range of 40 per cent in the intensity of its radiation.

Since the chief purpose of the paper was the array of geological evidence in support of the theory, the discussion was mainly carried on by the geologists. The present writer gained the impression that the latter accepted the general implications of the theory, but found considerable difficulty in agreeing to the details. On one point, however, there was general agreement: the explanation of the discrepancy between the centre of glaciation and the present north pole by purely geographical reasoning was welcomed as a relief from the difficult assumption of a shift of the poles.

The difficulties of detail are threefold. In the first place, Penck and Brückner's simple scheme of four major glaciations cannot be applied directly to countries outside the Alps. In the British Isles, for example, the succession was much more complicated than that suggested in Dr. Simpson's scheme, and even the number of major glaciations has not yet been determined. The second difficulty concerns the place in the scheme of the archæological stages. Some competent authorities place the Acheulean not in the Riss-Würm interglacial but in the Mindel-Riss, which according to the theory was cold and dry. Even the climate in which Acheulean man lived has not been surely determined, for the interglacial which contains Acheulean implements also includes a loess. Allied to this is the difficulty that the Great Chalky Boulder Clay has features which show that the end of that particular glaciation was dry, though by Dr. Simpson's scheme it leads up to a wet warm interglacial. Finally, one of the fossils used most definitely as an index of a warm climate—*Corbicula fluminalis*—has recently been found associated with a marine cold fauna, and its climatic value is open to doubt. Dr. Simpson was not worried by these objections, maintaining that if his theory is correct, he had given geologists a useful means of aligning new discoveries, while existing discrepancies would gradually be cleared up.

One interesting point brought out in the discussion was that no difficulty exists from the astronomical point of view in the sun being a variable star. A range of 40 per cent means very little in terms of stellar magnitude, and is unimportant compared with some known variations.

Obituary

Prof. W. H. Welch

THE death of Prof. William Henry Welch, of Baltimore, on April 30 at the age of eighty-four years, removes from the scientific world a man who enjoyed an international reputation as a reformer of medical education, sanitarian, pathologist and bacteriologist.

Shortly after obtaining his medical degree at Yale, Welch spent two years in Europe, where he studied normal histology, pathology, physiological chemistry and practical medicine at Strasbourg, Leipzig, Breslau and Vienna under the leading teachers of that day, visited various Paris hospitals and attended Lister's lectures at King's College Hospital, London. He was thus fully equipped with the latest and best medical teaching on his return to New York in the spring of 1878, where he was soon appointed lecturer on pathology at Bellevue Hospital Medical College.

In 1884 Welch was made professor of pathology at Johns Hopkins University and pathologist to the Johns Hopkins Hospital. Before entering on his new office, he made another journey to Europe, where he studied bacteriology and hygiene under von Pettenkofer, von Flügge and Koch. On his return he played an important part in the development of the Johns Hopkins Hospital, and was largely responsible for the election of the other three original members of the staff, namely, Osler, the physician, Halsted, the surgeon, and Kelly, the gynæcologist, who figure with him in Sargent's well-known picture. From 1893 until 1898 he was dean of the Johns Hopkins Medical School, being succeeded by Osler. In 1916 he was appointed the first director of the new School of Hygiene and Public Health at Baltimore and held this post until 1926, when he became professor of the history of medicine in the Johns Hopkins University.

Welch's work may be summed up under the headings of sanitation, pathology, bacteriology and medical education. As president of the Maryland State Board of Health—an office which he held for twenty-four years—he played an important part in converting Baltimore, which had hitherto been a focus of typhoid fever, into a healthy city. His advice on sanitary matters was often sought by presidents of the United States and other public authorities, and it was due to him that a Yellow Fever Commission was created, which led to the discovery of the rôle of the mosquito in the spread of the disease. He was the author of numerous important articles on pathology, the best known being those on thrombosis and embolism, which were published in 1899 in Allbutt's "System of Medicine". In 1892 he described the *Staphylococcus epidermidis albus* and the *Bacillus aerogenes capsulatus*, the cause of gas gangrene, commonly known as the Welch bacillus.

As medical educationist, Welch is to be credited with having introduced modern methods into the medical schools of the United States and to have trained a large number of pupils, jocularly described as 'Welch rabbits', who afterwards attained a high distinction in the world of medical science.

MR. H. G. MILLER

AGRICULTURISTS all over Great Britain will hear with deep regret of the death of Henry G. Miller, son of Dr. G. W. Miller, of Dundee, and until lately manager of the experimental farms at Rothamsted and Woburn.

Miller was born in Dundee in 1903 and was in the first instance intended for an engineering career; he entered on the engineering course at the University of Glasgow for this purpose, but his desire had always been towards agriculture and he soon transferred to the agricultural side, and afterwards to the University of Edinburgh. At both places he achieved remarkable success. He was then appointed to an Empire Cotton Growing Corporation scholarship and proceeded to the University of Cambridge and afterwards to the Imperial College, Trinidad, where he studied tropical agriculture and especially cotton growing.

Finding that tropical conditions did not suit him, Miller returned to Great Britain and was appointed farm manager at Boghall, the experimental farm of the Edinburgh and East of Scotland Agricultural College. His work here attracted attention from discerning observers and when the farm managership of Rothamsted became vacant in 1927 he was appointed to it.

Two important tasks were entrusted to Miller at Rothamsted. One was to complete the programme of converting a wholly arable farm without animals into a mixed grass and arable farm carrying a considerable head of livestock. This was done with great energy and efficiency and with a minimum of disturbance of the experimental work. The other task was to deal with the cultivation problems associated with the new methods of field experimentation designed in the Statistical Department at Rothamsted for the purpose of giving an estimate of the error of the experiment, a quantity which agricultural experiments had usually ignored in the past. In collaboration with his colleagues at Rothamsted, methods were worked out which satisfied the requirements both of the cultivator and the statistician.

Miller's personal bent was towards experiments on sheep, and several of these were begun at Rothamsted and will be continued. Perhaps the most interesting was the selection of a number of four-teated ewes and rams from four-teated mothers, on the basis of which a little flock is being built up to see whether this character is advantageous to a ewe suckling twins.

Miller's death is a great loss to agriculture as he was a man of undoubted promise. He combined to an exceptional degree the qualities of hard work, enthusiasm and genius for agriculture, and had he lived he would have been marked out for a brilliant career.

News and Views

Lieut.-Col. S. P. James, F.R.S.

THE Darling Medal and Prize was founded by the Health Section of the League of Nations in memory of that great malariologist, Dr. S. T. Darling, who met his death as the result of a motor accident in the Lebanon Mountains outside Beirut when carrying out malaria inspection work for the League. The choice of Lieut.-Col. S. P. James as the first recipient of this award is a most appropriate one, for malaria and the problems associated with it have occupied the foremost place in his mind since he first joined the Indian Medical Service in 1896. In India he carried out important pioneer work on the anopheles mosquitoes and their classification, and laid the foundations of the subsequent malaria work which has been accomplished in that country. He pursued other lines of research, and, independently of Low but a little later, was able to demonstrate that the embryos of *Filaria bancrofti* in their development in the mosquito pass ultimately into the proboscis of the insect, so that there is every probability that infection occurs when the mosquito feed. On his retirement from the Indian Medical Service in 1918, after war service in Mesopotamia, James joined the Local Government Board, now the Ministry of Health, as adviser in tropical diseases. There he was instrumental in organising and developing the malaria treatment of general paralysis in mental hospitals and asylums.

THE opportunity this gave of studying malaria under carefully controlled conditions was fully realised by Col. James, and, as a result, there was established at the Horton Mental Hospital the now well-known laboratory, which has been the means of bringing to light a whole array of new and important facts regarding the biology of the various malarial parasites, including the comparatively new form *Plasmodium ovale*, the diseases they produce and the factors which govern the action of quinine, plasmoquin, atebrin and other drugs in their treatment and prevention. The results obtained at this laboratory, which has been visited by nearly all the best-known malariologists and has been copied in other countries, have had a profound influence on malarial thought and action throughout the world. As a member of the Malaria Commission of the Health Section of the League of Nations, Col. James has taken an active part in its deliberations and recommendations and has visited most malarial countries, where his wide experience of the disease in all its aspects has enabled him to give valuable advice as to the methods which should be adopted to control this most widespread of all diseases. Col. James is still pursuing his investigations, and there is no doubt that he will continue to add to our knowledge of those minute parasites which are inoculated to man by mosquitoes, and attack the red blood corpuscles with such disastrous results. We wish him every success in his further endeavours.

U.S. National Academy of Sciences Awards

IT is announced by Science Service that the Elliot Medal for 1931 has been awarded to the late Prof. Davidson Black, of the U.S. National Academy of Sciences, for his researches on the skull of Peking man. The medal and honorarium is awarded annually for work on zoology or palæontology. The first award of the Charles Doolittle Walcott Medal and honorarium of 1,350 dollars of the Academy has been made to Dr. David White, of the U.S. Geological Survey, in recognition of his work on the pre-Cambrian algæ of the Grand Canyon of Arizona, which are among the very oldest of plant fossils. Other awards just announced are: Agassiz Medal, to Dr. Bjorn Helland-Hansen, of the Geophysical Institute, Bergen, Norway; Public Welfare Medal, to Dr. David Fairchild, formerly of the U.S. Department of Agriculture; and the Elliot Medal and honorarium of 200 dollars for 1930, to Dr. G. E. Coghill, Wistar Institute of Anatomy and Biology, Philadelphia.

U.S. National Academy of Sciences

AT the meeting of the National Academy of Sciences held in Washington on April 23–25, the following elections were made. *Members:* Prof. V. Bush, professor of electrical engineering and vice-president of the Massachusetts Institute of Technology; Prof. H. S. Gasser, professor of physiology, Cornell University Medical College, New York; Prof. E. N. Harvey, professor of physiology, Princeton University; Prof. D. R. Hoagland, professor of plant nutrition, University of California; Prof. E. O. Lawrence, professor of physics, University of California; Prof. J. F. Norris, director of the research laboratory of organic chemistry, Massachusetts Institute of Technology; Dr. J. H. Northrop, biochemistry, member of the Rockefeller Institute; Prof. C. Palache, professor of mineralogy, Harvard University; Dr. T. M. Rivers, pathology, member of the Rockefeller Institute; Prof. E. Sapir, Sterling professor of anthropology and linguistics, Yale University; Dr. E. C. Stakman, plant pathologist, U.S. Department of Agriculture; Prof. H. S. Vandiver, associate professor of mathematics, University of Texas; Prof. N. Wiener, professor of mathematics, Massachusetts Institute of Technology; Prof. S. Wright, professor of zoology, University of Chicago. *Foreign associates:* Prof. V. F. K. Bjerknes, professor of meteorology in the University of Oslo; Prof. Robert Robinson, Waynflete professor of chemistry in the University of Oxford.

Native Lands in Kenya

ANY apprehension that the rights and sentiments of the Kenya natives in the matter of their lands are likely to be endangered by future government action, taken without full knowledge, should be allayed by the Report of the Kenya Land Commission which has now been issued with a White Paper stating the views of the Government. (Cmd. 4556, 11*s.* and Cmd. 4580, 2*d.*) The appropriation of a part of the native reserve in the development of the Kakamega gold-fields, notwithstanding arguments advanced in justification, aroused a feeling of uneasiness and a fear lest any policy of development, however short-sighted, might in future be allowed to override obligations or measures framed to preserve the integrity and ultimate stability of native society. The report of the Commission and the supporting body of evidence, which examine native claims relating to the land in detail, tribe by tribe, provide a permanent record defining the position in native land tenure, and at the same time, by recommending that the Native Lands Board no longer exercise administrative functions but be devoted entirely to the office of protection—a recommendation accepted by the Government—ensures that, given a satisfactory constitution of the Board, the interests of the native as determined in this combination of Domesday and Magna Charta, shall not go by default. Further, the Board is given the power of veto over leases of land exceeding ten acres in extent. The principle of leasing is to take the place of exclusion of land from the reserve and exchange, the land thereby remaining part of the reserve. This, together with the requirement that native opinion shall be consulted, is not only in harmony with the sentiment and practice of the natives, but also avoids the more objectionable features which have hitherto appeared in land development.

THE Commission does not confine itself to present grievances and difficulties, but has a clear view of the future development of the native. Not only are 1,474 sq. miles added to the native reserve in satisfaction of present claims, but also a further area, totalling in all more than 2,000 sq. miles, is to be set aside to meet present and future economic requirements. In part of this additional area the system of tenure is to be more elastic than in the native reserve. Tribal tenure will no longer be the only system, and the tendency of the native towards other forms of the economic unit will be recognised. In other words, the native will be afforded an opportunity to habituate himself to a form of tenure more nearly in accord with the economy of European civilisation. It is also suggested—though this recommendation will not be adopted until it has been considered by the local legislature—that certain reserve boundaries should be eliminated or modified to permit intertribal expansion and interpenetration. The trend in these recommendations towards a modification of native culture is carried further in the stress laid on the necessity for a less wasteful use of the land and the references to proposals for restriction of the excessive number of cattle now carried. As cattle form the currency and wealth of the native, should these proposals be given effect, he must needs accustom himself to some new form of wealth. Up to the present, the increased resources which civilisation has brought to the native, in so far as they are not absorbed in the acquisition of an excessive number of cattle, would appear mainly to have been expended wastefully. On the whole, it may be said that in its outlook on the future, the report, recognising that the native is entering upon

a period of transition in which traditional culture must suffer modification, has suggested lines on which development will bring about the least dislocation and can most effectively be brought under an enlightened control.

Petrol from Coal

THOSE who have maintained that the successful production of petrol from coal would prove of incalculable benefit to our long languishing coal industry will derive much satisfaction from a reply given in the House of Commons on May 17. Mr. Mitcheson asked the Secretary for Mines if he could furnish an estimate of the increased consumption of coal in Great Britain which has resulted from the imposition of a duty on fuel oil. The Secretary for Mines (Mr. Ernest Brown), in reply, said: "Official information is not available. But a short time ago I received a deputation from the Coal Utilisation Council and other bodies, which furnished detailed information, collected by various trade organisations. This showed that, in terms of coal, there had been conversions from oil to coal and coal products, and business retained which it was stated would, but for the tax, have been lost to home produced fuels, representing an annual rate of consumption of over 600,000 tons."

Sexual Selection in the Pheasant

THE Zoological Society of London has just received a noteworthy addition to its Gardens in a pair of Rheinhardt's Argus pheasants (*Rheinhardtius ocellata*), for this is one of the rarest of the pheasant tribe. Those who are interested in problems of sexual selection will find these birds well worth thoughtful study, for they present a striking contrast with the commoner and better known Argus pheasant (*Argusianus*). This bird occupied a prominent place in Darwin's "Descent of Man", on account of the enormous development of the secondary wing-feathers, the like of which is seen in no other bird. These feathers are also remarkable for their ornamentation, which consists of a series of ocelli which, as Darwin pointed out, when they are displayed in the courtship attitude, look like a series of balls lying within a cup-shaped socket, while the primaries are marked by a pattern of indescribable beauty. The wings of Rheinhardt's pheasant lack any form of ornament, and in shape conform to the usual type of pheasant wing. The tail feathers, however, are prodigiously long and marked by a pattern of considerable beauty. This striking difference in the secondary sexual characters in these two birds is puzzling. Nothing seems to be known of the nature of the display of *Rheinhardtius* in its amorous moods. It is to be hoped, therefore, that the new arrivals will greatly enlighten us on this point. The display of the wings in the Argus pheasant is unique, the two wings being widely spread so as to form an enormous circular fan completely concealing the rest of the body. It affords an unanswerable argument to those who hold that birds in 'display' are not conscious of their finery.

Mathematics and Cosmic Research

IN a lecture entitled "World-Gravitation by Kinematic Methods" given by Prof. E. A. Milne before the London Mathematical Society on May 17, his hearers had the thrilling experience of seeing a possible model of the universe constructed before their eyes by a simple, but wholly brilliant, application of apparently trivial mathematical methods. Starting with Newtonian time, Prof. Milne envisaged the behaviour of a set of particles of which the description given by an observer placed at any one of them would be the same as that given by an observer placed at any other. The hypothesis leads to certain functional and differential equations from the solution of which Prof. Milne deduced a statistical model of extreme elegance. The astonishing result was obtained that in a given volume of the observer's space there are particles the velocity of which is arbitrarily near that of light. On this, Prof. Milne showed how a theory of cosmic rays and obscuring matter in interstellar space could be based. The striking simplicity of the method and the far-reaching character of its interpretations open up a new vista of possibilities for cosmic research.

Demonstration of Television

ON May 15 a demonstration of the use of the cathode ray tube in television reception was given before the Electrical Association for Women at the showrooms of the Edison Swan Electric Co. Ltd., London. After a very clear and non-technical exposition of the basic principles had been given, the B.B.C. 30-line transmission was received. The results obtained suggested that the cathode ray tube is capable of giving as good an image as the limitations of the transmission will permit. There was very little flicker, owing to the large afterglow of the fluorescent material of the screen. The latter was of the usual type giving a green image; the use of white fluorescent screens is not considered desirable at the low picture frequency at present in use, as the afterglow with these is much less. The scanning is accomplished by means of two small oscillators giving voltages of saw-tooth wave-form and appropriate frequencies which are applied to the two pairs of deflecting plates; the incoming signals hold these oscillators in synchronism with the transmitter and also modulate the intensity of the electron beam. Difficulty was experienced in keeping the picture steady during the demonstration, but this was attributable to the exceptionally bad local reception conditions. It was stated that in normal circumstances the controls need not be touched during the whole transmission period of half an hour. The advantages claimed for the cathode ray tube are that it is noiseless, that signals of good headphone strength only are required to operate it, and that by the alteration of a few minor circuit components it can be easily adapted to suit transmissions of different numbers of lines and picture ratios. The last point is important in view of the uncertainty in the future development of television. Suitable tubes can now be marketed at six guineas and this price could be

substantially reduced if the demand became large enough. As the auxiliary apparatus required is not excessive, and can be assembled from standard components, the system is quite practicable for domestic use.

New Electric Lamps

IN a paper read to the Royal Society of Arts on March 7, Mr. J. W. Ryde of the G.E.C. Research Laboratories, Wembley, gave a full account of the working of the new electric discharge lamps. The sodium discharge lamp is practically monochromatic and of a brilliant yellow colour. Hence coloured objects illuminated by it all appear to be various shades of brown. Its efficiency, about 40 lumens per watt, although three times that of the ordinary filament lamp, is yet only about a tenth of the maximum possible yellow light that could be obtained for the same power. It is well known that the efficiencies of all kinds of electric lamp vary with their life. The problem of candle power maintenance is one that constantly engages the attention of every lamp manufacturer. In spite of years of research, the light output of incandescent filament lamps still drops by a certain amount after several hundred hours burning. The candle power maintenance for the new lamps has now been raised to a reasonable figure, but it is recognised that considerable improvements are possible. It is rapidly approaching that of the filament lamp. At present there is no sign that the eminently simple and highly developed filament lamp will shortly be replaced by discharge lamps for purposes of indoor illumination; but it must be admitted that discharge lamps will play an ever increasing part in the future of electric lighting. Already there are 65 street lighting installations for which these lamps have been adopted. Street lighting is the one use of artificial lighting for which we have never produced enough light. The use of the new lamps is an excellent opportunity of improving the lighting of our streets at little, if any, increase in the cost.

Importance of Deep Borehole Surveying

DESIGNERS of apparatus for surveying deep boreholes have in the past consistently underestimated difficult engineering problems necessarily attendant on such surveys. On April 10, W. E. Bruges read a paper before the Institution of Petroleum Technologists in which he made some pertinent remarks on the usefulness of well surveys as an adjunct to drilling logs and geological data. Geologists can utilise the results of accurate surveys for correcting underground contours, choosing such surface locations as will ensure economic spacing of wells in the oilsand below and making deductions as regards the formation as a whole from direction, deviation and irregularities of the hole as portrayed by the survey. Administration is facilitated by a knowledge of exact spacing of wells in an oilsand. Decisions regarding drilling activities can be taken with confidence, and the risk of overcrowding, hence decreasing production, is minimised. Recent experiments in Burma have shown that of available apparatus for this work, that designed and manufactured by Martienssen is the most satisfactory. The instrument is fitted with a gyroscope for obtaining direction and two pendulums for inclination, results being recorded photographically. It has the advantage that the gyroscope is unaffected by magnetic influences, while the pendulum method of obtaining inclinations allows a number of readings to be taken at one run. Photographic recording of results means that the instruments below ground can be light, obviating necessity of following-up gear; moreover, their relative places in the well can be photographed without disturbing position or setting.

Automobiles Run by Charcoal Fuel

IN Italy, automobiles have recently been operated on a gas fuel made in transit from charcoal and steam. It is recalled in a recent paragraph issued by Science Service, of Washington, D.C., that similar experiments were made in France and other European countries several years ago. The principle involved is the same as that used in the manufacture of some kinds of gas employed in operating stationary internal combustion engines. A carbon-containing material, usually coal, is heated, and then water in the form of steam is passed over it. Carbon monoxide and hydrogen are formed in this process and both these gases burn with high heat output. Mixtures of this sort are known as 'water' gas or 'producer' gas. This gas can be used as fuel in internal combustion engines. The drawback to using these gas engines in motor vehicles is the difficulty of carrying the fuel supply. In permanent locations they can be used very effectively for power generation. To a limited extent, vehicles that run on wood or charcoal and manufacture their own gaseous fuel as they go along are used commercially in France. Science Service points out that this type of self-propelled vehicle may become important in countries like France and Italy which have no petroleum supplies within their borders. In the United States, on the other hand, owing to the cheapness and availability of petroleum, there would be no need for this kind of vehicle. In those countries where imported oil supplies are likely to be interrupted in war time, automobiles using charcoal fuel would have advantages.

Science and Industry in the U.S.S.R.

IN a recent publication entitled "Organisation et Principes de L'Enseignement en U.R.S.S." (Paris: Hermann et Cie, 6 Rue de la Sorbonne) Prof. Jean Trillat gives an interesting description of the relations between science and industry in Soviet Russia. One of the most important transformations brought about by the Russian revolution has been the establishment of compulsory education, and this in turn has led to a considerable development of scientific studies. Prof. Trillat points out that in order to understand correctly the nature of educational and scientific progress in Russia, it is essential to remember that there such developments have been

based on a materialistic philosophy. The religious mysticism of pre-War Russia has now been replaced by the mysticism of the machine. The conception of science in Soviet Russia is that of an auxiliary to socialism. Education figures as a definite part of the Five Years Plan, and the Educational Plan comprises a general scheme of public education, the preparation of technicians and scientific workers from among the working classes, together with a general scheme of scientific research and the establishment of numerous scientific institutes. The author describes a number of these institutes which he visited, including the physico-technical "Kombinat" at Leningrad with its subsidiary institutes of physical chemistry and electro-physics. In addition, it has an experimental workshop of a unique character which manufactures scientific instruments for the "Kombinat" and other institutes. Employing about 300 workers, it is a half-industrial and half-scientific organisation. Soviet industry has thus behind it very extensive means for scientific research, and the various problems, classified according to interest or urgency, are investigated by the specialised chemical, physical or electrical institutes.

Chemical Researches in Czechoslovakia

EVER since the middle of last century, much chemical research work has been carried out at Prague. Some of the investigations, notably Prof. B. Brauner's work on atomic weights and on the rare earth elements, attracted wide attention, but much valuable, if less spectacular, work was overlooked. Few Czech men of science published in English journals; the majority of their researches appeared in the little-read Czech publications. To direct more attention to their achievements, Czechoslovak chemists founded in 1928 under the joint editorship of Profs. Votoček and Heyrovský the *Collection of Czechoslovak Chemical Communications*, in which the contributions were written in French or English. Among the more interesting contributions that have appeared recently in this journal mention may be made of the discovery by Prof. Křepelka and Dr. Novotný that mercurous halides show marked triboluminescence, the actual intensity depending on the conditions of preparation. Prof. Šimek has also made some observations on the curious electrical behaviour of fused tellurium dioxide. In organic chemistry, Drs. Landa and Machaček have described a new solid hydrocarbon, $C_{10}H_{16}$, to which they assign the name adamantane. A series of researches by Prof. Votoček and his collaborators has cleared up a number of points in connexion with the lesser-known sugars such as rhamnose, rhodeose and fucose. Prof. Heyrovský has also published a series of papers (referred to in NATURE of March 10, p. 385) dealing with his polarographic studies with the dropping mercury cathode.

The Indian Chemical Society (1924–1932)

PROF. B. K. SINGH'S presidential address to the Indian Chemical Society (*Journal of the Indian Chemical Society*, vol. 10, No. 1, p. 1, 1933) deals with "Optics in the Service of Chemistry", and includes a review of recent work on optical rotatory power and rotatory dispersion, to which he has himself contributed. He also records in a tabular form the growth of the Indian Chemical Society, during the nine years of its existence. During the first five years the growth was rapid, but the Society has held its own during the more difficult years from 1929 until 1932. It now includes 360 fellows and 100 subscribers, and is publishing approximately 100 papers in each year, of which 750 pages are printed free of cost by the University of Calcutta. Under these favourable conditions an income of about 10,000 Rs. has usually provided a credit balance, and a reserve fund of 21,000 Rs. has been built up, in addition to a donation of 10,000 Rs. from Sir P. C. Rây which is earmarked for the provision of a headquarters for the Society.

Schlieren, Striæ or Streaks?

IN the January issue of the *Journal of Scientific Instruments*, Mr. T. Smith, of the National Physical Laboratory, raises the question whether it is fair to Foucault to continue to describe the method he introduced for observing small optical differences of path by the name "schlieren" used for the method by Töpler in his paper of 1866 on the motion of singing flames. Messrs. Taylor and Waldram, who had used the term 'schlieren' in their paper in the December issue of the *Journal*, point out that Töpler in giving the method that name made no claim to its invention but only to an extension of the use of it to general scientific investigations. Would striæ or streaks be adequate equivalents of, and suitable alternatives for, *schlieren*?

Uniformity in Bibliographical Particulars

REFERRING to recent correspondence on this subject (NATURE, **133**, 380, March 10; 495, March 31, 1934), Mr. A. Windelbandt, bibliographer in the library of the Institute of Plant Industry, Leningrad, writes pointing out the practical value of accurately given bibliographical citations in articles and books. Mr. Windelbandt states that footnotes and other references are often given in such a way as to make it impossible to recognise the publication. While the name of the author is quoted, the title of the article is often omitted and sometimes it is difficult to identify the journal owing to the manner in which the name is abbreviated. The absence of the year and volume in the case of articles, and the place of publication and name of publisher in the case of books, also renders it difficult for the reader to find the publication. Lack of pagination, too, may lead to a lengthy search, if a volume has no special index.

Institute of Physics

THE annual general meeting of the Institute of Physics was held at the Royal Institution on May 15. After election of the officers and completion of the panel of the Board, it was announced that the following would take office on October 1 next: *President*, Sir Henry Lyons; *Vice-President*, Prof. W. L. Bragg; *Honorary Treasurer*, Major C. E. S.

Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *New Members of the Board*, Dr. Allan Ferguson and Mr. R. S. Whipple. In pursuance of one of the main objects of the Institute, namely, "to urge the importance of Physics in Industry", the Board has decided to arrange a two-day conference in the spring of 1935 on the applications of X-ray structural analysis to various industries. The main function of the conference will be to bring to the notice of industrialists what physics and physicists can do to help industry, rather than the discussion of technical matters among experts. The conference will be held in Manchester in conjunction with the local section of the Institute; and it is proposed to arrange an exhibition and visits in connexion with the meetings. Full details will be announced in due course.

Ancient Chinese Books on Materia Medica

IN the year A.D. 659, an illustrated volume of materia medica was published in China. It seems to have served until about 1061, when an extensive revision took place. Prof. Manzo Nakao has studied the history of this great compilation ("Notes on Shao-hsing Hsiao-ting Ching-shih Chêng-lei Pei-chi Pên-tsao (The Ancient Chinese Materia Medica Revised in the Sung Dynasty Shao-hsing period, 1131–1162)". *J. Shanghai Sci. Inst.* (3), 1, 1–9, May 1933). Much of the subject matter of the paper is of interest only to the Chinese historian, but some of the descriptions show that the work was very thorough, and covered at least 22 volumes. There were apparently several distinct revisions. The medicines can all be recognised; and the historical investigation was stimulated by the possibility of reviving some of the ancient remedies under modern conditions.

"World List of Scientific Periodicals"

THE second edition of the "World List of Scientific Periodicals" will be published in one volume by the Oxford University Press on June 30, at the price of £3 3*s*., but subscribers in advance will receive it at £2 2*s*. Such subscribers resident in Great Britain or Europe must post their cheques before June 30, or if outside Great Britain or Europe before July 30. The new edition will contain titles and holdings of periodicals current right up to the end of 1933. The number of libraries the holdings of which are listed has been increased by 39, the number being 189 as against 150. Approximately 10,000 new titles have been added, the total number of entries amounting to 36,380. Each entry contains the title and place of publication of the periodical, the abbreviation, and the symbols for the libraries in which it is to be found and the dates of their holdings. Further information can be obtained from the Secretary, "World List of Scientific Periodicals", c/o The Zoological Society of London, Regent's Park, London, N.W.8.

Announcements

THE annual visitation of the National Physical Laboratory, Teddington, will be held on Tuesday, June 26, at 3–6 p.m.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 2. The new 36-in. reflecting telescope will be opened by the First Lord of the Admiralty at 3 p.m., and the Observatory will be open for inspection by invited guests at 3.30 p.m.

PROF. LOUIS MARTIN has been elected director of the Pasteur Institute of Paris in succession to the late Dr. Roux, with whom he had been closely associated.

PROF. J. BARCROFT will deliver the Stephen Paget Memorial Lecture at the annual general meeting of the Research Defence Society at the London School of Tropical Medicine and Hygiene, Keppel Street, W.C.1, on June 5, at 3 p.m. The subject of Prof. Barcroft's lecture will be "Experiments on Man".

THE attention of chemists is directed by the Union Internationale de Chimie to the services rendered by the International Bureau of Physico-Chemical Symbols in placing at their disposal pure organic compounds the constants of which have been determined with great accuracy. The specimens supplied by the Bureau are guaranteed as possessing the constants of the values given in the published proceedings of the Bureau (*J. Chim. Phys.*, vols. 23, 25, 27, 29 and 31). They can be obtained at cost price from the Secretary of the Bureau, Prof. J. Timmermans, University, Brussels, from whom further information can be obtained.

THE McGraw-Hill Publishing Co., Ltd., has issued its catalogue for 1934, containing a classified list of its books on agriculture, zoology and botany. The catalogue can be obtained post free from Aldwych House, London, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the Inquiry Bureau of the Building Research Station, Garston—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (May 30). A professor of botany at the University of St. Andrews—The Registrar (May 31). An assistant keeper of Oriental printed books and MSS. in the India Office Library—The Establishment Officer, India Office, Whitehall, S.W.1 (June 1). A lecturer (woman) in mathematics (biology or botany subsidiary), at the Darlington Training College—The Principal (June 4). A lecturer in physics and elementary science at the City of Leeds Training College—The Director of Education, Education Department, Calverley Street, Leeds (June 5). A curator of the Museum and Art Gallery at Barking—The Town Clerk, Town Hall, Barking (June 7). An assistant agricultural organiser to the Northamptonshire County Council—The Secretary for Education, County Education Offices, Northampton (June 9). A professor of electrical technology at the Indian Institute of Science, Bangalore, India—The Director (Aug. 1). A University professor of mining at Imperial College of Science and Technology—The Academic Registrar, University of London, S.W.7 (Jan. 14, 1935).

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.*]

Radio Exploration of the Ionosphere

(*a*) *Measurement of the earth's magnetic field in the ionosphere.*

The discovery[1] of magneto-ionic doubling of wireless echoes returned from the ionosphere and its explanation[2] in terms of the theory of double refraction have provided us with a method of estimating the intensity of the earth's magnetic field at the level from which the waves are reflected. The way in which the earth's magnetic field is related to the observational data was indicated by Appleton and Builder, who showed that, under conditions of quasi-longitudinal propagation, relative to the direction of the magnetic field, we have

$$H = \frac{2\pi m}{e}(f_e - f_o) \quad . \quad . \quad . \quad . \quad . \quad (1),$$

where H is the total magnetic intensity, f_e and f_o are respectively the critical penetration frequencies of the extra-ordinary and ordinary waves for any particular region, and e and m are the charge and mass of an electron. For conditions of quasi-transverse propagation, on the other hand, the corresponding formula is

$$H = \frac{2\pi m}{e}\left(\frac{f_e^2 - f_o^2}{f_e}\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad (2).$$

It was further shown by Appleton and Builder that their experimental results, obtained under conditions of quasi-transverse propagation, agreed approximately with (2) when the value of the earth's magnetic field at the ground was used for H, so that their observations could be interpreted as indicating either the approximately quantitative correctness of the magneto-ionic theory or that the magnetic field in the ionosphere does not differ very markedly from its value at ground level.

If we assume the quantitative correctness of the magneto-ionic interpretation of the results, it is obvious from equations (1) and (2) that we have here a method of measuring the magnetic field in the ionosphere. During the past year, I have therefore made as careful measurements as possible of the value of H for the upper ionised region during nocturnal conditions when critical frequency measurements are most reliable, my object being to look for small variations of H such as might be caused by the upper-atmospheric currents envisaged in present-day theories of terrestrial magnetism[3].

The detailed examination of these results is still in progress, but one result of interest has emerged from the first series of two hundred measurements. The average value of H calculated from (2) is found to be 0·42 gauss. Now the value of the earth's total magnetic field at the surface of the earth in south-east England is 0·467 gauss, so that the radio observations suggest that the average magnetic field in the ionosphere is about 10 per cent less than its value at the ground.

Now, according to Schmidt, the earth's magnetic field intensity above the surface may be expressed, as a first approximation, by $H_0\ (1 - 3h/R)$ where H_0 is the ground value, h the elevation and R the earth's radius. The values of the magnetic field at 200 and 300 km. above the earth's surface in south-east England should therefore be 0·42 and 0·40 gauss respectively. It will be seen that the value obtained by the radio methods is of about this order of magnitude.

(*b*) *A new method of ionospheric investigation.*

One of the fundamental quantities measured in the study of the ionosphere is the group-time for a signal to travel to the stratum of reflection and back to the ground. To measure such a group-time, we must impress some kind of mark on the signal in order to recognise it on its return. Now the essential characteristics of an electric wave are frequency and amplitude, and the two basic methods of group-time measurement are thus those involving frequency-modulation and amplitude-modulation. It must not be assumed, however, that in their simple forms they always represent the most convenient ways of marking a signal for group-time measurements, and I have recently found that there are sometimes advantages in combining the methods so as to produce a frequency change on a pulse emitter. It will readily be seen that in doing this we extend the frequency range examined in the experiment and obtain, in effect, information comparable with that which we should get with an extremely brief pulse. This means that we can investigate the structure of echoes which are normally unresolved.

As an example of the use of this combination method, as I propose to call it, let us consider the case of an unresolved magneto-ionic doublet. If the mean frequency of the emitter is varied continuously through a sufficiently large range, we get interference effects in the echo itself, so that any component amplitude varies through a series of maxima and minima. If, in this case, a linearly polarised receiver aerial is used, we have :

$$c\frac{\Delta n}{\Delta f} = P'_o - P'_e \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where P'_o and P'_e are the equivalent paths of the ordinary and extraordinary waves, Δn the number of interference fringes produced by a change of frequency Δf and c is the velocity of light.

When apparatus is available for providing automatic maintenance of sender and receiver tuning during the frequency change, such as that first described by Gilliland, the usefulness of the combination method may be strikingly demonstrated. For example, in a test carried out at Slough at 1530 on March 8, 1934, using an apparatus of similar principle designed by Mr. L. H. Bainbridge-Bell, an alteration of mean frequency of from 4·0 to 4·2 mc./s. produced five interference fringes in a first order F-region reflection. This corresponds to an equivalent path difference for the two magneto-ionic components of 7·5 km., or to a difference in equivalent height of 3·75 km. It is obvious that differences in equivalent height of 1 km. or less can be detected in this way.

The work described above was carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.

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May 14.

[1] Appleton and Builder, *Proc. Phys. Soc.*, **44**, 76, January 1932.
[2] Appleton and Builder, *Proc. Phys. Soc.*, **45**, 208, March 1933.
[3] Cf. McNish, *Terr. Mag. and Atmos. Elect.*, **39**, 5, March 1934.

Atomic Disintegration by 'Non-Capture'

IT has been assumed[1] that the nucleus of an atom may be disintegrated by either (1) a process in which the projectile (A), which is another nucleus, is captured, or (2) one in which it is not captured.

$$(1) \quad A + B \rightarrow (AB) \rightarrow C + D$$
$$(2) \quad B \rightarrow C + D$$

These are illustrated in Figs. 1 and 2.

While the evidence for the occurrence of disintegration by capture is so good as to be undisputed, that for non-capture is less convincing.

Probably the best evidence for disintegration by non-capture is that given by photographs of tracks of the disintegration particles C and D, where the projectile A is a neutron and B is a nitrogen nucleus. Thus Feather, in a discussion of his excellent work with neutrons, says, "of these about thirty resulted in disintegration, more than half of the latter without capture of the neutron"[2].

In this laboratory about a hundred disintegrations of nitrogen nuclei by neutrons were photographed[3],

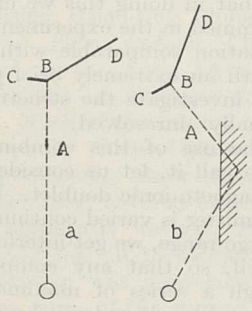

FIG. 1. Capture.

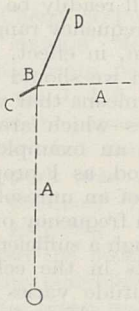

FIG. 2. Non-capture.

and of these, 26 were of such high quality as to give good measurements. For 17 of these it was found that the straight line (a) for A passes directly through the source. These may be assumed to represent disintegrations by capture.

The remaining nine might be considered as possible cases of non-capture. However, in one of these the tracks C and D were turned in such a way as to prove that the neutron could not have come in a straight line from the source; that is, it was a scattered neutron.

The values for the velocity of the incident neutron, assuming non-capture, were calculated from the best five photographs both by our equations involving rest masses (3) or including the complete relativity relations (4) as given below.

$$V_A = \frac{M^2 + 2m_A\,(E_C + E_D + E_m)}{2m_A\,M\,\cos\alpha} \qquad (3)$$

or

$$V_A = \frac{M}{2m_A\cos\alpha} + \frac{(E_C + E_D + E_m)}{M\,\cos\alpha}, \qquad (3')$$

where V_A and m_A are speed and mass of projectile; M is magnitude of resultant momentum of B and C; E_C and E_D are their kinetic energies; E_m is energy corresponding to increase of mass in the reaction, or $E_m = c^2 \triangle m$; α is angle between $\bar{V}_A$ and direction of $\bar{M}$.

It is assumed that a γ-ray is not emitted. However, an approximate solution may be obtained if the term $E\gamma$ is added to the quantity between the parentheses, since the momentum of the γ-ray is, in general, negligible.

The relativity equation, similar in form to (1), may be written

$$V_A = \frac{c\,(w^2 - K^2) + 2k_A cK}{2k_A w\cos\alpha} \qquad (4)$$

in which $k_A - k_A' \equiv K$ and $\frac{k_A\,\bar{V}_A}{c} - \frac{k_A'\,\bar{V}_A'}{c} \equiv \bar{w}$

and c is the velocity of light.

It was found (a) that the velocities thus calculated were very much higher than those of any known neutron. However, if (b) it is assumed that the disintegrations correspond to Fig. 1b, that is, the neutron is first scattered and then gives a disintegration by capture, the neutron velocities for the nine disintegrations are not only of the right order of magnitude, but also the distribution curve which plots number of events against velocity of the neutron, is the same as that obtained for the disintegrations caused by neutrons directly from the source.

Thus the evidence seems to indicate that these disintegrations also occurred with capture of the neutron. It seems reasonable to conclude that there is at present no evidence which proves that any nucleus has been disintegrated by a non-capture collision. Obviously this does not prove the non-occurrence of disintegrations of this type.

We wish to thank Prof. A. C. Lunn for his co-operation.

WILLIAM D. HARKINS.
DAVID M. GANS.

University of Chicago,
Chicago, Ill.
March 23.

[1] Chadwick and Gamow, NATURE, **126**, 54, July 12, 1930. Chadwick, Constable and Pollard, *Proc. Roy. Soc.*, A, **130**, 463; 1930. Feather, *Proc. Roy. Soc.*, A, **136**, 709; 1932.
[2] loc. cit., p. 720.
[3] Harkins, Gans and Newson, *Phys. Rev.*, **44**, 529; 1933.

X-Ray Photographs of Crystalline Pepsin

FOUR weeks ago, Dr. G. Millikan brought us some crystals of pepsin prepared by Dr. Philpot in the laboratory of Prof. The Svedberg, Uppsala. They are in the form of perfect hexagonal bipyramids up to 2 mm. in length, of axial ratio $c/a = 2{\cdot}3 \pm 0{\cdot}1$. When examined in their mother liquor, they appear moderately birefringent and positively uniaxial, showing a good interference figure. On exposure to air, however, the birefringence rapidly diminishes. X-ray photographs taken of the crystals in the usual way showed nothing but a vague blackening. This indicates complete alteration of the crystal and explains why previous workers have obtained negative results with proteins, so far as crystalline pattern is concerned[1]. W. T. Astbury has, however, shown that the altered pepsin is a protein of the chain type like myosin or keratin giving an amorphous or fibre pattern.

It was clearly necessary to avoid alteration of the crystals, and this was effected by drawing them with their mother liquor and without exposure to air into thin capillary tubes of Lindemann glass. The first photograph taken in this way showed that we were dealing with an unaltered crystal. From oscillation photographs with copper $K\alpha$-radiation, the dimensions of the unit cell were found to be $a = 67$ A., $c = 154$ A., correct to about 5 per cent. This is a minimum value as the spots on the c row lines are

too close for accurate measurement and the c axial length is derived from the axial ratio. The dimensions of the cell may still be multiples of this. Using the density measured on fresh material[2] as 1·32 (our measurements gave 1·28), the cell molecular weight is 478,000, which is twelve times 40,000, almost exactly Svedberg's value arrived at by sedimentation in the ultracentrifuge. This agreement may however be quite fortuitous as we have found that the crystals contain about 50 per cent of water removable at room temperature. But this would still lead to a large molecular weight, with possibly fewer molecules in the unit cell.

Not only do these measurements confirm such large molecular weights but they also give considerable information as to the nature of the protein molecules and will certainly give much more when the analysis is pushed further. From the intensity of the spots near the centre, we can infer that the protein molecules are relatively dense globular bodies, perhaps joined together by valency bridges, but in any event separated by relatively large spaces which contain water. From the intensity of the more distant spots, it can be inferred that the arrangement of atoms inside the protein molecule is also of a perfectly definite kind, although without the periodicities characterising the fibrous proteins. The observations are compatible with oblate spheroidal molecules of diameters about 25 A. and 35 A., arranged in hexagonal nets, which are related to each other by a hexagonal screw-axis. With this model we may imagine degeneration to take place by the linking up of amino acid residues in such molecules to form chains as in the ring-chain polymerisation of polyoxy methylenes. Peptide chains in the ordinary sense may exist only in the more highly condensed or fibrous proteins, while the molecules of the primary soluble proteins may have their constituent parts grouped more symmetrically around a prosthetic nucleus.

At this stage, such ideas are merely speculative, but now that a crystalline protein has been made to give X-ray photographs, it is clear that we have the means of checking them and, by examining the structure of all crystalline proteins, arriving at far more detailed conclusions about protein structure than previous physical or chemical methods have been able to give.

J. D. BERNAL.
D. CROWFOOT.

Department of Mineralogy and Petrology,
Cambridge.
May 17.

[1] G. L. Clark and K. E. Korrigan (*Phys. Rev.*, (ii), **40**, 639 ; 1932) describe long spacings found from crystalline insulin, but no details have been published.

[2] J. H. Northrop, *J. Gen. Physiol.*, **13**, 739 ; 1930.

IT is now some time since we first took X-ray powder photographs of crystalline pepsin kindly sent by Prof. J. H. Northrop, but no really satisfactory interpretation of these photographs presented itself because they show features which we have learnt recently to associate with the fibrous proteins[1] : even single crystals, so far as we could judge with the minute crystals available, appeared to give results similar to those produced by many crystals in random orientation. The two chief rings have spacings of about 11·5 A. and 4·6 A. at ordinary humidity, corresponding to the 'side-chain spacing' and the 'backbone spacing', respectively, of an extended polypeptide[1].

It was difficult, of course, to reconcile such findings with external morphology and the Law of Rational Indices, but the photographs of Bernal and Miss Crowfoot, taken before the degeneration which we now see the crystals must have undergone on drying, clear up this long-standing problem at once. Furthermore, their photographs tend to confirm the suggestion[2] that the numbers 2, 3, 4, and 6 occurring in Svedberg's multiple particle weights are fundamentally of *crystallographic* significance, even though their conclusions to date appear to be against the chain mechanism proposed for the building-up of the various crystallographic groups[2].

We are left now with the paradox that the pepsin molecule is both globular[3] and also a real, or potential, polypeptide chain system, and the immediate question is whether the chains are formed by metamorphosis and linking-up of the globular molecules, or whether the initial unit is the chain itself, which is afterwards folded in some neat manner which is merely an elaboration of the intra-molecular folding that has been observed in the keratin transformation[1]. What is either an exceedingly valuable clue or else only a fantastic coincidence is found in the fibre photograph of feather keratin[4], a study of which will be published shortly ; for if, as Bernal thinks, the pepsin molecules are piled, perhaps in a screw, along the hexad axis, their length in this direction is 140/6, that is, about 23½ A., which is almost exactly the strongest period along the fibre-axis of feather keratin, a period which is again repeated probably six (or a multiple of six) times before the fundamental period is completed ! The innermost equatorial spot of the feather photograph also corresponds to a side-spacing of about 33 A. (though this is probably not the maximum side-spacing), which again is in simple relation to the side dimensions of the pepsin unit cell. As just said, these resemblances may be only accidental, but we cannot afford to overlook anything in such a difficult field, and it is not impossible that we have here an indication of how very long, *but periodic*, polypeptide chains can arise by the degeneration and linking-up of originally globular molecules.

W. T. ASTBURY.
R. LOMAX.

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[1] W. T. Astbury, *Trans. Faraday Soc.*, **29**, 193 ; 1933. W. T. Astbury and A. Street, *Phil. Trans. Roy. Soc.*, A, **230**, 75 ; 1931. W. T. Astbury and H. J. Woods, NATURE, **126**, 913, Dec. 13, 1930. *Phil. Trans. Roy. Soc.*, A, **232**, 333 ; 1933. W. T. Astbury and W. R. Atkin, NATURE, **132**, 348, Sept. 2, 1933.

[2] W. T. Astbury and H. J. Woods, NATURE, **127**, 663, May 2, 1931.

[3] J. St. L. Philpot and Inga-Britta Eriksson-Quensel, NATURE, **132**, 932, Dec. 16, 1933.

[4] W. T. Astbury and T. C. Marwick, NATURE, **130**, 309, Aug. 27, 1932.

Transitions to Optical Levels in the Argon *L* X-Ray Absorption Spectrum

THE so-called fine structure of X-ray absorption edges is caused by the possibility of transition of an inner electron to *different* upper levels, these levels being more or less discrete for the lowest energies and approximately continuous for the higher ones. In the ordinary X-ray region, the fine structure observed with crystalline absorbers usually extends over more than 100 v. from the main edge. It was pointed out by Kronig[1] that in this case the discrete character of the upper states may be considered as due to the wave character of the motion of a 'free' electron in

the *periodic field* of the lattice. This conception has been successfully applied to many cases[2].

In some cases, however, it seems more natural to visualise the upper states in a slightly different way, namely, as optical 'orbits' of the *single* atoms[3]. This would seem to apply in the first place to monatomic gases like argon; and perhaps also more or less to some cases of fine structure observed at small distances (<20 v.) from the main edge in solids and molecular gases.

A narrow fine structure of the argon (18) *K*-edge found by Coster and van der Tuuk[4] was explained by the authors in this way. They remarked that in

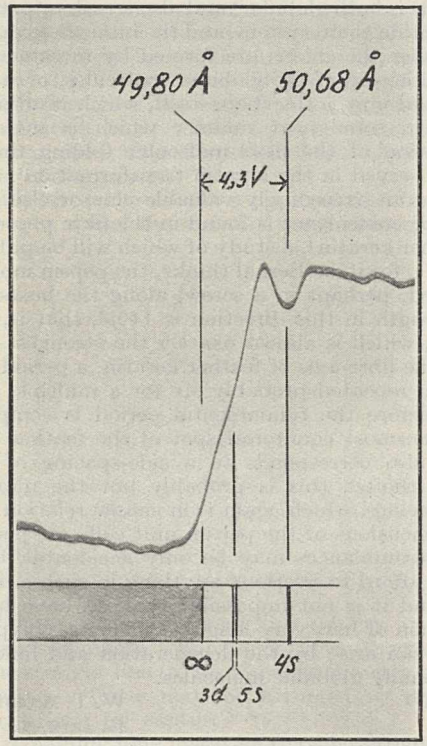

FIG. 1. Comparison of the argon $L_{II, III}$-absorption spectrum (upper curve) with the optical spectrum of potassium (lower figure) on the same energy scale.

this case the upper levels in question should lie very close to the optical levels of potassium (19), as the absence of the inner electron will make itself felt in the outer regions of the atom in much the same way as an increase of the nuclear charge by one unit. Owing, however, to the small energy resolution in the ordinary X-ray region, the authors were not able to establish the predicted correspondence conclusively, though they showed it to be a probable explanation for the experimental results.

Now recently I have photographed the absorption spectra of some gases and vapours in the ultra-soft X-ray region by the plane grating method, giving a resolution of about 0·5 v. The vacuum spectrograph[5] was filled with the gas at a pressure of 0·5 mm. mercury or less, the X-ray tube being closed against the spectrograph by a thin film of cellulose nitrate.

In Fig. 1 the photometric record of one of my plates for argon (18) is reproduced together with the energy spectrum of potassium (19) on the same scale. It will be seen that the correspondence between the two figures to be expected on the above considerations seems to exist, provided the *p*-levels of potassium be omitted. These are not indicated in the figure, but as they would lie between successive *s*-levels, their presence would make the correspondence less satisfactory. Now this omission of the *p*-levels is just what is to be expected *if the ordinary selection rules apply* to this case, as the inner electron removed is itself a *p*-electron and so should pass over to *s*- and *d*-levels only. Of course the multiplicity is higher in our case than with the spectra of the alkalis, but we may neglect the spin altogether[6] and consider the argon atom approximately as a certain central field of force in which the absorbing electron in question jumps from one 'orbit' to another.

From Fig. 1 and other analogous curves, the 'number of absorption electrons per atom' or strength of the virtual oscillator corresponding to the transition $2p \rightarrow 4s$ may be estimated at about 0·005, which seems a reasonable value from a theoretical point of view[6]. Regarding the experimental width of this absorption line, it may be remarked that it is not due to insufficient spectroscopic resolution, but represents a real phenomenon inherent to X-ray absorption- and emission-lines and connected with the existence of the Auger effect, etc.

Analogous fine structures are present in other cases[5]. The full report is to appear in *Physica*.

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March 22.

[1] R. de L. Kronig, *Z. Phys.*, **70**, 317; 1931; J. D. Hanawalt, *J. Franklin Inst.*, **214**, 569; 1932.
[2] D. Coster and J. Veldkamp, *Z. Phys.*, **74**, 191; 1932.
[3] W. Kossel, *Verh. d. D. phys. Ges.*, **18**, 339; 1916.
[4] D. Coster and J. H. van der Tuuk, NATURE, **117**, 586, April 24, 1926.
[5] *Z. Phys.*, **81**, 507; 1933; and **84**, 65; 1933.
[6] *Z. Phys.*, **77**, 478; 1932.

Isotope Effect in the Band Spectrum of Aluminium Hydride

IN a previous letter[1], we published some preliminary results from an investigation on the band spectra of AlH and AlD. As a remarkable result, we stated that the ratio of the reduced masses of both molecules, $\rho^2 = \frac{\mu_{AlH}}{\mu_{AlD}}$, has a mean value 0·51897, deviating considerably from the value $\rho^2 = 0{\cdot}51848$ to be expected when applying the known atomic weight figures to the general expression of the reduced mass of diatomic molecules $\mu = \frac{Mm}{M+m}$, M and m representing the atomic weights of aluminium and the respective hydrogen isotopes.

Considering possible causes for this discrepancy, we now find it most probable that it arises from an uncritical application of the expression for μ. In the case of a metal hydride, where the centre of gravity is situated close to the heavy metal nucleus, a small correction in the effective moment of inertia I arises from the contribution of the electronic system. To a high degree of exactness the moment of inertia can be written as follows:

$$I = \mu\bar{r}^2 + i_e,$$

where μ refers to the reduced mass of the molecule, deduced as before, and i_e represents the moment

of inertia of the electronic system in the metal atom. Assuming that the electronic system partakes fully in the rotation and vibration of the molecule, that is, suppose there is no lag of the inner shells in aluminium, a rough estimation of this correction on the basis of classical theory with electronic orbits leads to $\rho^2 = 0{\cdot}5190$, in good agreement with the spectroscopic value. A more refined calculation of the electronic effect, using methods given by Thomas[2] and Hartree[3], leads to $\rho^2 = 0{\cdot}51892$. As a matter of fact, this value is in surprising agreement with our latest value, $\rho^2 = 0{\cdot}51889$, obtained from recalculation of the spectrum, based on improved measurements.

W. HOLST.
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Laboratory of Physics,
University of Stockholm.
April 23.

[1] NATURE, **133**, 496, March 31, 1934.
[2] *Proc. Camb. Phil. Soc.*, **23**, 542; 1927.
[3] *ibid.*, **24**, 89; 1928.

Enzyme Catalysis of the Ionisation of Hydrogen

THE well-known analogy between the colloidal metallic catalysts and certain enzymes early suggested to us the inclusion of the latter in our survey of catalysts for the ionisation of hydrogen[1], and the work of Stephenson and Stickland on "hydrogenase"[2] indicated the most promising material for investigation. Work has now been in progress for some time on several strains of *Bact. Coli* and on *Bact. Acidi Lactici*, and we wish to make a preliminary report of our results—the more so as the announcement of a forthcoming paper by Hughes, Yudkin, Kemp and Rideal includes a brief reference to work which may be following parallel lines.

We have found that these bacteria are able, like platinum black, to catalyse the reaction:

$$HD + H_2O \rightarrow H_2 + HDO,$$

and in the case of *B. Acidi Lactici* we have measured the first-order velocity constant ($K = \frac{1}{t} \ln \frac{C_0}{C}$) at 37° for a known number of organisms:

Number of Organisms		Partial Pressure of Hydrogen	Initial Atomic per cent Diplogen	K in min.$^{-1}$
Total	Living			
5×10^{11}	$2{\cdot}2 \times 10^{11}$	360 mm.	1·08	0·0065

The 'total' number of organisms was estimated by comparison with standard (killed) suspensions, the number living by dilution and agar-plate-count. The bacteria, which in each case were washed three times in 0·85 per cent saline (with centrifuging) and finally aerated before use, were presumably in the 'resting' state (so far as the living are concerned). Partially 'heavy' hydrogen and the (de-aerated) saline suspension of the bacteria were the only materials present in the (sealed) reaction vessel, which was vigorously shaken.

B. CAVANAGH.
J. HORIUTI.
M. POLANYI.

University,
Manchester.
May 17.

[1] NATURE, **132**, 819, Nov. 25, 1933, *et alia*.
[2] *Biochem. J.*, **25**, 204, *et alia*.

Breathing Movements of Whales

WHALES, when breathing, usually keep on the move; the purpose of this letter is to explain why. All aquatic air-breathing creatures have to contend with the risk of water entering their lungs. Although the blow-holes of whales are valvular and situated on the highest part of the head, these animals, usually, can only breathe with safety when their blow-holes are at some height above the surface of the sea.

Owing to their shape, whales, usually, can only bring their blow-holes into a favourable position for breathing by coming up to the surface obliquely at some speed, and as they only get time to take a single breath, they have to repeat the performance again and again. The following extract from a paper by Racovitza[1] shows that this, in fact, is their usual behaviour.

"The whale, having returned to the surface, after a long immersion, emits a prolonged expiration, makes a short inspiration, dives a little, re-appears to breathe, dives again, and then many times in succession; then it makes a long inspiration and plunges into the depths for a considerable time." Again, he says, "the number of these intermediate immersions before sounding varies according to the species. In general, whale-bone whales execute but a few, the toothed whales very many. In all cetaceans, however, they are characterised by the following . . . (2) the interval between the re-appearances is very short; (3) the animal dives only to a slight depth; . . . (5) the whale, during the time it is under water, progresses quite rapidly, usually in a straight line."

The effort that whales require to make on these occasions seems to depend on the roughness of the sea; and the height of the animal's crown, on which the blow-holes are situated, above the water. The Greenland whale, or Bow-head, is well off in this respect, owing to its high crown. It is able to lie motionless with its blow-holes a foot or two above the surface.

Exceptionally, whales sometimes breathe while lying motionless at the surface. This generally occurs where the sea is very smooth and applies more particularly to the Greenland whale and narwhal—whales that habitually frequent the ice.

The Greenland whale frequently breathes while motionless or nearly so. Indeed, in narrow situations it is difficult to see how it can do otherwise. Scoresby[2] says, "Several (Greenland) whales being astir and the weather fine, we . . . sent all our boats in pursuit. These whales were rather numerous, four or five being sometimes seen at a time. The usual stay of a whale at the surface for breathing is about two minutes, seldom much longer, but it was a remarkable circumstance in the conduct of these whales, that they remained regularly from five to fifteen minutes at a time, and some, nearly half-an-hour before descending out of sight. During this long interval they were generally quite motionless."

Greenland whales, when there is no ice, probably behave in the usual way. This in fact seems to be the case. Sutherland[3], referring to Davis Strait and the 'fall' of the year when there is no ice, says, "Whales are very numerous and, at the same time, they are so wild that it is almost impossible to approach them."

Narwhals are sometimes seen breathing while motionless, particularly in very fine weather and in narrow situations. These animals are provided with

a subcutaneous chamber connected with their single blow-hole which may help to prevent water reaching their lungs. Scoresby[4] says, "When respiring at the surface, they [narwhals] frequently lie motionless for several minutes with their backs and heads just appearing above the surface." Where there is no ice, they probably behave in the usual way.

Blue whales are occasionally seen amongst the ice; they seem to avoid narrow situations and, when breathing, are usually on the move. Scoresby says, "It [the Blue whale] seldom lies quietly on the surface of the water, but usually has a velocity of from four to five miles an hour."

In the Greenland Sea, outside the ice, I have only seen Bottlenose whales breathing while motionless. This occurred alongside and in lee of the ship where the sea was very smooth. The weather was fine at the time. They formed an interesting sight, and their breathing made a peculiar noise.

R. W. GRAY.

Exmouth.
Feb. 26.

[1] "The Spouting and Movements of Whales", Annual Report of Smithsonian Institution, 1903.
[2] "Journal of a Voyage", p. 287.
[3] "Voyage of the *Lady Franklin* and *Sophia*", 2, 324; 1850–51.
[4] "Arctic Regions", 1, 494.

Active and Inactive Forms of the Hormone Promoting Comb Growth

FUNK[1] has shown that the hormone promoting comb growth can only be extracted from the urine of men in the presence of large quantities of acid (see also Kabak[2]). By means of acid extraction, I demonstrated the presence of about 40 capon units per litre in hundreds of batches of normal urine, but I could not detect even 20 units per litre by injecting the fresh concentrated urine itself.

I concluded that the hormone must be present in the urine in an inactive form, and therefore tried to isolate it in this state. This has been accomplished by extracting fresh urine of men at its original *p*H (5·3) by means of butanol. When testing this extract (after having taken it up in oil), the reaction of the capons was negative to doses which would have corresponded to 15 and 12 units per litre respectively. From this it was supposed that the butanol extract contained the inactive form of the hormone for which I was seeking. 240 c.c. of this extract, corresponding to 15 litres of urine, were boiled for 8 hours after the addition of 29 gm. of trichloracetic acid. The butanol was then washed with 10 per cent caustic soda and with distilled water, after which it was transferred into oily solution and tested in capons. The product gave positive reactions in quantities equivalent to 27 and 40 capon units per litre.

It is thus evident that the hormone promoting comb growth is present in the urine of men in an inactive form, in which it can be extracted by means of butanol. The inactive form can be turned into the active one by boiling the extract with trichloracetic acid.

A. A. ADLER.

Organon Laboratories,
Oss, Holland.
April 23.

[1] Funk C., B. Harrow and A. Lejwa, *Proc. Soc. Exper. Biol. Med.*, **26**, 569; 1929.
[2] Kabak, J. M., *Endokrinol.*, **9**, 84, 250; 1931.

A Provitamin A other than Carotene?

A TURBOT concentrate estimated by spectrographic and colorimetric tests to contain 60 per cent vitamin A (the vitamin A of Carr and Jewell[1] taken to be 100 per cent) was irradiated in spectroscopic alcohol in the complete absence of air with light of wavelength 300–390 mμ. Solutions containing 0·0011 per cent vitamin A were found to be only slightly affected by exposures up to three hours' duration whilst solutions containing 0·00011 per cent were remarkably sensitive. Solutions of this latter concentration were irradiated in lots of 60 ml. for different periods and kept stirred during irradiation by a magnetic stirrer. After irradiation of one lot it was evaporated *in vacuo* at 50° and brought to such a concentration as was equivalent spectroscopically at 328 mμ to a solution containing 0·0011 per cent vitamin A. Its absorption curve in the ultra-violet and its blue value were then determined.

Irradiation up to three minutes caused a decrease in *E* and blue units, so that the concentrate, which had a percentage vitamin A of 60, now shows a percentage of 30. Further irradiation caused a progressive increase in the spectroscopic and blue values, reaching a maximum after twenty-one minutes' irradiation when, for the concentrate, a percentage vitamin A of 140 was given by the spectroscopic value, 130 by the blue value. Further irradiation caused rapid destruction of the vitamin.

The non-irradiated concentrate in the blue value test showed a band at 565 mμ; after three minutes' irradiation the band had changed to 575 mμ; after twenty-one minutes, 575 mμ. Thus the chromogen responsible for the 565 mμ band is the precursor of the 575 mμ chromogen, which is either a purer vitamin A than that of Carr and Jewell or a sterol with very much higher spectroscopic and colorimetric values.

A report of these experiments has been sent to the *Biochemical Journal*.

EUGENE BOYLE.

Killean,
Cloughogue,
Newry.
April 23.

[1] NATURE, **131**, 92, Jan. 21, 1933.

China and the Maya Calendars

WITH reference to the note on the above subject in NATURE of January 13, p. 68, the resemblances in the calendar systems seem to be exaggerated by Dr. Kiang. The Chinese day-count follows the numbers 10 and 12 (L.C.M. = 60). The Maya follows the numbers 13, 20 and 365 for the 'calendar round' of 52 vague years and the further factors 18 and 20 for the long count. Apart from the mere principle of a continuous day-count with more than one concurrent numerator, the agreement is slight.

A more striking 'coincidence' is the use of the 5 epagomenal days and the taboo during them, which agrees with Egyptian practice and so lends support to Prof. Elliot Smith's diffusion theory.

HERBERT CHATLEY.

Whangpoo Conservancy Board,
Shanghai.
March 7.

Research Items

Prehistoric Lincolnshire. The first section of a survey of present knowledge of the prehistoric archæology of Lincolnshire by Mr. C. W. Phillips is published in the *Archæological Journal*, **90**. The county falls into well-defined geographical divisions, of which the most important are the marked oolite ridge called Lincoln Edge and the Wolds. There are two areas of low country, one, to south and east on the shores of the Wash, continuing round both sides of the Wolds, and the other, the Isle of Axholme, on the west side of the outfall of the Trent into the Humber. Although the geology of the lower grounds is not very conducive to prehistoric occupation, one of the surprises of the county archæology is the relatively considerable occupation of low-lying lands at several periods. There is little evidence of occupation of the county area in lower and upper palæolithic times. In the microlithic period two areas of exposure of sand show evidence of occupation, Risby Warren being regarded as the type-site of Great Britain for this period. In the neolithic period the discovery of nine, or possibly ten, long barrows on the Wolds has been one of the recent archæological surprises. The builders were Windmill Hill folk. Other neolithic objects, except finds in the neighbourhood of Grantham and at Risby Warren, belong to the Wolds. The distribution of Early Bronze Age objects is such as might be expected when intruders from the North Sea were making their way into the county by the Humber and the Wash. The distribution of beakers and daggers is entirely riverine, and there is evidence of only one landing on the coast. The destruction of round barrows owing to agriculture has been great. The majority stand on high ground away from the settlements. In the Middle and Late Bronze Ages the distribution of the population did not differ materially from that of the early period of metal, being confined mainly to the valleys. In the middle period the whole of Lincoln Edge from one end of the county to the other was occupied. A novel feature was the beginning of the concentration around Brigg, where a great dugout boat was found in 1886. Among gold objects found in the county two are important: a gold armlet, now lost, and a torc with Y-shaped section from the Isle of Axholme.

Pre-Conquest Mexico. In the fifth issue of *Ibero-Americana*, the publication of the University of California Press which is devoted to the study of material relating to the geography or ethnology of Central America in early Spanish records, Dr. Carl Sauer has reconstructed, so far as is possible, the distribution of aboriginal tribes and languages in north-western Mexico, thus supplementing, and in some instances revising, the linguistic researches of Swanton, Thomas and Orozco y Berra. The observations used are drawn from records dated between 1531, when Nuño de Guzman first entered the country, and 1768, when the Jesuits were expelled and the mission system began to come to an end. It is not possible to confine the study of pre-conquest conditions within narrower chronological limits, owing to the fact that while in the north Spanish influence was not felt until the end of the seventeenth century, in the south catastrophe overtook the native peoples at once. Indians from central Mexico settled the country, in part as a replacement of the native on the land, in part as a 'baboo class' intervening between the Spaniards and the indigenous population. Wars, in which they suffered from the attacks of both sides, and the exploitation of the mines, were alike disastrous to the sedentary Indians, while in Sinaloa and Nayarit aboriginal conditions are impossible to recover owing to the establishment of *encomiendas* (villages granted as private possessions to individuals) in the sixteenth century, the grantees making good any deficiency in the labour supply by the importation of labour from outside, in some instances negro labour, which rapidly brought into existence a mulatto population. It would appear that the Aztec migration myth, which asserts a widespread distribution of Aztec people and culture, rests on the fact that Aztec speech was introduced as a matter of convenience into non-Aztec areas by colonial settlers. The Aztec place-names quoted in evidence are in reality translations of indigenous names.

Characteristics of Tumour Cells. Prof. Warren H. Lewis summarises in "Some Characteristics of Tumour Cells" (News Bulletin, Carnegie Institution, Washington) the principal differences between normal and tumour cells. In the body, malignant cells show uncontrolled disorderly growth, lack of useful function, rapid cell death, transplantability from animal to animal, injurious effect on normal tissues and acid metabolism. The differences seen *in vitro* are: more granular cytoplasm, more refractive fat globules, smaller mitochondria, and no increase in neutral red granules. The nuclear membrane is thicker, nucleolar material increased and the nucleus itself appears to be more granular. The cells migrate more readily, and their shapes and general character in colonies help to differentiate them from one another and from the normal cells.

Life-Cycle of a Human Echinostome. Marcos A. Tubangui and Antonio M. Paseo (*Philippine J. Sci.*, **51**, 1933) have elucidated the life-history of *Echinostoma* (*Euparyphium*) *ilocanum*, a small human intestinal trematode discovered by Garrison (1908) in Manila. The life-cycle conforms to that usual for echinostomes. Two molluscan intermediate hosts are involved; in the first, a small fresh-water planorbid, are found the miracidium, sporocyst, redia and daughter-redia stages, and from the last-named the cercariæ escape and encyst in any of the common fresh-water snails which form the second intermediate host. The adult flukes were obtained by feeding encysted cercariæ from these snails to rats, a cat and two monkeys, and it is concluded that human infestations are brought about by consumption of raw or insufficiently cooked snails harbouring the encysted cercariæ. The limited geographical distribution of the fluke is explained by the observation that the habit of using raw snails as food is found only in the north-west provinces of Luzon, that is, among the Ilocanos, The various stages are described and figured.

Histology of Eye Mutants in *Gammarus*. A series of colour mutations in the eyes of the Amphipod *Gammarus chevreuxi* are well known to be inherited as Mendelian differences. Wolsky and Huxley (*Proc.*

Roy. Soc., B, 114, 364) have made a study of the histology and development of the eye in the various mutant types in comparison with the normal. Eye-colour mutants, such as red and no-white, differ from normals only in pigmentation, while such eye-structure mutants as albino and colourless show a structure which is markedly abnormal, the animals being blind. The genes for the latter class of mutants might be likened to timed bombs which completely derange the development of the eye and adjacent structures. The rate of development of the optic tract is slowed down and inhibited, especially in its distal portion, the retinular cells are deficient in number, they fail to arrange themselves in groups of five and soon degenerate, while the interstitial cells show signs of hypertrophy. The crystalline-forming cells fail to form normal cones. In explaining these results the following principles are utilised: (1) alteration in the rate of a differentiation process, leading to inhibition; (2) an intensity-gradient in the amount of inhibition; (3) development proceeding centrifugally in the optic tract; (4) struggle between parts, leading to failure of the retinular cells and multiplication of the interstitial cells; (5) effect of the nervous system. In the albino mutant, both the black melanin and red lipochrome pigments are absent because the retinulæ in which these pigments normally appear are suppressed.

Chromosome Structure in *Allium*. A detailed investigation of chromosome structure in *Allium*, by Prof. T. K. Koshy (*J. Roy. Micro. Soc.*, 53, No. 4), introduces several new conceptions. The work of several other investigators is confirmed in showing that the chromosome is a double structure throughout the mitotic cycle. Koshy goes further and shows that the chromomeric appearance frequently found in chromosomes is due to the close intertwining of two spiral chromonemata. He also finds that the spiral of the chromonema is reversed at the point of the spindle fibre attachment constriction. This is the point where the daughter chromosomes begin to separate in metaphase. But before this has happened, each daughter chromosome has undergone a split into two chromonemata. This is not a straight longitudinal split, but a spiral line of cleavage. At about the time this spiral cleavage appears, the two daughter chromosomes in which it occurs unwind from each other just before the anaphase. This unwinding proceeds from both ends towards the constriction where the reversal of the spiral takes place, this null point being regarded as a fulcrum. The anaphase and telophase chromosomes thus contain two spiral chromonemata owing to the spiral split in pro-metaphase. In late telophase the two threads are found to approximate very closely due to the elongation of the chromosomes, and their duality is thus obscured, but it reappears in the following prophase. These observations have significant bearings on various current views in cytology and genetics. They uphold the chromonema as against the chromomeric theory, and strongly support the generally accepted view that the anaphase and telophase chromosomes are double.

New Gentians. Capt. F. Kingdon Ward writes on "Some New and Rare Gentians" in the *Gardeners' Chronicle* of April 21. The wet zone to the south of the Great Wall of China provides a suitable habitat for *Gentiana stylophora*, *G. gilvostriata*, *G. setulifolia* and others, whilst the dry regions to the north of the Great Wall have other species. There is a further subdivision of the dry parts into forest and grassland, each with its own gentian flora, though some species are very widely distributed. The notes also include descriptions of several gentians introduced by Capt. Kingdon Ward from Tibet last year: *G. Waltonii*, *G. Georgii*, *G. trichotoma*, *G. filistyla*, *G. Wardii*, *G. sino-ornata* and *G. detonsa* are described, in addition to the three mentioned above. The Lhagu gentian, a mat-forming species, was found among the grassy slopes of the snow range at 14,000 ft., and promises to be a delightful plant if it can be introduced to cultivation.

Geography of Earthquakes. In a long article in *Matériaux pour l'Etude des Calamités* (No. 30–31, 1933) entitled "Die Anthropogeographische Bedeutung der Erdbeben", Dr. W. Severit gives a useful summary of the geographical distribution of earthquakes in recent times with special reference to the more destructive ones. A map shows the number of shocks during the last century. This part of the memoir is followed by a discussion of the effects on soil, drainage, climate, human distribution and the works of man. Finally, there is a study of the measures of prediction, security and relief. The whole is well documented, and may usefully serve as an introduction to the subject.

Wind Structure. As a result of the special inquiry into wind structure that was carried out at Cardington a few years ago, by the Airship Services Division of the Meteorological Office, Mr. C. S. Durst formed a novel theory of wind structure that explains many features shown on continuous records of the speed and direction of the wind such as those obtainable with the aid of the Dines' pressure tube anemometer. In addition to the rapid and irregular fluctuations of speed and direction that are regarded as the result of irregular eddies with axes inclined in all directions, caused apparently by the striking of air against obstacles, Durst found large excursions of the speed and direction pens, generally lasting 1–30 minutes and showing as a rule a rapid initial increase of speed followed by a gradual decrease accompanied by increasing small disturbances of the frictional type just described. There was abundant evidence that the initial squall corresponded with the arrival of faster moving air from a higher level, and that the whole phenomenon up to the beginning of another sudden increase of speed was associated with a local convectional circulation which he termed a 'cell', this circulation being superimposed on the general drift of the wind. Mr. Durst has recently discussed the anemograms from a number of places with anemometers having widely different exposures from this point of view (*Quart. J. Roy. Met. Soc.*, Oct. 1933). It is found that over the sea the frictional eddies are better developed in air of equatorial origin than in polar air, doubtless because the increase of wind with height is greater in the equatorial air, but that, given sufficient vertical stability in equatorial air over the sea, smooth-flowing air can persist with higher speeds there than over agricultural land.

Acuity of Vision. Kruysuyk and Zwikker (*Physica*, 1, 4, Feb. 1934) have published an account of experiments in which the acuity of vision was tested at different intensities of illumination, using as a criterion the recognition of small solid objects. These were

placed in effect at variable distances from the observer. The acuity of vision was tested for several observers in white and in monochromatic sodium light. The curves connecting intensity of light with acuity of vision slope upwards, following roughly a $\frac{1}{4}$ power law, and show in general a bending over (saturation effect) at high light intensities, but this effect is much more marked for some of the test objects than for others. For the lower intensities of illumination, the acuity at given intensity is much better for sodium light than for white light, but they tend toward the same saturation value. The acuity is considerably greater and the effort of discrimination is less for two-eyed than for one-eyed seeing.

Valve Amplification at Radio-Frequencies. A paper published by Mr. F. M. Colebrook in the *Journal of the Institution of Electrical Engineers* of February 1934 discusses the relative merits of screen-grid valves and three-electrode valves for amplification at frequencies of the order of a million cycles per second. Voltage amplification by means of tuned circuits and screen-grid valves is limited by conditions of stability and by the curvature of the amplification characteristic. In the reception of broadcasting in particular, this curvature of the characteristic may lead to a reduction in apparent selectivity due to cross-modulation, and an increase in background noise. This effect is illustrated in the paper by typical measured amplification characteristics. An analysis of a triode amplifying stage shows the possibility of securing inherently stable tuned-circuit amplification by using a buffer-valve stage to minimise the effects of the input impedance of the amplifying valve. A measurement of such a stage at a frequency of a million cycles per second gave results in agreement with theory and showed that an output of about 100 volts could be obtained without appreciable curvature of the amplification characteristic. Thus, although the three-electrode amplifying circuit may not be preferable to the screen-grid stage in all cases, it should facilitate reception at large power output with a minimum of audio frequency amplification. With this object in view, special emphasis is laid in the paper on the desirability of making a simple modification to the design of the standard receiving triode in order to reduce the capacitance between the grid and anode.

Emission of Electrons in Chemical Reaction. Denisoff and O. W. Richardson have published (*Proc. Roy. Soc.*, A, March) a further instalment of the work on the emission of electrons when gases at low pressure react with sodium-potassium alloy. A refined re-investigation of the reaction with phosgene has been made in order to determine the energy spectrum of the emitted electrons with considerable accuracy. The paper summarises the general conclusions reached by these and by the former experiments—it is found that the energy distribution is not Maxwellian, as was formerly suspected, but that the distribution curve rises to a maximum at a certain energy and falls nearly to zero at a certain maximum energy, E_m. Beyond this there is a very small tail, like that observed for the photoelectric effect. For the chlorine compounds studied, $E_m + D$ is a constant where D is the dissociation energy of the compound. The authors account for the distribution by supposing that the reaction between the metal atom and a chlorine atom to form a polar bond may be effected by a three-body collision in which a metallic conduction electron carries off the surplus energy of the reaction. The maximum energy E_m is thus the chemical reaction energy diminished by the work function of the metal. This result appears to agree with experiment.

Hydrazoic Acid. Most of the reactions of hydrazoic acid, HN_3, support the conclusion that it is an ammono-nitric acid :

$$HONO_2 + 2NH_3 = H-N=N\equiv N + 3H_2O$$

(Franklin, *J. Amer. Chem. Soc.*, March 1934). The potassium salt can be obtained by the reaction

$$KONO_2 + 3KNH_2 = KN=N\equiv N + 3KOH + NH_3.$$

The action of the acid on metals is in many ways analogous to that of nitric ("aquonitric") acid : the evolution of hydrogen reported by previous experimenters does not occur with zinc, iron, manganese, nickel and copper, the products being the metallic azides, nitrogen (previously mistaken for hydrogen), and ammonia with small amounts of hydrazine ; with magnesium (which also gives hydrogen with very dilute nitric acid), some hydrogen is also evolved. A mechanism of reduction of the hydrazoic acid is suggested. Hydrazoic acid does not dissolve gold ; it will do so (as well as platinum) if mixed with hydrochloric acid, and the "aqua regia" heated with the metal. The mixture of acids also slowly evolves chlorine on boiling. Ferrous azide is converted into ferric azide when heated with excess of hydrazoic acid ; hydrogen sulphide is 'nitridised' (rather than 'oxidised') to sulphur, and sulphur to sulphuric acid by hydrazoic acid, and a stannous salt can be converted into a stannic salt by a fusion reaction with sodium azide. Several organic reactions are also in agreement with this structure. It may be mentioned that there is physical and physico-chemical evidence besides the chemical evidence given in Franklin's paper, that hydrazoic acid and its salts have not the ring structure often given but a linear structure $H-N=N\equiv N$, or more strictly, $H-N=N\rightleftarrows N$, as proposed originally by Thiele.

Stellar Photometry in the Infra-Red. A new type of photoelectric photometer, employing a cæsium oxide cell, has been described by J. S. Hall (*Astrophys. J.*, **79**, 145). It is only possible to use this type of cell for stellar photometry if it is cooled to about $-40°$ C. by means of solid carbon dioxide, in order to reduce the 'dark current', or current which flows when no light strikes the cathode. The colour curve of such a cell shows great sensitivity in the infra-red, and intensity measurements may be made at well-separated effective wave-lengths. A detailed description of the apparatus is given, as used in conjunction with the Loomis cœlostat telescope of the Yale Observatory. The Pleiades were used for calibration purposes, and colour observations made on 347 stars and on the variable star ζ Geminorum. The phases in the light-curve of this variable as observed in the infra-red are later than those observed in the visual, corresponding to the previously noticed phase difference between observations in the visual and the blue regions. An interesting suggestion is made as to the possibility of finding the absolute magnitudes of giant stars of later spectral types from accurately measured colour excesses, observed in this manner in the infra-red.

Dipole Moments and their Interpretation

FEW branches of physical chemistry can show a more rapid development than the study of dipole moments. The theoretical work of Debye goes back to a discussion of the Mosotti-Clausius equation in 1912, but the experimental work really begins with Zahn's measurements on gases in 1924 and the work of Smyth, Williams and others on solutions a few years later. To-day, values of the dipole moment have been determined for more than a thousand substances, and measurements of dielectric properties are applied to such varied topics as the determination of valency angles, the size of colloid molecules, and the order of the boiling points of isomeric substances. It is not surprising therefore that the discussion on "The Determination and Interpretation of Dipole Moments" held by the Faraday Society at Oxford on April 12–14 attracted a large number of British and foreign workers in this field. The outstanding figure was, of course, that of Debye; those who attended the meeting will long remember his shrewd comments on every paper, his genial smile and his cigar which served so aptly as a model of a dipole.

It is only possible to mention a few of the many papers which were read. The first group was concerned with the determination of electric moments of molecules. It seems to be generally agreed that atomic polarisations are small and are rarely greater than 5 c.c. Anomalous dipole moments can now no longer be ascribed to large values of P_A. On the other hand, the work of Horst Müller, Jenkins and others shows clearly that the magnitude of the dipole moment deduced from measurements in solution is influenced by the dielectric constant of the solvent. A number of formulæ connecting measured polarisation and dielectric constant were discussed, but much more work on vapours as well as on solutions is needed before the solvent effect can be accurately determined.

Debye's opening paper contained an account of novel work by Martin on dielectric losses in dilute solutions of a polar substance in a non-polar solvent. Following Malsch, the thermal expansion of the solution was used as a delicate method of measuring the heat developed by absorption of electrical energy. Non-polar substances gave negligible heating but polar substances showed a marked effect. Thus with 0·1 molecular solutions of orthodichlorobenzene ($\mu = 2{\cdot}25$D*) and paradichlorobenzene ($\mu = 0$), the relative heating effects were in the ratio 310 : 1. Theory indicates that the effect should be proportional to the square of the dipole moment μ, and from the measured energy absorption the relaxation time of the polar molecule can be computed. In accordance with elementary theory, this is found to be of the order of 10^{-12} seconds for solutions in solvents of low viscosity, such as benzene. The elementary theory assumes spherical molecules and Stokes's law, and the experimental data diverge considerably from the predicted results. It seems probable that further investigations along these lines may give information about the shapes of molecules.

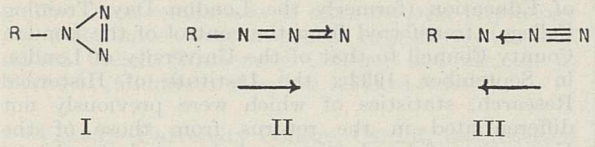
Determinations of relaxation time from measurements of anomalous dispersion at high radio frequencies were discussed in the papers contributed by Williams and by Girard. The latter finds anomalies in the shape of the dispersion curve for glycerol which he ascribes to the presence of two species of molecules, namely, normal and associated molecules. Girard also notes some curious empirical relations between the dielectric properties of hydroxyl compounds. Thus for the normal aliphatic alcohols from propyl alcohol upwards, the product of the molecular weight and the dielectric constant at 20° C. is nearly constant.

Another group of papers was concerned with the problem of free rotation. There is, of course, a mass of chemical evidence in favour of free rotation about a single bond. More accurately, it should be said that if isomerides exist which differ in structure merely by the relative angular orientation of groups about a single bond, then these isomerides are so readily interconvertible that they cannot be isolated. Dipole moments give a good deal more information about such rotations. Thus the existence of a dipole moment for hydroquinone dimethyl ether is explained by the rotation of the —OMe groups about the C—O bond. Williams and others have discussed molecules of the type of ethylene dichloride and distinguished three extreme cases: (*a*) the repulsions between the chlorine atoms fixes them in the *trans* position giving $\mu = 0$; (*b*) the chlorine atoms are fixed in the *cis* position and $\mu = 3{\cdot}6$D; (*c*) the CH_2Cl groups rotate freely about the C—C axis with all orientations equally probable and $\mu = 2{\cdot}5$D. Zahn has measured the dipole moment of ethylene dichloride in the vapour state and finds that it varies with temperature from 1·12D at 32° C. to 1·54D at 281° C. This is interpreted as indicating that the *trans* position is the most stable, and that increasing thermal vibrations give oscillations from this position. The problem is, however, one which deals with phenomena on the atomic scale and can only be solved satisfactorily by the methods of wave mechanics. An illuminating discussion of the restriction of free rotation in molecules of the type XCH_2CH_2X was given by Lennard Jones. From suitable molecular models a wave equation was set up and an equation obtained which accounts quantitatively for the change of dipole moment with temperature.

Another interesting quantum discussion of a similar problem was given by Penney and Sutherland on the structure of hydrogen peroxide and hydrazine. These molecules give unexpectedly large dipole moments, which have been ascribed to free rotation. An examination of the problem by quantum mechanical methods shows that the main forces determining the structure of the molecule are not the electrostatic repulsion between the terminal hydrogen atoms but the interaction between the electron clouds associated with the oxygen atoms in HOOH and the nitrogen atoms in H_2NNH_2. The most stable configuration for hydrogen peroxide is a skew one in which the planes through the O—O axis and the H atoms are nearly at right angles. In other words, the most stable position is about halfway between the *cis* and *trans* positions. A similar structure is found for hydrazine; for both substances the observed dipole moments are in fair agreement with the values calculated for the skew configuration.

* D is the Debye unit, 10^{-18} E.S.U. C.G.S.

A group of papers was devoted to the discussion of resonance phenomena. Here one is concerned primarily with the rapid oscillation of electrons between different positions in the molecule, and not with the movements of nuclei as in the free rotation problem. The problem of the structure of the organic azides was discussed by Sidgwick. The azide ion has undoubtedly the linear structure $N\rightleftharpoons N\rightleftharpoons N$; for the covalent organic azides three structures are possible as shown below. Parachor and volatility favour I, whilst chemical reactions, electron diffraction, and recent crystal structure measurements reported by Bernal indicate a linear structure, II or III. The dipole moments of a number of azides give for the moment of the Ph–N_3 group about 1·5D. This is scarcely larger than the moment of the Ph–N group, so that the links in the N_3 group contribute very little to the moment. II and III should give



I II III

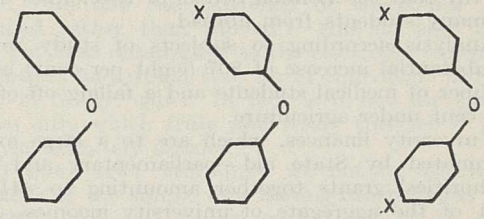
large contributions in the senses indicated by the arrows below the formulæ, so the dipole moments seem to favour structure I. This is, however, quite incompatible with the electron diffraction and crystal measurements.

The low moment cannot be reconciled with a linear arrangement of the nitrogen atoms by postulating tautomerism in the chemical sense of the word between forms II and III. If the time of interchange between the two forms is less than the relaxation time (*c.* 10^{-12} sec.), then each form would orient under the influence of the applied field and the observed moment would be large, although the two forms have moments of opposite sign. Quantum mechanical resonance between the two forms with an interchange time of the order of 10^{-15} sec. would account for the observed moment. For this to occur it is necessary for the two forms to have equal or nearly energies. Sidgwick has computed the heats of formation of the N_3 group making certain plausible assumptions with the following results:

I, 170 k. cal. II, 191 k. cal. III, 180 k. cal.

The observed value calculated from the heats of combustion of organic azides is 211 k. cal. This seems to exclude I and is compatible with resonance between II and III, since resonance increases the stability of the molecule and would increase the heat of formation.

The vector addition of dipole moments and the calculation of valency angles were considered in another group of papers. The chief difficulty met with in this field is the uncertain magnitude of the interaction between two dipoles in a molecule or between a dipole and the polarisable part of the same molecule. Hampson described a method of eliminating such errors considering the moments of a series of compounds, for example:



where X is a group of known moment. From the three measured moments it is possible to fix upper and lower limits for the valency angle and to estimate the magnitude of the perturbing induced dipole along the X–O axis. For the oxygen valency angle consistent values of about 130° were found; the induced dipole was small when X was Cl but when X was NO_2 amounted to half a Debye unit.

Finally, mention must be made of the remarkable results found by Hassel for certain cyclohexane derivatives. 1:4 dichloro-, dibromo-, and di-iodo cyclohexane were found to have zero moment in solution in benzene. This result is not easily reconciled with the usual view that cyclohexane derivatives consist of a tautomeric mixture of two strainless forms with a non-planar configuration.

S. S.

University Statistics of Great Britain

UNIVERSITY statistics of Great Britain for the year 1932–33, recently issued by the University Grants Committee*, show that the attendance of students has been well maintained and university finances have a healthy appearance. It would seem that the measures taken to temper the effect on universities in Great Britain of the inclement economic weather prevailing in the past few years have achieved their object. The enrolment of full-time students has been gradually rising since 1924–25 and showed last year a further increase of 1,255—1,267 more men and 12 fewer women. Of the aggregate total of 50,155, five per cent were engaged in research and other advanced work, seventy-seven per cent were reading for a first degree and eighteen per cent for a diploma. Part-time students numbered 13,960, of whom rather more than half were not pursuing regular courses leading to a degree or diploma.

A regional distribution of the full-time students gives to: London, 24 per cent; Oxford and Cambridge, 21 per cent; provincial universities of the Midlands and northern England, 21½ per cent; Reading, Southampton, Exeter and Bristol, 5 per cent; Wales, 6⅔ per cent; and Scotland, 22 per cent.

Students from abroad, that is, from homes outside the British Isles, numbered 5,870—about one tenth of the total number—considerably more than half of them being from countries within the British Empire: these show, however, a tendency to decrease in proportion to those from foreign countries. The following table gives particulars in respect of universities where such visitors from abroad were most numerous, showing (1) full-time students from places outside the British Isles but within the Empire, (2) those from foreign countries, and (3) the

* University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1932–33. Pp. 26. (London: H.M. Stationery Office, 1934.) 1*s.* 3*d.* net.

percentage of (1) plus (2) to the total number of students :

	Students from abroad (1)	(2)	(Per cent) (3)
London	1,191	674	16
Sch. of Economics	141	234	39
Imperial College	163	50	20
University Coll.. .	221	118	17
Guy's Hospital ..	99	18	14
St. Bart.'s Hospl.	78	34	15
Oxford	290	234	11
Cambridge ..	346	192	9
Birmingham ..	28	85	11
Edinburgh ..	329	176	14
St. Andrews ..	14	87	11

In view of current controversies and world-wide perplexity in regard to economic doctrine, it is noteworthy that the London School of Economics draws so many students from abroad.

Analysis according to subjects of study reveals a substantial increase of 807 (eight per cent) in the number of medical students and a falling off of five per cent under agriculture.

University finances, which are to a large extent dominated by State aid—parliamentary and local authorities' grants together amounting to 44½ per cent of the aggregate of university incomes—have called for close and unremitting attention on the part of university administrative authorities since the national financial crisis of 1931. Evidence of the effectiveness of their control is to be found in the fact that there were only four institutions the accounts of which showed deficits on the year and in only one was the deficit of any substantial amount. The aggregate amount of debt on capital account at the close of the year was about one million pounds, or one sixth of the aggregate annual income.

Expenditure on libraries is dissected in a special table which shows that of the total, £210,756, sixteen per cent was on account of purchase of periodicals, the increasing number and cost of which was already, three years ago, when they were responsible for little more than ten per cent of library expenditure, a source of embarrassment.

Four London institutions now make their first appearance in the returns : the Courtauld Institute of Art, first opened in October, 1932 ; the Institute of Education (formerly the London Day Training College), transferred from the control of the London County Council to that of the University of London in September, 1932; the Institute of Historical Research, statistics of which were previously not differentiated in the returns from those of the University of London as a whole ; and the School of Slavonic and East European Studies, transferred from King's College to the University of London in August 1932.

Quantitative Methods of Biological Assay

THERAPEUTIC substances, which cannot yet be completely defined by their physical and chemical characteristics, can only be used with safety when their activity has been determined by tests on animals. The accuracy of such tests has been greatly increased during the last decade, especially since it was realised that large numbers of animals must be used in each assay, so that the average response of a group of animals can be determined, allowance thus being made for the differences in response of the individual animals. Such tests may be of two types : either the response of each animal to the drug is accurately measured, for example, the effect of insulin upon the blood sugar of the rabbit; or observation is only made as to whether some specific effect is produced or not, for example, the effect of insulin upon the mouse, when the end-point is the occurrence, or not, of convulsions. Gaddum has recently made an analysis of the latter type of test and his report should be of great value in the interpretation of the results of such experiments.*

In tests of the 'all-or-none' or 'quantal' type, it is now usual to inject several doses of the substance under test into a series of animals, ten or twenty or more being used for each dose, and to plot the percentage number responding on each dose against the dose given. The curve which is then drawn to pass approximately through the plotted points is *S*-shaped, the shape and slope of the curve being characteristic for each combination of drug and test-animal species. It is often more convenient to plot the effect of the drug against the logarithm of the dose (to base 10) instead of against the dose itself; the characteristic curves are then easier to interpret. The most satisfactory index of the slope of the curve, and so of the uniformity of the animals, is the standard deviation of the logarithms of the individual effective doses, which can be estimated with sufficient accuracy by taking from the curve the log-dose corresponding to 84 per cent, subtracting from it the log-dose corresponding to 16 per cent and halving the result.

Gaddum also recommends that instead of using the percentage of responses on each dose as a measure of the effect, the normal equivalent deviation be plotted against the logarithm of the dose, since this function gives a more satisfactory measure of the effect than the percentage does. It is equal to the deviation from the mean, and is obtained in practice from tables. When the normal equivalent deviations are plotted against the logarithms of the doses, the points so obtained lie approximately on straight lines, when the logarithms of the individual effective doses are normally distributed. It is therefore usually sufficient to use only two doses and to take the line joining them as an indication of the relation between the logarithm of the dose and the effect. This line is completely described by calculating the dose which produces the effect in half the animals and the standard deviation of the logarithms of the individual effective doses.

The report is illustrated by a number of curves obtained by different observers in assays of different drugs or hormones such as ouabain, neoarsphenamine, œstrin and pneumococcus antibody. The control of variables which affect the homogeneity of the animals used, such as their genetic composition, weight, age, sex, diet and environmental temperature, is also discussed. The mathematical argument involved in the use of these curves is described and, in greater detail, the methods of carrying out a test, two examples being included.

* Reports on Biological Standards. (3) "Methods of Biological Assay depending on a Quantal Response." By J. H. Gaddum. Medical Research Council, Special Report Series, No. 183. (H.M. Stationery Office, London, 1933.) 1*s*. net.

University and Educational Intelligence

CAMBRIDGE.—It has been recommended that one University lectureship in forestry be transferred from the Faculty of Agriculture to the Department of Botany, and that the lectureship be called the University lectureship in forest botany.

LONDON.—The following appointments have recently been made: Capt. G. T. R. Hill to the Kennedy chair of engineering (University College); Dr. L. P. Garrod to the University readership in bacteriology (St. Bartholomew's Hospital Medical College); Dr. G. R. Cameron to the University readership in morbid anatomy (University College Hospital Medical School); Mr. John D. Cowley to the directorship of the University School of Librarianship at University College.

The Dunn exhibitions in anatomy and physiology for 1934 have been awarded respectively to Mr. Alfred Cohen (University College) and Mr. A. J. Bernfeld (Middlesex Hospital Medical School).

WALES.—University College, Cardiff, has received a further gift of £1,000 from the Rothschild residuary fund. It has been decided to expend the greater part of the sum on library purposes.

Sir Howell Williams, of Corris, Merioneth, has promised £10,000 for the new college building scheme of the University College at Aberystwyth. This scheme is estimated to cost £500,000. Lady Gladstone of Hawarden has offered to endow two Rendel Memorial Scholarships as a memorial to the late Lord Rendel.

The University College of North Wales at Bangor celebrates its jubilee this year.

HISTORY and geography teaching, considered in relation to the problems of 'moral disarmament', is dealt with in several papers published in the December issue of the League of Nations' *Educational Survey*. There is, first, the full text of a lecture by M. Maurette, assistant director of the International Labour Office, giving a vivid presentation of methods whereby history and geography teaching in primary and secondary schools may help their pupils to grow up "to realise the only hope for the salvation of man on earth and the law which must govern the inhabitants of a globe whose limits are shrinking daily and whose different parts are becoming increasingly members one of another". It is followed by two authoritative *communiqués* concluding an acrimonious debate provoked by an article which appeared in a previous issue of the *Survey*. The position of the writer of the article, Mrs. Corbett Ashby, as a delegate at the Disarmament Conference necessarily aggravated the seriousness of her accusations that "national and racial animosity are inculcated by teachers . . . in obedience to false ideals of morality". A communication from Dr. C. W. Kimmins includes a memorandum by Dr. C. B. Firth on the general characteristics of the way in which children are now encouraged to learn history in English schools, and emphasises that for the last twenty years the kind of geography taught in the majority of schools in England has been equally unlike anything that Mrs. Ashby described and rightly condemned.

Science News a Century Ago

"Great Points in Electricity"

In 1834 Faraday was approaching the end of the electro-chemical researches which had occupied him for the previous two years. His paper on the "Electricity of the Voltaic Pile" was read before the Royal Society in June of that year, and a few days earlier, on May 29, he wrote in his Diary a short passage which gives an interesting indication of his ideas on electrolytic conduction at the time. He hoped that electrolysis might afford a means of distinguishing between elementary and compound bodies.

The passage, which is headed "Great Points in Electricity which require to be decided", shows that he had grown accustomed to using the new word 'ion': "Is not the existence of compound *ions* assumed rather than proved? Has an acid or a base yet been determined to the electrodes except in a solution, and would they go in equivalent proportions in ordny. salt? In fact is it not the simple bodies only which truly and freely traverse? This not yet definitely decided."

"If there are; still, may we not by Electrical relations of the simple *ions* distinguish between real elements and such as we may think to be such because we have not decomposed them? That is, will not electricity prove to be the test between bodies really simple and those which are compound? If so, probably our present elements are true and ultimate elements."

Death of Laumont

On June 1, 1834, the French mineralogist, François Pierre Nicholas Gillet de Laumont, died in Paris. Born on May 28, 1747, he was educated at a military school and served in the army from 1772 until 1784. He was then appointed an inspector of mines and devoted his leisure to the study of mineralogy. He wrote many papers for the *Annales des Mines* and assisted in organising the Paris School of Mines. The mineral laumontite was named after him by Haüy.

London and Birmingham Railway

On June 1, 1834, at Chalk Farm, the first sod was cut for the London and Birmingham Railway, the first main trunk line in Great Britain. The royal assent to the bill for its construction had been obtained on May 6, 1833, after a Parliamentary struggle which had cost the promoters of the line £72,869. Robert Stephenson, then thirty years of age, had carried out the surveys for the line, and though there was much opposition, the directors on September 7, 1833, resolved "That Mr. Robert Stephenson be appointed engineer-in-chief for the whole line at a salary of £1,500 per annum, and an addition of £200 per annum to cover all contingent expenses, subject to the rules and regulations for the engineers' department, as approved by the respective committees". Fixing his residence in St. John's Wood, and with the Eyre Arms Hotel as his office, Stephenson reserved for his own personal supervision a length of about nine miles from Maiden Lane, Camden Town, and divided the remaining 103 miles into four districts, each under an assistant engineer. The actual construction of the line was entrusted to about twenty contractors, but the completion of

some of the most difficult portions had to be superintended by Stephenson himself. The work of the greatest magnitude was the construction of the Kilsby Tunnel south of Rugby, a costly undertaking rendered necessary through the short-sighted opposition of the inhabitants of Northampton to the proposal that the line should pass by way of that town.

John Dalton

Dalton was elected a fellow of the Royal Society in 1822, and received one of the Society's Royal Medals in 1826, the first year of award, but until May 1834, he had not attended to be formally admitted. Babbage was, at the time, actively interesting himself in Dalton's presentation at Court, duly effected, it may be mentioned, though he did not go clad in levée dress. The particular reason, however, for Dalton's stay in London was to give sittings to Chantrey, the sculptor, who had been commissioned by a representative committee to execute a statue of him. Dalton recorded his visit to Chantrey thus: "He [Chantrey] took a profile as large as life by a camera lucida, and then sketched a front view of the face on paper. He then gave me the next day for a holiday and told me I should see my head moulded in clay on Wednesday morning, at which time he invited me to breakfast. I went accordingly, and found, as he said, a head *apparently* perfect. He said he had not yet touched it, the head having been formed from his drawings by some of his assistants. He set to work to model and polish a little whilst I was mostly engaged in reading the newspaper, or conversing with him. On looking right and left he found my ears were not alike, and the modeller had made them alike, so that he immediately cut off the left ear of the bust and made a new one more resembling the original. At last he took a pitcher and blew a little water in my face (I mean the model), and covered my head with a wet cloth and we parted, he having desired me to bring Dr. Henry and Dr. Philip with me next morning to breakfast. We went accordingly and found an abundant table; soon after Dr. Faraday came in and we all went into the working room for a time. . . . At intervals we have a little amusement and instruction about our respective arts and sciences, and how we acquired our knowledge, etc., in which we vie with each other". . . . (Henry, "Memoirs of John Dalton", 1854.)

Sir Henry Holland in his "Recollections" (p. 212) remarks, referring to Dalton's early years, that he "well knew that philosopher in his rude laboratory of bottles and uncouth apparatus at Manchester—an individuality in himself, apart from the Quaker garb he wore."

Wernerian Natural History Society, Edinburgh

In May 1834 the Society promoted and offered a number of honorary premiums, open unconditionally to all scientific workers. The terms were incorporated in a circular notice, from which three examples are quoted :—

(1) Twenty sovereigns, or a suitable piece of plate of that value for the best geological account, with a geognostical map, sections, and specimens, of the Three Lowthians, with as much of the neighbourhood as may be required for the elucidation of the districts. To be given in against December 1835.

(2) Ten sovereigns, or a piece of plate for the best natural and economical history of the fishes, marine, fluviatile, and lacustrine of the river district of the Forth. To be given in against December 1835.

(3) Ten sovereigns, or a piece of plate for the best account of the entomology of the Three Lothians, and river district of the Forth; with a collection of specimens, and map of the distribution of the insects. To be produced against December 1836. (Memoirs, vol. 7.)

Societies and Academies

London

Physical Society, March 16. N. Thompson: The effective rotation temperature of the negative glow in nitrogen. The effective temperature increases slightly with the pressure and current strength, and to a much greater extent with the temperature of the furnace surrounding the discharge tube. At high temperatures it becomes less than the temperature of the furnace, and an explanation of this surprising behaviour is sought. It is concluded that, in this particular case at least, the effective temperature is not identical with the gas temperature, though it depends in part on that quantity. S. S. Watts and B. J. Lloyd-Evans: The measurement of flame-temperatures in a petrol engine by the spectral line-reversal method. Until recently no satisfactory method existed for the measurement of the temperatures during combustion in a petrol engine. The reversal of a spectral line provides a suitable method which shows that the maximum temperature in the engine cylinder persists for a longer period than the maximum pressure. E. B. Moss: An apparatus for the determination of the dew point. The paper describes an optical system which uses diffraction by the dew droplets on a mirror and aids greatly the visual detection of dew-formation. Then follows an account of the application of this system to an automatic photoelectric apparatus for maintaining a mirror at the dew point.

Dublin

Royal Irish Academy, April 9. R. Southern: Food and growth of brown trout in Lough Derg and the River Shannon. The growth-rate and size of the trout is definitely correlated with the composition of the rocks in the drainage area. The water of Lough Derg and the Shannon is derived from limestone rocks and is alkaline; that of Lough Atorick comes from an area of Old Red Sandstone and peat and is acid. The trout from Lough Derg and the River Shannon are large, quick-growing, have a relatively long life and mature late. Those from Lough Atorick are small, slow-growing, have a short life and mature at an early age. In the diet of the Lough Derg trout, 'mid-water' food, consisting of *Cladocera* of the plankton and perch fry, forms a considerable part, but the Lough Atorick trout do not utilise this abundant food and live to a large extent on terrestrial insects blown on to the water. The Shannon trout subsists almost entirely on bottom-living organisms.

Leeds

Philosophical and Literary Society, March 6. A. Y. Amin: Note on a property of *Steinerian trihedra*. H. Frazer: Subharmonic functions. The author generalises the various results he has given recently

concerning subharmonic functions. R. WHIDDINGTON, E. G. WOODROOFE and J. E. TAYLOR : Note on the excitation of the neon atom by electron impact. The changes of energy of the neon atom when bombarded by electrons of 120 volts are considered. Three transitions from the ground state 2^1S_0 to the $3s_2$, $3p_5$, $3s'_1$ states are observed. The energy changes agree with those expected spectroscopically and the probabilities of the excitations are approximately in the ratio 16 : 4 : 5. J. E. ROBERTS : Excitation of the nitrogen molecule by electron impact. A brief survey is made of the question of the excitation of diatomic molecules by electrons, from the normal to higher electronic states, and two problems arise : (*a*) the most probable energy loss of the exciting electron ; and (*b*) the probability of excitation of vibrational levels near to the most probable levels. The case of the $X \rightarrow a$ transition in nitrogen is considered in detail. The best available potential energy curves are obtained using the known spectroscopic data and the Morse formula. Assuming harmonic vibration of the nuclei, the relative probabilities of excitation of a few of the vibration levels of the *a* state are calculated. These are in good agreement with the experimental results of Brindley though the most probable energy loss found by Rudberg is somewhat higher. H. M. DAWSON and W. LOWSON : Velocity of the reaction between sodium chloroacetate and sodium hydroxide. Measurements at 25° with the chloroacetate in considerable excess ($1M.CH_2Cl.CO_2Na + 0{\cdot}1M.NaOH$) show that the bimolecular velocity coefficient remains sensibly constant until about 70 per cent of the alkali has disappeared, but increases continuously in the later stages of the reaction. This increase appears to be due to the simultaneous occurrence of three other reactions in which the products of hydrolysis are formed as a result of the interaction of the chloroacetate ion with water molecules, other chloroacetate ions and glycollate ions respectively. W. CAMERON WALKER : A portrait of Joseph Priestley and some of its associations. E. MARJORIE WRAY : Structural changes in a woody twig after summer pruning. The basipetal development of the cambium and the dependence of radial growth upon the developing bud results in the isolation of any part of the stem left above the topmost bud, as a result of pruning, as a snag. This explains the pruning instruction always given, to prune immediately above a bud. The rapid drying of the snag is very unfavourable to meristematic activity and the only evidence of cambial activity in the snag is the formation of cork phellogen round the schlerenchyma and also just within the protoxylem. The healing of a well-pruned stem is so complete that in a year or two the cut is almost obliterated and thus entry of disease is prevented. Late summer pruning is followed almost immediately by the outgrowth of a single bud. This is attributed to the fact that at this time of the year, when the water-table in the tree is low and the air temperature is high, there is only sufficient water available to force one bud into growth.

PARIS

Academy of Sciences, March 26 (*C.R.*, 198, 1193–1280). H. LECOMTE : Notice on Dukinfield Henry Scott, *Correspondant* for the Section of Botany. J. COSTANTIN, MAGROU, BOUGET and MLLE. V. JAUDEL : The experimental production of mycorrhiza in the potato. ANDRÉ BLONDEL : Some remarks on the use of headlamps on motor-cars with a yellow beam. Physiological reasons are given for the known favourable effects produced by the use of yellow glass with motor headlights in preventing dazzle. A. R. CRATHORNE : Moments of the binomial with respect to the origin. PAUL LÉVY : The *V* and *W* spaces. J. GÉRONIMUS : Some extremal properties of polynomials the total variation of which is given. KING-LAI HIONG : The growth of integral functions of infinite order defined by a Taylor's series. JULIUS WOLFF : The integral of a holomorph function with real positive part in a demiplane is univalent. V. LALAN : An axiomatic definition of impulse and energy. EDMOND BRUN : The distribution of temperature in an insulating cylinder in rapid displacement in air. P. LEJAY and LOU JOU YU : The general characters of the intensity of gravity in the north-east of China. The value of *g* diminishes as the distance west of the coast increases : the results are indicated on a chart. GEORGES VAUDET : The time of discharge of a battery of condensers in a metallic wire. The explosive volatilisation of a copper wire by the discharge has been studied by photography on a film with an interposed rotating mirror. The time varied from 14 to 36 microseconds according to the conditions of the experiment. N. THON : The alternating current capacity of a non-polarisable electrode. H. HULUBEI and MLLE. Y. CAUCHOIS : Weak lines in the $K\beta$ spectra of the elements 42 (molybdenum), 45 (rhodium) and 47 (silver). R. GUILLIEN : The absorption of liquid oxygen studied in great thicknesses. In these experiments the absorption spectra have been studied in thicknesses of liquid oxygen up to 109 cm. The results are discussed in connexion with previous work (McLennan, Ellis and Kneser). MICHEL KANTZER : The absorbing properties of chromyl chloride. A list of lines in the absorption spectrum between the wave-lengths 5428 A. and 5016 A. A. ROUSSET : The molecular diffusion of light in liquids : the fluctuations of orientation of homopolar and heteropolar molecules. MLLE. C. CHAMIÉ and M. HAÏSSINSKY : The rôle of age and concentration of polonium of solutions in centrifugation experiments. The quantity of polonium precipitated on centrifuging (4,000 revs. per minute) increases with age : the amount diminishes as the concentration in polonium increases. L. HACKSPILL, A. P. ROLLET and LAUFFENBURGER : The double decomposition between ammonium nitrate and sodium chloride in the presence or absence of ammonia. The experimental results are given graphically on a Löwenherz diagram. A. DAMIENS : The expression of deliquescence and efflorescence. MLLE. BLANCHE GREDY and LÉON PIAUX : The *cis-trans* isomerism and synionic isomerism in the case of the crotyl derivatives. P. BRAUMAN : Some organic compounds of vanadyl. Description of the preparation and properties of methyl vanadylsalicylate, methyl phenoxyvanadylsalicylate, vanadyl salicylate and vanadyl benzoate. ALEXIS TCHITCHIBABINE : Phosphoric acid as a condensing agent. The alkylation of phenols and of their ether oxides. GEORGES RICHARD : Contribution to the study of the α-chlorketones. EDMOND URION : A functional exchange between organo-magnesium compounds and halogen derivatives. Grignard has recently described a method of obtaining magnesium compounds the preparation of which is impossible by the ordinary methods ; he ascribes the effects to the removal of a deposit from the surface of the magnesium. The author gives an alternative explanation which he regards as more probable.

R. PAUL: A method of preparation of the α-alkyltetrahydropyranes. RAYMOND FURON: Preliminary observations on the existence at Damergou (Niger) of a Cretaceous fauna analogous with that of Djoua (South Algeria). HENRY HUBERT: The circulation of atmospheric air at high altitudes above Madagascar. R. GAUTHERET: Researches on the reduction of silver nitrate by the chloroplasts. According to the author's experiments, the action of light is necessary to start this reaction. R. ECHEVIN: The evolution of the phospholipids of leaves in the course of the autumnal change of colour. H. COLIN and J. CARLES: Chemical affinities and hybridisation in the Iris. G. MALENÇON: New observations concerning the etiology of Bayoud (disease of the palm). F. DIÉNERT: Contribution to the study of occult condensations (hydrogenesis). J. LEGENDRE: Longevity in the larvæ of a tree-frequenting mosquito. A. GRUVEL: Concerning some of the causes preventing the penetration of animal species into the Suez canal. Besides mechanical effects due to the direction of the tides at the entrance, the high salinity and drainage from oil refineries prevent the access of animal life to the canal. GABRIEL BIDOU: Protractor with index. An instrument for measuring the amplitude of movements of limbs. RAOUL LECOQ: The possible existence, in proteins, of substances producing lack of food equilibrium. W. KOPACZEWSKI: The gelatinisation of serum by organic acids. Blood serum is rapidly converted into a transparent gel by the addition of lactic acid. Other organic acids can produce the same effect but less rapidly. C. LEVADITI, MLLE. R. SCHŒN and A. VAISMAN: The mode of transmission and of propagation of the spirochætosis produced by *Spirochæta muris* and *Spirochæta morsus-muris*. J. VERGE and H. LANCE: Swine influenza.

VIENNA

Academy of Sciences, February 1. GEORG KOLLER and KARL PÖPL: A lichen substance containing chlorine. This substance, which contains about 4 per cent of chlorine, appears to be chlorinated atranorin. ALOIS ZINKE and OTTO BENNDORF: Perylene and its derivatives (40). FRANZ HÖLZL and JOSEF KRAKORA: Hexacyanoferro-acid and ethyl alcohol. ODOMAR GUGENBERGER: The Cardita strata of Launsdorf in Central Carinthia and their fauna: (3) Scaphopods and cephalopods. (4) Lamellibranchs.

February 8. GEORG HORNINGER: The granite of Schärding (Upper Austria). This granite resembles in appearance and structure the Mauthausen type, but is distinguished therefrom by the presence of large numbers of dark inclusions, frequently rich in biotite. GEORG BAIERSDORF: Experiments on the limiting proportions of cadmium and palladium detectable spectroscopically in silver. These proportions depend greatly, especially with cadmium, on the mode of excitation. J. D. ALFKEN, H. BISCHOFF, F. MAIDL and ST. ZIMMERMANN: Hymenoptera (3). The occurrence of many species of insects on the islands of the Ægean Archipelago is recorded. *Pheidole teneriffana*, Forel, previously met only in Northern Africa and Western Asia, is found on Milos. ANTON FUCHS and FRANZ KAÜFEL: Land and freshwater molluscs from Greece and the islands of the Ægean Sea. AUGUST GINZBERGER: The 'houses' of the larvæ of the cicada, *Fidicina chlorogena* Wlk. ARTUR WINKLER: Results of new [geological] studies in the middle and upper Isonzo region.

Forthcoming Events

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

Monday, May 28

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—M. Conrad Kilian: "Exploratians Sohariennes" (in French).

Tuesday, May 29

CHADWICK PUBLIC LECTURE, at 5.30—(at the Royal United Service Institution, Whitehall, S.W.1).—Dr. J. B. Orr: "The National Food Supply and Public Health".*

Wednesday, May 30

ROYAL SOCIETY OF ARTS, at 4.30.—His Excellency Mirza Sayyed Hassan Khan Taqizadeh: "Modern Persia".

BRITISH SCIENCE GUILD, at 9.30—(at the Royal Institution). Lord Rutherford: "Helium and other Rare Gases" (Research and Development Lecture).

Thursday, May 31

THE MEN OF THE TREES, at 5.30.—Sir E. Denison Ross: "Trees in Oriental Art and the Desiccation in the East".

ROYAL AERONAUTICAL SOCIETY—(at the Science Museum, South Kensington, S.W.7).—Prof. B. Melvill Jones: Twenty-second Wilbur Wright Memorial Lecture.

IRON AND STEEL INSTITUTE, May 31–June 1.—Annual Meeting to be held at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1.

BOARD OF GREENKEEPING RESEARCH, May 30.—Conference to be held at St. Ives Research Station. Sir John Russell: Chairman.

Prof. R. G. Stapledon: "The Age of Scientific Practice".

Official Publications Received

GREAT BRITAIN AND IRELAND

The Carnegie United Kingdom Trust. Twentieth Annual Report, January–December 1933, approved by the Trustees at their General Meeting held on Friday, March 9th, 1934. Pp. vii+94+9 plates. (Dunfermline: Carnegie United Kingdom Trust.)

Ancient Monuments of Great Britain. List of Monuments prepared by the Commissioners of Works (to 31st December 1933). Pp. 82. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

The National Physical Laboratory. Report for the Year 1933. Pp. iv+264+11 plates. (London: H.M. Stationery Office.) 13*s.* net.

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1933; with Report and Notes of the Director, Rev. J. P. Rowland. Pp. xxiii+42. (Stonyhurst.)

OTHER COUNTRIES

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 20: October, November, December, 1933. By Ernest A. Hodgson. Pp. 339–368. (Ottawa: King's Printer.) 25 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. Zoological Results of the Dolan West China Expedition of 1931, Part 2: Mollusks. By Henry A. Pilsbry. Pp. 5–28 + 6 plates. Review of the Planorbidæ of Florida, with Notes on other Members of the Family. By Henry A. Pilsbry. Pp. 29–66 + plates 7–11. (Philadelphia.)

An Introduction to Social Insurance: Five Lectures delivered under the joint auspices of the University of the Witwatersrand, Johannesburg, and the Transvaal Workers' Educational Association. By Prof. John P. Dalton. Pp. viii+116. (Johannesburg: University of the Witwatersrand Press.) 1*s.*

Carnegie Institute of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Year Book No. 32, for the Year 1932–33.) Pp. 211–266. (Washington, D.C.: Carnegie Institution.)

Straits Settlements. Annual Report of the Director of Gardens for the Year 1933. By R. E. Holttum. Pp. 8. (Singapore: Government Printing Office.) 1 dollar.

CATALOGUES

Catalogus van diverse Bibliotheken, verkooping 14–18 Mei 1934. Pp. 98. (Leiden: Burgersdijk and Niermans.)

Zeiss Nachrichten. Heft 6, April. Pp. 40. (Jena and London: Carl Zeiss.)

Watson's Microscope Record. No. 32, May. Pp. 24. (London: W. Watson and Sons, Ltd.)

Galvanometers, Photographic Recording Apparatus, Galvanometer Accessories. (Galvo 33.) Pp. 24. (Delft: P. J. Kipp en Zonen.)