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Science and Progressive National Policy

The Special Areas and the School Leaving Age

THE second report of the Commissioner for the Special Areas* presented to Parliament in February reviews the progress made during the six months ended December 31, 1935, in the economic development and social improvement of the Special Areas. The policy advocated is essentially a long-term policy, and the Commissioner points out that while many schemes, some of considerable importance, have been sanctioned, the benefits arising from their execution will accrue cumulatively and time will be required before these benefits can be fully secured. Spectacular results are not to be expected but rather a steady improvement, and it would be wrong to judge the value of these schemes solely or even mainly by the amount of employment given. The Special Areas Act does not provide for expenditure on schemes primarily intended to give immediate employment, and no artificial creation of employment has been attempted.

The Commissioner has operated generally through existing authorities, organisation and agencies, and his report, which gives a comprehensive picture of the work so far accomplished, will commend itself to the scientific worker for the width of vision and moderation displayed. Industry in general does not appear to be sufficiently interested in the Special Areas, and there is apparently little prospect of the Special Areas being assisted by the spontaneous action of industrialists now located outside the areas, although inquiry has indicated no well-defined or insurmountable obstacle to the establishment of new industries in the areas.

Measures are required, however, to make the areas more attractive and their economic advantages better known; and some welcome signs of improvement are reported. The necessity for Government action in the financing of new industries in these areas, and also the advisability of extending the preference, other things being equal, given under agreements with the London Passenger Transport Board and the railway companies to manufacture in the Special Areas, is emphasised. Reference is made to the reports submitted by the Newcastle Section of the Society of Chemical Industry and by Armstrong College, Newcastle, on science and industry in the north-eastern area and on the distribution of unemployment in the same area. Specific recommendations regarding the application of science to industry are being considered by the North East Development Board.

Assistance has been given or will be given, subject to the satisfactory outcome of negotiations, to a number of public works of industrial utility, including an afforestation plan proposed to the Forestry Commission which the Chancellor of the Exchequer has since indicated has been accepted in principle and towards which he has agreed to recommend that the annual grant-in-aid to the Forestry Fund should be increased to £500,000 for the next five years.

What is most evident from the report, however, is the necessity of attacking the problem on a wide front by a combination of different methods. The work of the Special Commissioner is severely limited by the narrow official interpretation of the section in the Special Areas Act which restricts his grants to local authorities for "public works for

* Second Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 5090.) Pp. vi+120. (London: H.M. Stationery Office, 1936.) 2s. net.

which no specific grant is payable by any Government Department" and debars him from helping any road or bridge scheme or educational service. The Special Areas, however, cannot be considered apart from the general welfare of the nation as a whole. Their problems will only be solved when they are dealt with from the point of view not of some special area or district but in relation to the resources and needs of the whole community. The greatest need of the Special Areas is that of the whole community—the planning of national resources by creative minds awake to all the possibilities which scientific knowledge and technical skill have put into our hands.

The practical impossibility of dealing with Special Areas alone in any satisfactory way has been ably pointed out by Prof. H. A. Marquand in a recent book*, which indicates the necessity of taking South Wales as a whole, the present 'special area' limits being indefensible. The same unity of the problems of the special areas with the national problems is emphasised in the present report in dealing with such matters as unemployment among young persons. The most serious human problem of the special areas is that presented by unemployment among young men between eighteen and twenty-one years of age. Many of them have done practically no work and, brought up in homes where the father has been continuously out of work, they have little or no conception that a man's ordinary occupation should be such as will provide the means of subsistence for himself and for his family. They have come to accept it as a normal condition for their own families and their friends to be kept for years by the State. In such circumstances, it is not surprising that these young men should be ready victims of all manner of demoralising influences, and they present the most tragic aspect of the problem of the Special Areas, and one fraught with great danger to the State. This problem cannot be ignored by the rest of the community. Great as may be its burden on the Special Areas, it is of manageable dimensions. There are only about 11,000 of these young men, and some 7,000 have been unemployed for more than three months. It calls for urgent and drastic treatment, and none of the recommendations in the report deserve closer attention than those bearing on this question.

In his first report, the Commissioner for the Special Areas recommended raising the age of entry to industry to sixteen years, as an important contributory measure for the reduction of juvenile unemployment. The demoralisation to which reference has just been made emphasises once more the importance of measures which can diminish to any extent this evil, and links up this problem of the special areas with the discussions on the Government proposals for raising the school leaving age which are at present proceeding. It emphasises, in fact, the human and social aspects which have in many such discussions in Parliament and elsewhere been overshadowed by industrial and financial considerations.

The effect of raising the school leaving age to fifteen years on juvenile unemployment throughout the country may well be sufficient by itself to justify taking this step, apart from educational considerations. What is much more important, however, is the reduction of the risk of exposure of the adolescent to periods of recurrent unemployment and its demoralising effects on character. The danger of allowing to grow up within the community a class of young people who have never known the meaning of continuous employment, and who are the ready prey of those dangers to which the Commissioner refers, is far from being appreciated as it should be.

Something more is required than the mere reduction of the risk of unemployment to which these young persons are exposed. An educational and welfare policy must be planned to enable the adolescent to withstand the risks to which he is exposed and to take his or her place as a normal useful and contented member of the community with the capacity and opportunity for expressing his individuality. This need is fully appreciated by the Commissioner for the Special Areas, as is shown in those sections of his report which deal with social service and local amenities, etc. It was equally present in the minds of the Hadow Committee when its report was issued in 1924. Its proposal was not merely the addition of another year to the school life of the child but also the reorganisation of schools into primary and post-primary so as to secure the advantages of a four-year course for senior schools.

Opposition to the Education Bill recently introduced is consistent and widespread from all types of educational authorities, largely because the present proposals of the Government appear to ignore this point. Many experienced administrators have expressed the emphatic opinion that, under the Government scheme, exemptions will be on a

* "South Wales Needs a Plan." By H. A. Marquand. Assisted by Gwynne Meara. Pp. 256. (London: George Allen and Unwin, 1935.) 7*s*. 6*d*. net.

scale that makes the promised reform a farce and defeats any real hope of the post-primary schools functioning as they are planned to do. The uniformity with which responsible educational opinion has condemned the Government proposals, the protests of the county councils associations, the summoning of a national conference by the Association of Education Committees indicate the disappointment aroused by this short-sighted step.

In educational policy, as in dealing with the Special Areas, the primary need is some means of planning the whole question in relation to the ultimate needs of the community and its available resources, and then some authority sufficiently powerful to co-ordinate the various interests and factors concerned in action upon the agreed policy, without let or hindrance from sectional interests which at first sight it may appear to affect. The value to the community of the reorganisation in education which the raising of the school leaving age makes possible, whether measured in terms of industrial efficiency or the reduction of juvenile unemployment, is now undisputed.

Apart from its bearing on unemployment, many industries are already prepared for a higher age of entry to industry on the ground of industrial efficiency, and are recruiting accordingly. It should be intolerable that sections of industry or commerce which have been too indolent or incompetent to plan the necessary readjustment should be allowed to prejudice the general interests. Moreover, the effect of the additional year at school in fitting the adolescent to make use of his leisure is a safeguard against the demoralisation referred to by the Commissioner, the value of which is not easily overstressed if the post-primary system outlined in the Hadow report really functions and the last year of school life is something more than the mere waiting or looking for a job.

In education, as in housing, unemployment, nutrition and the depressed areas, much fundamental thinking on the long-range problems involved has already been done. The National Housing Committee has done valuable work towards outlining a national housing policy to deal with the evil of ribbon development and promote a broad master plan including the control of industrial localisation, itself related to the rehabilitation of the Special Areas. Apart from the reports to which reference has already been made, there have been the investigations carried out by the universities in different parts of the country at the request of the Board of Trade. Statisticians have already provided the Ministry of Labour with many of the important relevant facts about unemployment and the labour surplus, as was indicated by M. S. Warrington in a recent paper before the Manchester Statistical Society. The importance of a food policy in relation not merely to agriculture but also to unemployment and health was emphasised recently at a Conference which was arranged by the League of Nations Union, and many of the relevant basic facts have been laid bare by the Committee of the British Medical Association on Nutrition as well as by the Engineers' Study Group on Economics (see NATURE, April 11, p. 627).

What has hitherto been wanting is some sign that such facts and policies are fairly evaluated against the many other claims on the resources and activities of the State. Warmly as Sir Austen Chamberlain's plea for a thinking machine on defence which will not merely co-ordinate the defence forces of the nation but also all the industrial resources at our disposal has been welcomed, we need even more a mind that will co-ordinate not only defence but also all those other policies and factors concerned in the preservation and development of national morale and welfare. Expenditure of, say, £5,000,000 on education and pensions on the lines advocated by Political and Economic Planning last year, or up to £100,000,000 on national food policy as advocated by Sir John Orr, will then be determined less by the financial exigencies of the moment and the demands of other departments of State than by a long-range view of national welfare.

Until we can attain such a position, the utilisation and direction of scientific and industrial research will suffer as have the questions of unemployment and education and the like. Nor can we expect either security or the enjoyment of that higher standard of living which science has undoubtedly placed within our reach, until we can evolve some means of organisation and direction of national policy in which social and scientific factors are evaluated by minds untrammelled by the past and awake to the possibilities of our heritage. Scientific workers cannot wisely evade their responsibility to assist the evolution of such an organisation, in place of the haphazard and often wasteful methods by which in the past we have stumbled along. The control of science itself no less than the welfare of the community depends largely upon the measure in which scientific workers seek to discharge that civic responsibility.

Animal Variation and Evolution

The Variation of Animals in Nature

By G. C. Robson and Dr. O. W. Richards. Pp. xvi + 425 + 2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21*s*. net.

THE theory of animal evolution is a perennial subject, and such subjects are very often benefited by occasional broad surveys of the knowledge upon which the theoretical conclusions are based. In the book under notice, Mr. Robson and Dr. Richards have set out to reconsider the theory of animal evolution in the light of our present knowledge of variation. Their survey is a broad one. They discuss not only the facts of variation as they are seen in the animal body and its behaviour, but also the genetical background and, on the theoretical side, the truth of the theory of natural selection and of other less widely accepted theories. They tell us that the book has been written with the chief object of providing the zoological systematist with an account of what is known of the biology of the structural differences with which he deals, and with a discussion of the theoretical results of this knowledge; but the book will also be useful to biologists of many other kinds. The facts discussed are biological, and this must be the justification for the present review, which is written from the point of view of the general biologist and not from that of the systematist.

In carrying out their plan, the authors have first given an account of the facts of variation. This, with various related subjects such as the effects of isolation on animal groups and of correlation between variations, occupies the first half of the book. Here there is one somewhat surprising gap in the account of the evidence. Very little space is given to the evidence of palæontological series such as Fenton's brachiopods from the Grand Canyon, the secondary echinoids and the less complete series of tertiary mammals. Such series are mentioned, but there is very little discussion of the nature of the changes, which can be seen in these series to be built up into differences of specific or higher order. Yet, surely, it is only here that we can avoid the difficulties imposed upon us by the narrow time-scale of our modern experience. Such evidence would seem to be particularly valuable for the authors' object. They give us no indication of their reasons for not including an account of this evidence, an account which most readers will anticipate and would have appreciated.

In their discussion of the genetical basis of variation, the authors appear to think that the hereditary variations from which specific differences are built up will be identical in nature with the mutations of genetical experiments. But there is evidence, more especially in plants but also in animals, that species differ in their complex backgrounds of modifying genes as well as in genetic alterations as large and clear-cut as the experimental mutations. If this is true of animal species in general, it would seem to demand a reconsideration of the whole subject. Small mutations in the very numerous genes of the background complex may, under the influence of a changed environment, be much more numerous than the larger mutations. Their effects are likely to be much smaller and more quantitative. Not improbably they would accord much better with the palæontological and other evidence. It is at least clear that, if this view of the genetic differences between species is correct, we shall not be able to argue directly from the properties of large mutations to the problems of specific evolution until we have more knowledge of the frequency and characters of the mutations of these background genes. Here the authors are unfortunate in the time of their publication. This evidence is recent and it could scarcely be expected that it should be considered in a book written, as the authors tell us, three years ago. Nevertheless, it seems to affect the reliability of some of their conclusions.

In the second half of the book, much space is given to discussion of the validity of natural selection as an important factor in the causation of evolution. Throughout, the evidence is considered from a severely critical point of view, an advisable and indeed necessary attitude in view of the very large amount of questionable evidence which is put forward on this and similar subjects. The conclusion is reached that there is some evidence for natural selection as a real factor in the evolutionary process; but the authors do not believe it to play the main part in the causation of evolution. The average reader will probably be surprised by the paucity of the evidence which the authors have been able to collect in favour of natural selection, and by the cogency of their arguments against it. It must be left to each reader to decide whether they have established their case.

Finally, a protest must be raised against the view, which the authors seem to favour, that the genetical character rather than the animal body as a whole is the real unit of zoological systematics. It is true that they admit the unity of the animal organism, but they seem to think this fundamental fact is not of great importance in zoological

systematics. If this is so, systematics must move farther from, and not nearer to, natural history and biology, a result to be deprecated. It is undoubtedly Utopian to hope for a biological treatment of systematics in any near future, but yet it seems clear that the final systematics must be biological, based on the whole life of the animal rather than on the average structure of its adult body. A biologist, at least, may be allowed to hope so.

These criticisms must not be taken to imply that the present is not a valuable book. In it the authors have summarised a vast body of evidence which is not easily obtainable elsewhere, and have discussed this evidence critically. Not all biologists will agree with their conclusions ; but that can be said of most books which are written on so controversial a subject as animal evolution still is.

G. S. C.

The New Apocalypse of Man the Social Animal

Human Ecology
By Dr. J. W. Bews. Pp. xii+312. (London : Oxford University Press, 1935.) 15*s*. net.

THE advance of science is along two roads : the first is in the direction of greater intensity, particularism and of empiricism, and the second, from intensity, particularism and empiricism, towards extensity, generalisation and synthesis. Explorers along the road of scientific progress carve the challenging hypotheses of former pioneers on milestones which show the truisms from which they then proceed.

"Learning," in the Baconian idiom, "hath his infancy, when it is but beginning and almost childish, then his youth when it is luxuriant and juvenile, then his strength of years when it is solid and reduced, and lastly his old age, when it waxeth dry and exhaust." The childish steps of anthropology, the science of man, were directed by theology and religion, until, barely seventy years ago, it grew to the relative maturity of youth when evolution—Darwin's faith-challenging apocalypse—became the truism of to-day.

By the theory of evolution—which describes the process of adaptation, physical, mental and cultural, to environmental conditions—the study of man is linked in an embracing science to the study of his environment and of his cultural achievements. For while man makes culture, culture conditions man. It is to this synthetic study that Prof. Bews gives the title "Human Ecology". General Smuts in an introduction welcomes this contribution from a plant and animal ecologist as an advance in the methodology of *the* embracing human science, which is anthropology. Along the paths of extensity and synthesis each new step forward in science is taken when its empirical and morphological ground-work has been achieved. It matters little whether or not we all find any added meaning in the terminology whereby General Smuts lays down that it "is the holistic doctrine which underlies ecology".

The sterile and still surviving controversy between heredity and environment loses all meaning when approached through ecology, as do also many of the anthropological, no less than political, confusions surrounding the words 'race', 'culture' and 'people'. Prof. Bews's work has, therefore, an importance which is scientific, philosophical and, ultimately as have all human sciences, political. His book is also welcome as preparing the way for the new anthropology : "that learning that hath his strength of years, solid and reduced". The author insists, as he must, that anthropology is a department of zoology, and zoology a department of biology ; consequently neither race nor population, unless qualified as human race and human population, can be defined in terms peculiar to anthropology. In a diacritical definition the generic cannot be defined in terms peculiar to the specific. Race is a generic description, the definition of which gives no validity to the assumption that '*a* race' must be pan-diacritic. It is better, in any event, to define 'race' before attempting a definition of 'a race'. The new ethnology is concerned with race-types rather than with races.

From the ecological point of view, there is a functional relationship between organism (man) and environment. If regarded only from the environmental end we are discussing geography. The American group of human geographers, represented by Ellsworth Huntington and Griffith Taylor, is sometimes regarded as the school of pure human ecology. Valuable as are their contributions, they tend to over-emphasise the importance of environment and to distort the 'total situation'. For this and other reasons the reviewer would prefer the name 'ethnogenics' to human ecology ; and Prof. Bews's approach is that of an 'ethnogenist'.

Ethnogenics means the study of human history (and of prehistory) in terms of changing race, population and culture. It describes the ecological approach to anthropology, according to which organism, environment and function are studied as tripartite aspects of essentially indivisible

problems. The ethnogenist, or human ecologist in Prof. Bews's sense, insists on the value of 'function' for survival, and claims that the diffusion of cultural elements by borrowing between races in contact is a process which involves the selection of some elements only, their modification or adaptation to the needs of the borrower and the complete rejection of incompatible elements. Methodologically, Prof. Bews accepts the reviewer's classification of culture by distinguishing the social inheritance of 'culture-forms' and of 'culture-accessories' as well as the genetic inheritance of the 'culture-potential' of their culture-bearers; for at every stage culture is conditioned by the capacity of peoples to give expression to it (chapter vi).

The reviewer does not like the term 'ethnology' used as the equivalent for 'cultural anthropology' (p. 111). Ethnology is a term which should be restricted to the comparative and inductive science by which the races of mankind are compared, identified and distinguished. For the empirical and morphological sciences we have the terms 'ethnography' and 'demography'.

The book is well indexed, and bibliographies are appended to each chapter. In both index and the bibliographies there are, perhaps inevitably, some conspicuous omissions. A few authors who should certainly find a place are omitted, whilst some of us would hesitate to include others who are selected. Some of the authorities included in the bibliographies do not find a place in the general index even when they are mentioned in the text. But these are minor points. Anthropologists, archæologists and others must certainly read Prof. Bews's book. GEORGE PITT-RIVERS.

Science for All

More Simple Science:

Earth and Man. By Prof. E. N. da C. Andrade and Prof. Julian Huxley. Pp. x+352. (Oxford: Basil Blackwell, 1935.) 6*s*. net.

WE think it may be said, without exaggeration, that the average person knows very little about science and usually dislikes having anything to do with it. Frankly it bores him. A few years ago at the annual dinner of a scientific society, a Cabinet Minister, who was one of the guests, began his speech by apologising for his ignorance of science, and added that most of his knowledge of the subject was gleaned from the *Illustrated London News*! One can understand why our rulers often fail to appreciate the value of scientific methods, which often require them to take a long view, when applied to economic Empire development. It may be that much of this ignorance is due to the way men of science present their subject to the unscientific mind. Astronomy has been popularised, but there are many useful branches of science which have not been so treated, anyhow not in suitable language.

It is, therefore, a joy to read the book under review. The language is clear and easy, while there is behind every statement the weight of undeniable authority. Would that more men of science would take the trouble to do for the man-in-the-street what Profs. Andrade and Huxley have done. This volume, mainly by Prof. Julian Huxley, forms part of a series of separate books adapted for schools, which the joint authors are undertaking, and is a continuation of, and complementary to, a previous volume entitled "Simple Science". The opening words of the first chapter describe its objects: "In this Book we shall deal with some of the rules about living things in their relation to the planet Earth which serves as their home, ending up with some facts concerning man in his relation to the earth and to other living creatures." Following on these lines there are chapters on the climates of the earth; simple statements on geological structure; the chemistry of life, dealing with various cycles in the circulation of matter through life including an interesting section on the wastefulness of man; how soil is formed and the different kinds there are; plant food and fertilisers, plant life and scenery; the stream of life, the life story of an animal and its development; animals and plants can change, and the deliberate improvement of living creatures.

The last two chapters are devoted to a sketch of the history of science through the ages, and how science has changed general ideas. "Science means finding out how things actually *do* happen, not laying down principles as to how they *ought* to happen."

As we have quoted the beginning of the volume we may now appropriately quote the end: "Without science and the scientific spirit, we shall just drift along; with their aid, man may be able to learn to control his destiny." The illustrations, by L. R. Brightwell and Comerford Watson, are cleverly done and suit their purpose admirably.

As part of the acquisition of a useful general knowledge of science in schools, we could not recommend a better book than this. H. L. C.

Reports of the Progress of Applied Chemistry
Issued by the Society of Chemical Industry. Vol. 20, 1935. Pp. 819. (London: Society of Chemical Industry, 1936.) 12*s*. 6*d*. (to members, 7*s*. 6*d*.).

To maintain a really adequate private library is unfortunately beyond the means of many chemists, who depend for their guidance to progress in their science on a carefully selected collection of monographs, summaries and abstracts. Among these signposts none is better known or more appreciated than this series of annual publications which, together with the series of reports on pure chemistry published by the Chemical Society, afford a very comprehensive survey extending to some of the farthest boundaries of the field. The success of such a survey depends in no small measure on the degree to which the contributors, forty-two in number, succeed in presenting a connected story rather than a mere collection of relevant abstracts, and there is evidence of considerable attention having been paid to this fact. On the other hand, a report is not an essay, and it is the business of the reporter to give chapter and verse for his statements, so that the harvest of references to original papers and their abstracts is as rich as ever.

The elimination of the report on explosives (which is dealt with every alternate year) has not appreciably diminished the size of the book, which comprises twenty-five reports on as many sections of applied chemistry under the editorship of Mr. T. F. Burton, editor of *British Chemical Abstracts* and of the *Transactions of the Society of Chemical Industry*. New reporters are Dr. D. Burton on leather and glue, Mr. W. A. Damon on acids, alkalis, salts, etc., Mr. C. Jepson on sanitation and water purification, and Messrs. H. A. Turner and W. F. A. Ermen on bleaching, dyeing, printing and finishing. To those also whose interest in applied chemistry is secondary to that in some other branch of learning this report can be recommended as a trustworthy guide. A. A. E.

Chronic Nasal Sinusitis and its Relation to Mental Disorder:
an Applied Pathology of Abnormal Conditions of the Nasal Sinuses found in Mental Hospital Patients. By F. A. Pickworth. Pp. xii+156+5 plates. (London: H. K. Lewis and Co., Ltd., 1935.) 16*s*. net.

As a presentation of the relation of sinusitis to the occurrence of mental disorder, this book is not convincing. If the author would only give us reliable control figures we might listen, but until we know what proportion of patients in general hospitals have sinusitis, as judged by the same standards, we shall not be convinced. We take serious objection to the statement that "Hysteria should be treated as a medical disease due to minute focal brain lesions, and not due solely to the imagination". The prevalence of agglutinins to organisms of the typhoid-dysentery-foodpoisoning group amongst mental hospital admissions probably corresponds to their occurrence amongst the general population of a large city like Birmingham. The percentage in admissions from rural areas is very small.

Mules and Men
By Zora Neale Hurston. Pp. 343. (London: Kegan Paul and Co., Ltd., 1936.) 12*s*. 6*d*. net.

WHILE the reader of this book may not feel constrained to endorse fully the publisher's exuberant statement that it is the most wonderful collection of folk-lore in the world, it will be admitted that it is a remarkable production, which gives an illuminating view of negro society in the southern United States. The book, indeed, is noteworthy because it is a record of negro mentality by one of themselves, who is also a trained anthropologist. Miss Hurston, who is a pupil of Prof. Franz Boas of Columbia University, after graduation elected to take up negro folk-lore as a subject of research, and chose her own home town in Florida as the starting point of her investigation. The narrative of her experiences in search of material is rich in vivid detail and characteristic touches, interspersed with sermons, songs, music and stories, in which humour, religion and unconscious irreverence are closely interwoven.

In the second part of her book Miss Hurston records her further experience when seeking initiation into the mysteries of voodoo in New Orleans. She became the acolyte or associate of a number of the leading exponents of this form of magical belief, some of whom claimed to be relatives of, or to have been associated with, the notorious Marie Leveau, well known as a voodoo priestess in New Orleans at the close of the last century. Miss Hurston has made an interesting record of her various initiations, which will be of value to students of this ritual. A note of the author's own emotional reactions would have been of considerable interest.

Lake Tana and the Blue Nile:
an Abyssinian Quest. By Major R. E. Cheesman. Pp. xiv+400+25 plates. (London: Macmillan and Co., Ltd., 1936.) 18*s*. net.

WHEN Major Cheesman entered upon his duties as H.B.M. Consul in north-west Abyssinia, he found that no large-scale maps of the Abyssinian portion of the Blue Nile were available. He was also informed that the course of the Blue Nile was the only part of Africa remaining which offered opportunity for pioneer exploration. During his nine years' residence in the country, he took full advantage of the opportunity and of the permission given him to explore. In this volume he gives his readers a record of his journeys. Not only is his account of special interest at the moment, but it is also of permanent scientific value as the story of the first visit of a European to the islands of Lake Tana and of the first journey to be made down the Nile through unexplored country to the point reached by previous explorers, who had entered Abyssinia by way of the Sudan.

Major Cheesman, already well known to students of geographical literature as a traveller in unexplored parts of Arabia, has made a notable addition to recent work dealing with a country but little known until the march of events brought it into the limelight. The narrative is illustrated by a series of excellent and illuminating photographs.

Physiology in Modern Medicine

By Prof. J. J. R. Macleod, assisted in the present edition by Prof. Philip Bard, Prof. Edward P. Carter, Prof. J. M. D. Olmsted, J. M. Peterson, Prof. N. B. Taylor. Seventh edition. Pp. xxxii+1154+7 plates. (London: Henry Kimpton, 1935.) 36*s*. net.

WE are fortunate in acquiring a new edition of this standard book on physiology since it turned out to be the last work of Prof. Macleod. During his extensive investigations, he made substantial contributions to the science of physiology especially on carbohydrates, while during his many years of teaching medical students in Great Britain and in Canada he established many friends in both continents. This explains the multiple authorship of the book and the guiding principles underlying its general design: Prof. Macleod here presents physiological principles on a strict physico-chemical basis. He has even gone further and has brought the phenomena of several diseased conditions to the same scientific basis.

It is this single purpose, which applies to the working of disabled as well as normal organs, which makes reading pleasant and ensures that the thousand pages are none too many. Some of the early chapters are expressly devoted to purely physical considerations, so that the reader can be sure of following the more applied sections of the book.

For the medical student who wants a scientific text-book of physiology and for the practitioner who wants to establish his everyday practice gained by experience on a scientific basis, this book will be found useful. It is one of the best books available which combines the modern science of physiology with the old art of medicine.

Factor Analysis in the Study of Personality

By John Clemans Flanagan. Pp. x+103. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1935.) 6*s*. net.

THIS monograph gives a clear account of the development of the statistical techniques that have been devised to analyse the multiple factors involved in tests and ratings, and in particular in those that are employed in personality study.

Beginning with Spearman's two-factor theory, the adequacy of which to deal with the simple case of hierarchical correlations is admitted as "firmly established", the author points out that this theory is inadequate to deal with complex factor patterns, in respect of which the work of Kelley, Thurstone and Hotelling is examined. The aim of all such techniques is to discover the basic independent factors which enter into functional synthesis and appear as abilities. These factors are 'indicated' rather than defined by the statistical procedures; and it remains to construct mental tests which will emphasise the factors individually in such a manner as to allow of the determination of their nature.

Factor analysis is rapidly coming to the fore in psychological work; and this monograph will be studied with profit by those who wish for a concise introduction to it.

Garden Science

By Dr. John Grainger. Pp. ii+265. (London: University of London Press, Ltd., 1935.) 4*s*. 6*d*. net.

IN this small volume a considerable amount of information concerning the fundamental principles underlying the practice of horticulture is compressed. It consists of eight chapters, the first three of which deal with physiology as concerned especially with the raising and growing of plants. The fourth chapter, dealing with vegetative propagation, grafting, pruning and the like, is of value to gardeners since it contains scientific information on subjects often ignored in text-books. The last three chapters deal with diseases (fungus and virus) and insect pests: they cover a wider range than might be expected in so small a volume (though T.S.W. virus is not mentioned), and many readers might prefer a fuller treatment of fewer subjects.

The section dealing with the flowers and the exposition of Mendelism is good, but the differentiation of the mechanisms which insure cross-pollination and those which prevent self-pollination is not very clearly defined. In the plant disease chapters the long-abandoned name *Synchitrium* [*sic*] *solani* is employed instead of *Synchytrium endobioticum* now in general use, whilst an error has obviously crept into Fig. 32. The book will be decidedly useful for purposes of horticultural training in schools and colleges.

Tissue Culture:

the Growth and Differentiation of Normal Tissues in Artificial Media. By E. N. Willmer. (Methuen's Monographs on Biological Subjects.) Pp. viii+126+2 plates. (London: Methuen and Co., Ltd., 1935.) 4*s*. net.

THIS brief account of the technique and results of the culture of tissues *in vitro* is to be commended to senior students of the biological subjects, as it presents the state of knowledge both of the growth and differentiation of the cell as well as a clear description of the role of the nutrient medium. The physiology of unorganised growth in epithelia and connective tissue is discussed with the same clarity as the organisation of embryonic tissues grown in cultures. The author is to be complimented on the avoidance of technical terms. A glossary, comprehensible even to the layman, is included.

Tropical Planting and Gardening:

with Special Reference to Ceylon. By H. F. Macmillan. Fourth edition. Pp. x+560. (London: Macmillan and Co., Ltd., 1935.) 25*s*. net.

IN Ceylon, cultivation, whether for profit or pleasure, is conducted under very varied conditions due to the great range of both altitude and rainfall. A comprehensive account of what is possible there is thus of great utility to residents in many parts of the tropics and sub-tropics. This work, now in its fourth edition, thoroughly revised and enlarged is, even more than its predecessors, an indispensable book of reference for all planters and gardeners in tropical countries, its value being enhanced by its wealth of illustrations and very full index.

The Total Solar Eclipse of June 19

THE coming total solar eclipse should be very fully observed if the meteorological conditions are favourable.

Prof. Horn d'Arturo hopes to secure a photograph of the corona in Greece just after sunrise, while snapshots of the corona may also be obtained by some of those on a P. and O. Mediterranean cruise who will be off the Greek coast on the morning of the eclipse. Comparison of these photographs with any secured in Hokkaido will show what changes have taken place in the form of the corona during an interval of 2·5 hours. Between these extreme stations there will be a large number of expeditions.

Dr. Donitch, of the Starya-Doubossary Observatory of Rumania, accompanied probably by Dr. R. L. Waterfield, will observe the eclipse from the north coast of Asia Minor, where the weather prospects are favourable. Dr. Donitch will study especially the chromosphere with slit spectrographs and objective prism spectrographs, and the corona with a spectrograph of low dispersion and with cameras of short focal-length, while Dr. Waterfield will photograph the corona through a number of filters, with special attention to the infra-red. Two Russian parties from the Abarzumian and Kharkov Observatories will be stationed in the Caucasus, where also a party from Czechoslovakia under Dr. Slouka will be stationed, and also possibly an expedition from Italy consisting of Prof. Abetti and Dr. Righini and equipped mainly with spectrographic apparatus. The last-named party may, however, be going to Japan.

Numerous Russian parties will be distributed along the eclipse track across Siberia. In the lower Volga area there will be an expedition from the Moscow Observatory and a smaller one from the Moscow Astronomical Society; at Kustanaj an expedition for the spectrophotometry of the chromosphere and the photometry of the corona from the Engelhardt Observatory; near Orenburg an expedition from the Pulkovo Observatory—the spectrum of the chromosphere will be obtained in the extreme ultra-violet with a quartz spectrograph and also in the infra-red, while the microstructure of the chromosphere will be examined with a prismatic camera. The second expedition from the Pulkovo Observatory will go somewhere near Omsk, where the corona will be photographed with two or three Ross lenses and with two spectrographs; the programme will include some spectrophotometry and the study of polarisation phenomena. At Kansk and Tomsk there will be expeditions from the Leningrad Institute; at Krasnoyarsk a further party from Moscow; at Bratsk another party from Leningrad under Prof. Noumerov; an additional party from Moscow at Alexandrovsk will examine the Einstein effect, while one of a series of six similar coronagraphs will be installed at Khabarovsk. In addition to preparing their own equipment for the eclipse, the Russian astronomers have placed their colleagues under a heavy debt by much spade work in the study of the meteorological and other conditions along the eclipse belt.

Other parties visiting the territories of the U.S.S.R. include three American and one British party. The expedition from Harvard University and the Massachusetts Institute of Technology—Dr. D. H. Menzel, Dr. J. C. Boyce and Mr. E. A. Benfield—will be at Ak-Bulak near Orenburg. They will use two 21-ft. concave gratings with moving plates and some grating spectrographs for a series of intermittent exposures on stationary films, also several prism spectrographs. Both the chromosphere and the corona will be examined. This party will be joined by Prof. W. R. Brode of the Ohio State University with a 3-m. concave grating and moving plate camera for the chromosphere.

The third party from the U.S.A. will be under Dr. P. A. McNally, *S.J.*, and will be organised by the Georgetown College Observatory and the National Geographic Society. It will be stationed at Sara and occupied mainly with direct photography of the corona.

The British party under Prof. J. A. Carroll, of the University of Aberdeen, will be at Omsk. Other members of the party will be Mr. E. G. Williams, of the Solar Physics Observatory, Cambridge, and Major Luck. With an objective interferometer, the widths and detailed structure of the chromospheric lines will be studied and also the internal motions in the corona. An attempt will be made to secure fresh lines in the infra-red in the coronal spectrum.

The other expedition under the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society is proceeding from the Solar Physics Observatory, Cambridge, to Kamishari in Hokkaido. The members of the party are Prof. F. J. M. Stratton, Dr. R. O. Redman and Dr. F. W. Aston of Cambridge, Dr. T. Royds, director of the Kodaikanal Observatory in South India, Dr. C. W. Allen, of Mt. Stromlo Observatory, Mr. A. D. Thackeray, of Cambridge (from Mt. Wilson Observatory), and Major R. A. Bagnold,

Royal Signals. It is hoped that Dr. C. D. Stewart of Singapore, Dr. Jeffreys from Hong-Kong and one or two others stationed in the Far East may get short leave and join this party.

The programme includes spectrophotometry of the chromosphere by means of a series of short exposures on a moving plate held fixed for each exposure, a study of the extreme ultra-violet spectrum of the chromosphere and corona with a quartz spectrograph fed by aluminised mirrors in place of mirrors of speculum metal, a study of high-dispersion spectrograms of the limb near totality and of the chromosphere for accurate wave-lengths, an examination with Nicol prisms and Savart prisms of the polarisation of the corona and of the surrounding regions of the sky, a study of the Fraunhofer lines in the spectrum of the outer corona and direct photography of the corona in the ultra-violet, photographic and infra-red regions.

If, as was not definitely known at the time of writing, Dr. Johnson of the California Institute of Technology comes to Japan, he will continue the investigations on the polarisation of the corona, which he carried out at the last eclipse.

Finally, we come to the list of Japanese expeditions, and here tribute must be paid to the Eclipse Committee of the Japanese National Research Council for the many steps taken to help the visiting observers. From the Tokyo Astronomical Observatory and the National Science Laboratory at Shanghai a party will proceed to Manchukuo to observe the eclipse from a station near the frontier. Director Sotome and other members of the staff of the Tokyo Astronomical Observatory will form three parties observing at Nakatonbetu, Abashiri and Monbetu : they will take photographs of the eclipse star field for the Einstein effect, and also take direct photographs of the corona. Prof. T. Tanaka, of the Physics Department of the Tokyo Imperial University, will examine the spectrum of the corona from the Mitsui Agricultural Farm near Syari ; Director Okada and Dr. Sekiguti, of the Central Meteorological Observatory, will arrange observations of the eclipse from aeroplanes at Nemanbetu ; Prof. Ono, of the Tokyo Bunrika University, will take observations of terrestrial magnetism, while Prof. S. Nakamura, of the Tôhoku Imperial University, will study earth currents and other geophysical phenomena at Kosimizu ; Prof. Matukuma, of the same university, will carry out further astronomical investigations, as also will Prof. Ueda and Prof. I. Yamamoto, of the Kyoto Imperial University.

No wide region of the eclipse track will be without its party of observers, and by general agreement, for the most part reached at the Paris meeting of the International Astronomical Union last year, the most important observations, where duplicated, are being made at well-separated stations. A reasonable amount of luck should secure from the successful parties a well-balanced body of fresh knowledge as to the upper layers of the solar atmosphere. F. J. M. S.

Late Cenozoic History in India

By Dr. Hellmut de Terra, Research Associate in Geology, Carnegie Institution of Washington and Yale University

THE progress recently made in the prehistory and geology of man in China, Java and Africa called for an organised study of the late Cenozoic history in India, the importance of which as a promising research field had been previously recognised by men of science such as Pilgrim, Merriam and Hrdlička. The approach to this complex task was determined by geological considerations, inasmuch as the stratigraphy of the Pliocene–Pleistocene sequence had to take account of the young Himalayan mountain uplifts and related phenomena. Two previous expeditions of mine had given me an intimate knowledge of the geology in north-west India, and therefore I chose for my studies a stretch of country extending from the Kashmir valley across the Pir Panjal range and Poonch to the Salt Range between the Rivers Indus and Jhelum. This sector comprises the slope of the main Himalaya and the adjoining plains in the Punjab with their more recently uplifted ridges.

The field work was carried out last year in association with Dr. Teilhard de Chardin who joined the expedition for the last three months, and with T. T. Paterson of the University of Cambridge. N. K. N. Aiyengar, of the Geological Survey of India, was in charge of the collecting of fossils, and D. Sen of the University of Calcutta acted as field assistant. Temporary associates of my party were H. J. H. Drummond and P. Krishnaswami.

The Pliocene formations, to which we also refer the Chinji-beds with *Hipparion* fauna, offered, as on my previous expedition in 1932, an opportunity

of gathering additional fossil material, particularly of the higher primate group, of which some new genera had recently been described. Last year, twenty-five primate remains were collected, consisting of two jaws, a few maxilla and mandible fragments and isolated teeth. These fossils will be worked out by Prof. W. K. Gregory, who believes that their study will add substantially to our still meagre knowledge on the evolutionary trends among the man-like apes of late Tertiary time.

glaciation, which Dainelli once referred to the Mindel advance in the Alps.

An important observation of ours was the merging of the 'Boulder Conglomerate' fans into ground moraines derived from the second ice advance. At Campbellpore, near the Indus, the Boulder Conglomerate carries erratic blocks and it overlies unconformably tilted fossiliferous early Pleistocene beds. In Kashmir also the older Pleistocene lake beds are folded and in Jammu

TABLE SHOWING THE LATE CENOZOIC SEQUENCE IN NORTH-WEST INDIA

Period		Stage	Fauna	Glacial cycle in Kashmir	Prehistoric culture
Pleistocene	Upper	Redeposited silt		4th ice advance. T.M. 8,000 to 10,000 ft.	? Upper Palæolithic
		Erosion		3rd interglacial erosion	
	Middle	*Potwar*: yellow, loess-like silt, and gravel	Narbadda fauna in 'upper group'	3rd ice advance; 3–4 recessional moraines. T.M. 6,500 ft.	Soan culture in lower gravel and in silt
		Erosion		Long 2nd Interglacial; Upper Karewa beds erosion	Lower Palæolithic Soan culture
	Lower	*Boulder Conglomerate*	Narbadda fauna in Central India. *Equus, Bubalus, Hippopotamus, Elephas namadicus*	2nd ice advance; boulder clay and gravel in Karewa beds	In Punjab: worn flakes. In Narbadda valley: Chelleo-Acheulean; ? early Soan
		Pinjaur	*Equus, El. namadicus, Bos, Sus, Rhinoceros, Cervus, Felis, Sivatherium*	1st interglacial; Lower Karewa beds, birch, oak, pine-forest	?
		Tatrot	*Stegodon bombifrons, Hippohyus, Hexaprotodon, Pentalophodon* falc.	1st ice advance. T.M. 5,500 ft.	
Pliocene		*Dhok Pathan*	*Hipparion, Tragocerus, Stegolophodon, Bramatherium*		

(T.M.—elevation of terminal moraine walls above sea-level. Broken lines—main unconformities.)

So far as our results on the Pleistocene succession in north-west India are concerned, they are briefly summarised in the accompanying table. This tabulated statement, however, should not be regarded as the ultimate résumé of my views, gained through field studies and clarified through repeated discussions with Dr. Teilhard and with Mr. Paterson. It may be seen that the Upper Siwalik stages, such as Tatrot, Pinjaur and Boulder Conglomerate (terms by Dr. Pilgrim) could be linked with the glacial cycle in Kashmir. Paterson and I surveyed and partly mapped the Pleistocene in Kashmir, and our views principally uphold Dainelli's theory of a fourfold Himalayan glaciation. However, we seem to differ from his views as regards the relative age of the first overthrust movements are clearly recorded from this period. A second major phase of diastrophism occurred during the second interglacial, and a third, but lesser one, after the third ice advance. We noticed a regional presence of five terraces in the valleys of Kashmir and of the plains which are clearly linked with the last two major glaciations and interglacial periods, and a minor late-glacial ice-advance.

The prehistoric cultures found in this area range from Early Palæolithic to Late Middle Palæolithic and Neolithic. The oldest is represented by worn flakes in the Boulder Conglomerate and by bi-faces, cleavers and hand-axes associated with gravels of perhaps similar age. The Soan culture, named after the Soan River near Rawalpindi, is

mainly a flake culture of distinct facies which may range from the Early to late Middle or even Upper Palæolithic. Workshops belonging to this Soan industry are numerous below the Potwar loess-like silt.

During the last two months, various excursions were made to Upper Sind, Central and Southern India. Along the Narbadda River, Dr. Teilhard and I collected Chellean and Acheulean tools from beds containing the Narbadda fauna of Middle Pleistocene age. Here also were found artefacts belonging to the Soan culture.

Paterson, Drummond and Krishnaswami studied the prehistoric collections in the museums at Lahore, Benares, Calcutta, Madras, Trivandrum, Colombo and Bombay, and field work was carried out by them in Madras and Bombay presidencies. They reported a widespread occurrence of the Soan culture, of a microlithic industry, and of a proto-Neolithic culture. The early Neolithic in these collections appeared to be akin to that of northern Europe, though there occur types similar to the latest Upper Palæolithic of North Africa.

The artefact collection, numbering more than four thousand specimens, will be worked out by Paterson and Drummond at the Archæological Museum of the University of Cambridge.

The researches were made possible through the support of the Carnegie Institution of Washington, the American Philosophical Society, the Royal Society of London and the University of Cambridge. The co-operative policy of the Government of India and of the Geological and Archæological Surveys of India is gratefully acknowledged.

Food from Wood

THE suggestion has recently been made that as much food might be obtained per acre of woodland as per acre of arable land, if the wood be so treated as to yield sugar. The production of sugar from wood has been a subject of much research, especially in Germany and the United States. There is no doubt that it can be achieved, not only on a small laboratory scale but also in commercial plant operation ; the difficulties that have had to be overcome have been those of chemical engineering rather than of chemical reactions. There is, however, a very real doubt whether such a process is justifiable, save perhaps in time of national emergency (for which purpose it was developed in Germany during the Great War), or whether it can ever be economically a sound proposition.

From a material point of view, timber is grown for two main purposes—either for use as a structural material or for its cellulose content. There are perhaps few structural uses of timber that could not be satisfied by other materials. Cellulose, however, is as yet quite indispensable, not merely as pulp and paper, but also in its myriad new uses for textiles or rayon, lacquers, cellophane, etc. To split up such a valuable raw material to sugar is certainly unsound from the point of view of the proper utilisation of natural resources, and only justifiable if the products cannot be obtained from any other source. The agriculturist will answer that sugar of a purer and more usable type may be obtained directly from sugar beet, or from cane, or can be obtained far more simply from starchy crops such as potatoes or maize. Sugar beet is capable of yielding 2–3 tons of sugar per acre, and sugar cane 4–5½ tons per acre. The starch in potatoes amounts to 1½–2 tons per acre, or in maize, 1 ton per acre, equivalent to an almost equal weight of sugar.

To make a comparison of these yields with those possible from woodland is difficult, inasmuch as the latter is obviously not an annual crop. The faster growing soft woods (conifers) may be said to give more than 300 tons of timber per acre per 100 years, or 3 tons per acre per year. The maximum yield of wood sugar so far claimed is two thirds of the weight of the wood, or 2 tons per acre on an annual basis. This calculation is rather questionable because the annual rate of increase of saplings is much greater for the first ten to twenty years than at maturity, and the yield of wood sugar per acre obtainable from young growth might be at a higher level. Against this must be set the fact that the rate of growth of most woods is considerably below that of the very vigorous soft woods such as silver fir.

The most serious objection that can be raised to the process, however, is the nature of the sugar produced. Whereas cane and beet give almost exclusively sucrose, that from wood is a mixture of several sugars, not all of them of equal value as food to man or animals, or even of equal availability for biological fermentations. The chief constituents of woods are cellulose, hemicelluloses and lignin. The proportions found usually lie within the following percentage limits—cellulose, 50–60, hemicelluloses, 10–15, lignin, 20–30. The cellulose of woods is not identical with the standard cellulose of cotton, but contains considerable amounts of the pentosan—xylan—particularly in the case of

hard woods, in which as much as 25 per cent of the wood cellulose may be xylan. Softwood cellulose contains less xylan but has in addition mannan. The hemicelluloses are carbohydrates built up from a number of sugars, such as galactose, arabinose, mannose and xylose, and may easily be split up into these components. Wood sugar is a mixture of all these sugars with glucose from the true cellulose, and even if complete breakdown of the wood is effected, the sugar mixture obtained may not contain more than 60 per cent glucose. It is important to keep this fact in mind when considering the possible uses of wood sugar.

Much of the work on the saccharification of wood has been directed to the production of alcohol from the product by fermentation. Of the sugars present only glucose and mannose are fermentable by ordinary yeasts, the pentose sugars and galactose remaining behind. Since the yield of alcohol from a fermentable sugar is less than 50 per cent, the amount of alcohol to be obtained from wood is not great. Yields of 25–30 gallons of alcohol per ton of sawdust have been obtained commercially, and higher amounts in laboratory scale experiments. The pentose sugars unattacked by the yeast may afterwards be fermented with special bacteria to give largely lactic acid and a little acetic acid. High yields of acids may alternatively be obtained by direct fermentation with such organisms as produce lactic acid from both hexoses and pentoses.

For use as food or as a raw material in the production of food, wood sugar may be employed in several ways. It may be fed directly as cattle food and has been said to have practically the same nutritive value as barley flour. The availability of the pentose sugars in the mixture is, however, a matter of doubt; xylose is little utilised by animals or man. The food value probably lies therefore in the glucose and mannose present. Alternatively, the glucose may be separated out in a pure condition and used in other foods. Glycerol might be obtained by modified yeast fermentations in the presence of sulphite, which results in a yield of 15–20 per cent of the sugar fermented, or protein obtained by using the wood sugar solution as a nutrient for yeasts or fungi under such conditions as result in the production of maximum yields of microbial tissue.

The actual production of wood sugar may be achieved in two ways. The complex carbohydrates of the wood may be split up either by dilute acids at high temperatures and pressures or by concentrated acids at ordinary temperatures. The latter procedure, which is the basis of the Bergius process, operated in Germany, gives both higher yields of sugar and higher percentages of fermentable sugar than the former. Unless the treatment is prolonged and the temperature high, dilute acids do not break down the true cellulose completely. Degradation products of the sugars, such as furfural and humus substances, are also formed. Concentrated acids, on the other hand, result in complete solution of the wood, leaving only the lignin behind. The wood in the form of chips is treated with 7 parts of 40 per cent hydrochloric acid in a continuously operated battery of 8–10 vessels. The acid is removed from the extract by vacuum distillation to give a product containing 60 per cent sugar and 8 per cent hydrochloric acid. An atomising drier concentrates this to 90 per cent sugar content with only 1 per cent hydrochloric acid.

The engineering difficulties in the recovery of the acid without damage to the product have been very great, but it is now claimed that the total acid loss is not more than 10 per cent calculated on the sugar obtained. The yield of sugar from a coniferous wood is 66 per cent, which approaches the theoretical. Although the action of the strong acid results in such an extensive breakdown, the true cellulose fraction is not completely split up to glucose but remains in the form of cellulose dextrins, which consist of cellulosic fragments each built up of a few glucose units. These are not fermentable, and to obtain the glucose from them an aqueous solution must be boiled with dilute acid for a short time. The wood sugar mixture then obtained may be separated or utilised in one of the ways mentioned above.

In normal circumstances, the commercial production of wood sugar, though a remarkable feat in chemical engineering, cannot be taken as any threat to agriculture in view of the heterogeneous nature of the product obtained, and the growing world shortage of timber for pulp. Claims have been made that in the most favourable situation and conditions glucose might be obtained from this source more cheaply than sucrose from sugar beet. Ordinarily, however, there must be a wide disparity in costs, and sugar beet cultivation has the advantage additionally of giving much employment. One development which might make the wood sugar process economically possible in normal times would be a demand for lignin for some manufacturing purpose. At present the residual portion of the wood, consisting almost exclusively of lignin, remains unutilised. This amounts to 20–30 per cent of the weight taken. The possibilities of lignin as a raw material in industry have not been adequately considered, perhaps because the constitution is still obscure. Because of its marked resistance to biological attack, and inertness to strong chemicals, other than oxidising agents, it should find a useful outlet. The production of wood sugar and lignin from wood would then be more defensible than that of sugar alone.

A. G. N.

Coal Hydrogenation in Great Britain

THE daily discussion of 'oil sanctions' will have served a useful purpose if it brings home to the public the perilous position of Great Britain in regard to oil supplies in time of war. Actually the London omnibuses alone consume more fuel than the total quantity of benzole produced by coke ovens and gas works, whilst apart from the new coal hydrogenation plant of Imperial Chemical Industries at Billingham, the total production of home-produced fuel is less than 7 per cent of British requirements. Germany is paying great attention to this same problem of producing oil internally and is already in a much more favourable position than Great Britain.

The main achievement in England so far is the hydrogenation of hard coal by a process, discovered by Bergius, developed by Imperial Chemical Industries, Ltd., as a member of the International Hydrogenation Patents Co., and brought into highly successful operation on a large scale at Billingham during last winter. The story of the achievement has been told in a paper read by Kenneth Gordon before the Institute of Fuel; it has been supplemented recently by a technical paper issued by the Fuel Research Board* describing the earlier investigations of Bergius and the action of the Department, and its connexion with other bodies interested in the subject prior to the advent of I.C.I. This forms a valuable historical survey.

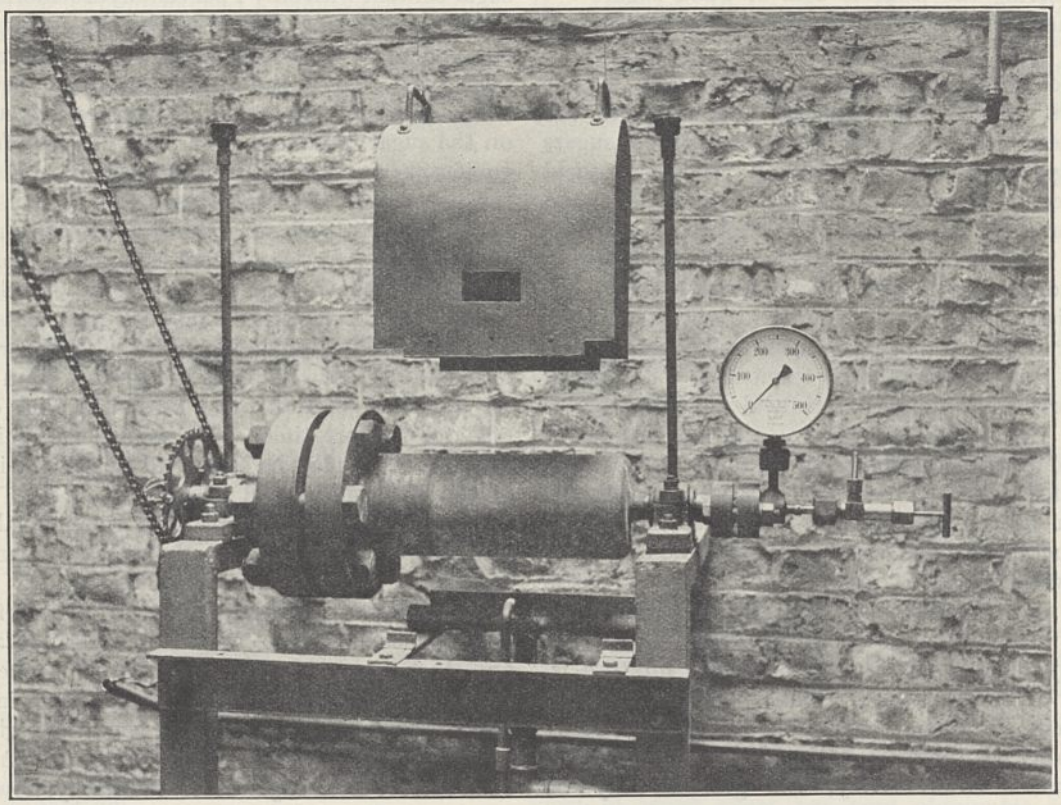

Fig. 1. Bergius 2-litre converter. From Fuel Research Technical Paper No. 42. Crown copyright reserved.

The earlier work of Bergius is now well known to those interested: it took him some time to reach the stage of the two-litre converter illustrated here (Fig. 1). Fig. 2, showing a single hydrogenation stall or unit at Billingham, indicates the growth of the process on the engineering side, though its practical development is due also to certain chemical discoveries, notably the favourable influence of adding hydrogen chloride during hydrogenation and its subsequent removal with a stable suspension of alkali in oil from the hot vapours.

* Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 42: The Action of Hydrogen upon Coal. Part 2: Early Experiments with the Bergius Process. By Dr. L. Horton, Dr. F. A. Williams and Dr. J. G. King. Pp. vi+58+9 plates. (Adastral House, Kingsway, London, W.C.2: H.M. Stationery Office, 1935.) 1s. 3d. net.

At a time when the Bergius experiments at Mannheim-Rheinau were languishing, they were revivified by the British Bergius Syndicate, formed largely by the efforts of Dr. Ormandy, which had for its object the proving of the process with British coals. After a time it was decided by the Government that the Department of Scientific and Industrial Research should proceed with the investigations, and towards the end of 1926, a plant embodying the latest improvements resulting from the work at Rheinau was installed at Greenwich, the small-scale experiments in Rheinau being terminated. The British Bergius Syndicate was acquired by I.C.I. in 1927, which started independent research at Billingham on a rapidly growing scale, so that by the end of 1933 the cost had amounted to approximately £1,000,000 : this is the outstanding example of the complexity and the high cost of working out a new chemical process to the point of industrial practicability. Such a cost makes it difficult for any one other than a large and prosperous company, or an association backed by ample Government support, to investigate new processes. The 'City', though apparently prepared to spend large sums to prove and develop a potential gold mine, will not support as a rule the development of elaborate industrial processes, though it is willing to buy them from abroad when developed. As a consequence, England is perforce content to lag behind in such developments, for which the credit is too often given to foreign scientific workers.

The work done on hydrogenation at Greenwich, though it has not yet developed to anything of industrial importance bringing a direct return to the nation, is of outstanding value both as serving to introduce the high-pressure technique into its laboratories and as securing that independent and continued study of hydrogenation which is so desirable.

The experiments recorded in the Fuel Research Board Technical Paper No. 42 referred to above are now largely of academic interest, but they serve to show that catalytic hydrogenation under pressure is widely applicable to British coals. An earlier Technical Paper (No. 29) deals with observations on the conversion of a non-coking into a coking coal when heated with hydrogen under pressure.

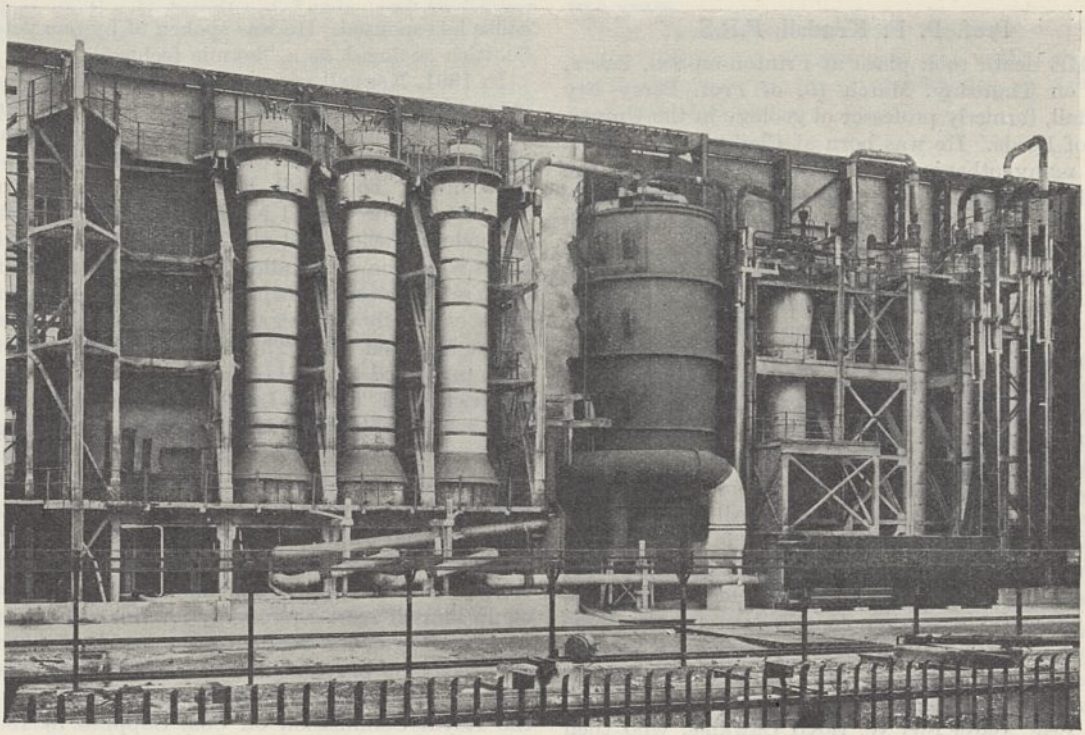

FIG. 2. General arrangement of a hydrogenation stall at Billingham. By courtesy of Imperial Chemical Industries, Ltd.

Such work is preliminary to the day when it will be realised that coal is in fact a chemical raw material and that there are many different kinds of it. Each will have to be treated in the most appropriate manner to give gaseous, liquid and solid products. The burning of raw coal will be regarded as waste, and coke of excellent quality will be available for metallurgical and domestic purposes according to its nature. The total value of these products should be far in excess of the mining cost of the coal plus the factory costs of

its subsequent elaboration, and allow of satisfactory employment to miner and factory worker and profit to mine-owner and chemical factory.

The coal question includes many pressing problems, as has been indicated. With defence in mind, the importance of home-produced oil seems paramount, and the Fuel Research Board should be urged to encourage the active study of other methods of making this, for example, from coke via water gas. Unless and until oil can be found deep down in our strata, we must depend on its production from coal and be satisfied that the amount so obtained bears a far larger proportion of the whole quantity used than is at present a fact.

Obituary

Prof. P. F. Kendall, F.R.S.

THE death took place at Frinton-on-Sea, Essex, on Thursday, March 19, of Prof. Percy Fry Kendall, formerly professor of geology in the University of Leeds. He was born at Clerkenwell in 1856. Like many others whose names are famous in the annals of geological science, Kendall was a product of the old Science and Art Department at South Kensington, and in the year 1874 he was awarded the Silver Medal of the Department, this being, the writer believes, the only occasion when such a distinction was gained by a student in geology.

Kendall entered the Science School, South Kensington in 1883 and here he came under the influence of those two great teachers, Judd in geology and Huxley in biology, with the result that he was most attracted to the biological aspects of geology, and his earliest work was upon the fossil fauna of the Pliocene deposits of East Anglia. It is interesting to record that he again took up research on these same deposits in his last years when resident at Frinton, and published a further contribution on the same subject. After leaving South Kensington he was elected Berkeley fellow of Owens College, Manchester, and was later appointed assistant lecturer in geology with Prof. (later Sir) W. Boyd Dawkins, who then occupied the chair of geology at Owens College.

Kendall had become interested in glacial geology by this time, and at the British Association meeting at Manchester in 1887, he had the good fortune to meet the brilliant American glacialist, Prof. Carvill Lewis, and encouraged by him, Kendall from that time devoted himself wholeheartedly to glacial studies. In the 'eighties, the problems connected with the Great Ice Age were receiving much attention, and he ranged himself with those few British geologists who argued that these islands had been covered by land ice, as Greenland is to-day, as opposed to those in the majority, who invoked submergence in an arctic sea with abundance of icebergs as being the best explanation of the deposits of that period. Many a pitched battle was fought upon this question in Section C of the British Association, the honours eventually all resting with the adherents of the land ice theory, of whom Kendall was one of the very foremost. His ready wit and command of language rendered him a doughty champion of any cause he espoused. He was spoken of by one veteran Scottish geologist as a "bonnie fechter".

In 1891, Kendall was appointed part-time lecturer in geology at the Yorkshire College (now University of Leeds) and he at once commenced the investigation of the glaciation of the Cleveland Hills in north-east Yorkshire. To enable him to do this the more successfully, he visited Norway to study the effects of modern glaciers and also to examine *in situ* those rocks which he was finding as pebbles in the drift of the Yorkshire coast. Switzerland also gave him many ideas, especially with regard to ice-dammed lakes such as the Marjelen See. The results of these researches were presented to the London Geological Society in a paper entitled "Glacier Lakes in the Cleveland Hills". This was published in 1902 and was an inspiration to many workers, who applied similar methods of investigation to other districts in the British Isles.

While prosecuting his glacial researches Kendall had also paid much attention to the solid geology of Yorkshire. It was part of his duties at Leeds to lecture to students of coal mining, and in order to equip himself more thoroughly for this work he took up the study of the Coal Measures, and in this branch of geology he proved himself as original an investigator as he had already done in glacial geology. For the Royal Commission on Coal Supplies in 1901–5 under the chairmanship of Lord Allerton, Prof. Kendall was asked to report upon the Yorkshire, Nottinghamshire and Derbyshire Coalfield, and in the attempt to determine the boundaries of the concealed coalfield on the north-east and south, where the Coal Measures are overlain uncomformably by newer rocks, he applied the principle of 'posthumous folding', the argument being that the foldings traceable in the newer covering rocks represent renewed activity along lines of folding already established in the older rocks below before the newer rocks had been laid down. The total area of the unproved coalfield was by this means estimated by Prof. Kendall to be 3,885 square miles, and whether or not this be established by future exploration, it is still true to say that the report forms a most stimulating and illuminating contribution to the tectonics of this great coalfield.

Another phase of Coal Measure geology engaged Kendall's attention for some years, namely, the abnormalities of coal seams and the adjacent beds

of sandstone and shale. The similarity of the phenomena presented in the strata of the Coal Measures with those recorded where alluvial beds had been traversed by recent earthquakes as in India and America led Kendall to see in the disturbances in the Coal Measures a number of 'fossil earthquakes', an idea which is engaging the attention of investigators in many other sedimentary deposits.

Prof. Kendall became a fellow of the Geological Society of London in 1889. The Society awarded him the Lyell Fund in 1895, and in 1909 further recognised his distinguished contributions to geological science by awarding him the Lyell Medal. He also served on the Council of that Society for some years. In 1922 he retired from the chair of geology at the University of Leeds, and two years later was elected a fellow of the Royal Society. The University of Leeds in 1926 conferred upon him the degree of doctor of science, *honoris causa*. In collaboration with Mr. H. E. Wroot he wrote the "Geology of Yorkshire", which was published in 1924 and is generally admitted to be one of the most 'readable' books on geology extant. A. G.

WE regret to announce the following deaths:

Lord Invernairn, who as Sir William Beardmore was president in 1917 of the Iron and Steel Institute, on April 10, aged seventy-nine years.

Prof. J. P. Khomenko, an authority on the Cenozoic palæontology and stratigraphy of the U.S.S.R., on August 7.

Prof. J. M. Page, formerly professor of mathematics, and dean of the University of Virginia, an authority on the calculus, on March 12, aged seventy-two years.

Prof. James Rice, associate professor of physics in the University of Liverpool and author of noteworthy books on the theory of relativity, on April 17, aged sixty-two years.

News and Views

Experiments on Mammalian Embryos

THE technical difficulties of experiments on embryos removed from the uterus are only very slowly being overcome. Nearly a quarter of a century ago, Brachet showed that the rabbit egg could be kept alive and developing for a short time in tissue culture, and slightly, but only slightly, better results have been obtained by later workers. Another method is to transplant the egg obtained from one animal into a new mother. The experiment was first successfully performed by Heape in 1890; he transferred the segmenting eggs of an Angora rabbit into the uterus of a Belgian hare, and got a normal development of Angora young. The transplantations can only be carried out with very young eggs, but there are many problems relating to the early stages of development which might be investigated in this way, and in recent years the method has been taken up again and several interesting results have been obtained. Thus Nicholas and Hall have been able to follow the development of isolated rat blastomeres into complete embryos, although they could not maintain the development for the full period of pregnancy.

PINCUS has combined the experiments of tissue culture and transplantation, and has recently, as reported in *The Times* of March 30, been able to verify the occurrence of parthenogenesis in the rabbit. His first experiments on the tissue culture of the rabbit egg, made at the Strangeways Research Laboratory some six years ago, showed that the unfertilised egg is very sensitive to external conditions, and may start to cleave under the influence of slight changes of temperature or the osmotic pressure of the medium. The attempts which were then made to transplant the parthenogenised eggs to other mothers were unsuccessful; but in his recent work the transplanted eggs have undergone normal development and eventual birth. Transplantations of older embryos into the uterus are not successful, and attempts have been made to find other transplantation sites (kidney, mammary gland, omentum, chamber of the eyeball, chick chorio-allantois), but the results have not been very encouraging. The tissue culture method, imperfect as it is, is still the only one which has made possible experiments on the crucial period of gastrulation, when, by analogy with other vertebrates, one may expect the major processes of determination to occur.

Sir George Grierson and Indian Linguistics

THE commemorative volume "Indian and Iranian Studies" presented to Sir George A. Grierson by friends and admirers on the occasion of his eighty-fifth birthday on January 7, and published as a special issue by the School of Oriental Studies of the University of London (*Bull.*, 8, 2–3, 504. 25*s*.), is a remarkable tribute to even so great a scholar. This will be most readily appreciated in the extent to which it shows how those who have here united to do him honour—fifty-three scholars drawn from thirteen different countries, including India and the United States—have been indebted to him in outlook or method or as a contributory source of their material. In this volume of "Studies" not unnaturally, and as is usual in collections of its class, a considerable proportion is of highly specialised interest, though even here certain of them as, for example, the communications dealing with the Karosthi material retrieved from the Central Asiatic Desert by Sir Aurel Stein or Colonel D. L. R. Lorimer's "Nugae

Burushaskicae", glance at broader issues. Others, however, such as the contributions by Dr. T. Grahame Bailey or Prof. A. Barannikov, to name two only, which deal with the relation of the Sanskritic to other elements in the vernaculars, or Dr. F. Otto Shrader on the Uralian element in the Drāvidā and the Munda tongues, have a direct interest for those who are dealing with current problems in Indian ethnology; while the value of linguistic studies in cultural investigation is shown by such inquiries as those of Prof. J. Block on the character of the Vedic plough and the late Dr. J. Charpentier on the meaning of 'Śakudhūma' and the suggestion arising therefrom as to ritual recognition of the Pleiades in Vedic times. It is remarkable, however, how on every side there is evidence that in these investigations the work of Sir George Grierson and his linguistic survey of India have been fundamental.

Chemical Society: Annual General Meeting

The ninety-fifth annual general meeting of the Chemical Society was held under the presidency of Prof. N. V. Sidgwick in the University of Bristol on Thursday, April 16. Fellows and their guests were received by Dr. Stanley H. Badock, treasurer and pro-chancellor of the University. At the annual general meeting, it was reported that the following had been elected on the Council: As vice-presidents who have filled the office of president: Prof. H. E. Armstrong and Sir William Pope. As vice-presidents who have not filled the office of president: Mr. J. Davidson Pratt, Sir Robert Robertson and Prof. R. Robinson. As honorary secretary: Prof. J. W. Cook. As ordinary members of council: Town Members: Prof. C. K. Ingold, Dr. R. P. Linstead and Dr. R. E. Slade. Country Members: Prof. G. R. Clemo, Mr. T. W. J. Taylor and Prof. R. V. Wheeler. The presidential address delivered by Prof. Sidgwick was on "Structural Chemistry: Old and New".

The Longstaff Medal for 1936 of the Chemical Society was presented to Prof. George Barger, and in making the presentation the president stated that it was the highest distinction which the Society could bestow on one of its fellows. He referred to the importance of Prof. Barger's researches on natural products of physiological interest, mentioning his researches on ergot and its constituents, and to Prof. Barger's work in increasing our knowledge of a large number of alkaloids, many of which he had synthesised. In presenting the Harrison Memorial Prize for 1935 to Dr. Leslie E. Sutton, the president remarked that the prize, which was founded in memory of an eminent fellow of the Society who gave his life to the service of his country in the Great War, is awarded every three years to the chemist less than thirty years of age who has made the most meritorious original contributions to chemical science. The president referred to Dr. Sutton's work in increasing our knowledge of molecular structure, which has helped to elucidate the formulæ of divalent carbon compounds, the oximes and the azides; he also referred to his work on the relation between dipole moment and substitution in benzene derivatives, and on electron diffraction. The anniversary dinner of the Society was held in the Great Hall of the University of Bristol on the evening of April 16. Prof. N. V. Sidgwick presided; and the number present was 158. The Hantzsch Memorial Lecture was delivered by Prof. T. S. Moore in the H. H. Wills Physics Lecture Theatre of the University of Bristol on Friday, April 17.

British Society for International Bibliography

The eighth ordinary meeting of the British Society for International Bibliography was held in the Science Museum, South Kensington, on March 25. After the president, Prof. A. F. C. Pollard, had opened the meeting, Dr. Van Heurn, director of the Intelligence Bureau of the Amsterdam Laboratories of the Royal Dutch Petroleum Co., gave a description of the work and organisation of this Bureau. The secretary of the Society, Mr. E. Lancaster-Jones, followed with an account of the progress of the English edition of the Universal Decimal Classification. He reported that the first fascicule of the work is now available, while the second will be ready very shortly. Messrs. Simpkin Marshall, Ltd., are the British agents. The main item on the agenda—a discussion on the preparation of indexes to periodical bibliographies and allied publications—then followed. This was opened by Dr. P. S. Hudson, deputy director of the Imperial Bureau of Plant Genetics at Cambridge, who described the preparation of the yearly cumulative indexes to *Plant Breeding Abstracts*, the quarterly publication of his Bureau. The abstracts are classified by the Universal Decimal Classification; hence the preparation of the index, in which the entries are arranged in numerical order of their classification numbers, is extremely simple.

Dr. A. S. Neave, assistant director of the Imperial Institute of Entomology, then spoke on the alphabetical index to the *Review of Applied Entomology*, pointing out the advantages of this type of index over a numerical one, in the particular case of this subject, with its extremely detailed nomenclature and its somewhat volatile systematisation. The discussion following centred around the relative advantages of a classification as the basis of an index. Dr. S. C. Bradford contended that most alphabetical indexes are based on concealed classifications. Mr. W. T. Astbury instanced the difficulty of obtaining uniformity in alphabetical indexing among a number of contributors. It was pointed out that a classified index in no wise precludes the employment of explanatory terms, or standard nomenclature. The classification itself possesses an alphabetical index, which serves automatically to correlate all synonyms to a unique class symbol, and thereby saves unnecessary repetition.

The Reclamation of the Zuider Zee

The epoch-making enterprise on which the Dutch nation embarked in 1920, and which is ultimately destined to add to the Netherlands more than half a

million acres, or about 7 per cent of the former area of the country, is now about to be advanced a further stage towards completion. It is announced from The Hague that a sum of two million florins (about £154,000) has just been voted in the national budget for continuing the work of reclaiming the Zuider Zee, and it is likely that additional grants will follow shortly. The scheme was described in detail in an article which appeared in the issue of NATURE of September 21, 1929 (p. 446), at which date the first section, the North-west Polder of 50,000 acres, was at the point of complete enclosure. This polder was pumped clear of water in the following year, and it has since been brought into cultivation with satisfactory results. It is now intended to proceed with the reclamation of the second section, the North-east Polder, containing 117,000 acres. The cost is estimated at about £9,600,000 and the work will take about five years, providing work for about 5,500 men. Another ten years will be required to bring the salt-saturated soil into a completely effective state of productivity. The outer dyke, or embankment, enclosing the polder, starts from Lemmer in Friesland and follows a widely sweeping curve, first westerly, then southerly and finally easterly to a point on the coast-line north of Kampen. It will be 35 miles long, and for a great part of that distance will run parallel to a new canal. The reclaimed area will lie at two different levels, one about 13 feet and the other about 18 feet below water-level at Amsterdam, and three large pumping stations are to be provided to deal with the fresh-water drainage after completion.

Oldbury Hill, Ightham

AN attempt to save Oldbury Hill, Ightham, from development for building purposes, is one which has a strong claim on the practical support of all archæologists. This Kentish woodland plateau, lying between Sevenoaks and Ightham, is for British archæology historic ground. At its summit is a prehistoric fortress, which is dated at about 200 B.C.; but its chief interest lies in its evidence of prehistoric man of a far earlier period. It is a part of the country over which Benjamin Harrison of Ightham, the apostle of the eolith, had his hunting ground; and through him it is linked with the great names in the study of British archæology—Sir Joseph Prestwich, Sir John Evans, Lord Avebury, and many others. The fortress itself is scheduled for protection under the Office of Works, and in the event of building development, provision for access will have to be made in the inevitable encroachment; but the character of the site with its associations and its wide views over pastoral lands, which preserve the meaning and purpose of its fortification, will be irretrievably lost. The extent of the estate now offered for sale is about 157 acres, and the owner, who is not in a position to present the site to the public, has fixed at the lowest possible figure the price at which he would be prepared to effect a transfer to the National Trust. This body, however, has no funds with which to purchase; but an effort is being made, up to the present with indifferent success, to organise a local fund. The importance to science of the high terrace gravels in which the evidence has been found for what is claimed to be the earliest traces of man's handiwork is obvious; the fact that that evidence has not been accepted universally makes it all the more important that such a site as Oldbury Hill should be preserved for the inspection and investigation of later generations.

History of the English Parliament

IT is announced that H.M. Stationery Office will publish at an early date a volume, the first to be issued, of the "History of Parliament", which has been in course of preparation for some time under the supervision of a committee presided over by the Marquess of Salisbury. This undertaking, which will cover the whole period of parliamentary government from its inception in 1264 up to 1918, is an outcome of the report of a committee which was appointed in 1929 with Colonel J. Wedgwood as its chairman, to examine the material available for a record of the personnel and politics of the members of the House of Commons. A joint meeting of both Houses decided that the scope of the work should be extended so as to make it as complete a record as possible of "the people in Parliament—their ideas, standing, and politics—and to trace the gradual growth of Parliamentary representation and government". The work will fall into seventeen or eighteen periods, the material for each being grouped into two or three volumes. This material will comprise biographies of members of the Commons, complete lists of the members of both Houses with identifications, a preface to each Parliament with a commentary on its composition and the work done, and conclusions, appendixes, documents, etc. It is expected that the "History" will consist of some forty volumes, and that it will be completed in about thirty years; but as the price—possibly not more than £2 2*s*. per volume—will cover cost of printing and publication only, the rate of production will depend upon the funds available for the collection and preparation of the material. For the first volume to be issued, covering the period 1439–1509, Colonel Wedgwood, it is understood, has been largely responsible. Subscribers to the whole work will be charged three-quarters of the published price, a first payment of £10 being required with the undertaking to subscribe, against which the cost will be charged as each volume is issued.

Higher Paraffins as Liquid Fuel

HIGHER paraffins such as butane are easily liquefied at air temperature, and give a concentrated and easily vaporised liquid fuel—the most concentrated fuel commercially available having a heating value of 21,000 B.T.U. per lb. In several countries this product has been recovered from natural sources or oil refineries, and distributed in cylinders. In the United States this 'bottled gas' has become extensively used in rural areas, and the development of coal hydrogenation in England has led to its being marketed now under the name of 'Calorgas'.

H. Pickering recently described its properties before the Institute of Fuel, and there is little doubt that the gas, which is practically free from sulphur, will find many applications where a public gas supply is not available. The scope will be more limited under British conditions owing to the wide dispersion of gas mains and the low price of public supplies per therm. On the figures given, the price of the unit of heat in Calorgas is 29*d*. per therm. In the compressed gas trade, the cost of cylinders and distribution usually form the main item, and so it seems that the use of 'bottled gas' will depend on the extent to which those charges can be lowered by developing the market.

Electrical Measurements in the Eighteenth Century

In the *Annals of Science*, 1, No. 1, January 1936, Mr. W. Cameron Walker, of Minchenden School, London, gives an interesting historical account of the detection and estimation of electric charges in the eighteenth century. Perhaps in no other branch of science could he have found a better illustration that progress in science is conditioned by the invention and improvement of instruments. Up to the time of Volta, Bennet's familiar gold leaf electroscope was the most sensitive detector of electricity. Its invention marks the end of a period of evolution beginning with the time when the experimenter obtained electrical charges by simply rubbing pieces of amber, glass or sulphur on his coat. Boyle and Newton had in turn extended the observations of Gilbert concerning the attractive powers of electrified bodies, while von Guericke came very near to anticipating Du Fay in the recognition of two opposite states of electricity. But to Hauksbee, with whom the story of the eighteenth century begins, belongs the credit of the first systematic investigation of 'electric effluvia'. He was surprised to notice that threads enclosed in an 'uncharged' globe of glass were immediately affected by the approach of a rubbed rod of sealing wax. But he makes no reference to the repulsion of the threads. For this new step we have to wait until twenty years later. In 1767, when describing a Leyden jar, Priestley writes that what electricians chiefly want to know is 'how high a phial is charged'. Methods of measuring this were soon described by Lane and Henly. Then we come to the wonderfully accurate experiments of Cavendish and the evolution of the condensing electrometer by Volta—the most skilful worker in this field. We think Mr. Walker has done well to direct attention to the valuable work done by eighteenth century electricians.

Preservation of Cornish Engines

It is with pleasure we learn that the Cornish Engines Preservation Committee has been successful in acquiring the early winding engine at Levant Mine in Cornwall, and in leasing for a small acknowledgment rent the engine house. Levant and the adjoining Botallack mine were famous for their richness in copper and tin, and for their deep workings, which extended far out under the Atlantic Ocean. The engine at Levant was designed by Francis Michell, and was probably built at the Copperhouse Foundry, Hayle, about one hundred and ten years ago. It is of the beam type with parallel motion, and has a cylinder 24 in. in diameter with a stroke of 4 ft. The total sum raised for its preservation was £130, the greater part of which, says Mr. W. T. Hooper, the honorary secretary of the fund, came from beyond the Tamar. Donations were received from the Institutions of Civil and Mechanical Engineers and the Newcomen Society, and from individuals in India, China, Australia and America. The Committee has in view the preservation of some of the larger pumping engines, and arrangements are now being made to complete the model of the 90 in. pumping engine at East Pool Mine, which was begun by the late Mr. Oswald Swete of Truro.

National Academy of the Lincei

At a meeting of the National Academy of Lincei held in Rome on June 2, 1935, in the presence of H.M. the King of Italy, an account of which has just been issued by the Academy, it was announced that the new statutory regulations of the Academy, which have received the royal sanction and the approval of the head of the Government, are now being put into operation. The most notable of these regulations, because it symbolises the strict adherence of the Academy to the Fascist regime, is that the nomination of the president and vice-president (still to be announced) and of the national members is made by royal decree proposed by the Duce. The following members have been nominated under the new statutes: L. Berzolari, U. Amaldi, A. Crocco, E. Soler, A. Alessio, E. Fermi, G. Vallauri, F. Giordani, R. Fabiani, G. Quagliariello, P. Rondoni, C. Formichi, G. Bertoni, C. M. de Vecchi, L. Federzoni, G. Volpe, P. S. Leicht, A. Torre, A. Carlini, P. Carabellese, G. Della Valle, A. Solmi, S. Riccobono, S. Romano and A. de Stefani. Among the chief awards announced are the following: Prizes presented by H.M. the King: the late Prof. G. Viale, University of Genoa, for his work on physiology and pathology, and A. Maiuri, for his contributions to archæology; Cannizzaro Prize in chemistry, Prof. P. Karrer, University of Zurich, for his work in biochemistry; Santoro Prize: G. Fauser, for his scientific services to the nitrogen fixation industries. In his address to the Academy on "The Tradition of Rome in the Middle Ages", Pietro Fedele concluded by emphasising the glorious role of Fascist Rome as the true successor of the Rome of the Cæsars and of the Popes.

The Meaning of 'Survival'

In the fourth Frederic W. H. Myers Memorial Lecture, which was given by Mr. Whately Carington on October 30, 1935, and is now published by the Society for Psychical Research, the speaker stressed the importance of language in any serious consideration of the problem of 'personal survival' after bodily death. He pointed out that one of the great difficulties of the subject lies in the incorrect use of terms, which, although they might mean something in connexion

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Angerer, Ernst von. Technische Kunstgriffe bei physikalischen Untersuchungen. (Sammlung Vieweg : Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Heft 71.) Dritte Auflage. Demy 8vo. Pp. ix +201. (Braunschweig : Friedr. Vieweg und Sohn, 1936.) 9.80 gold marks.*

Blaschke, Wilhelm. Exposés de géométrie. 1 : Integral-géométrie. (Actualités scientifiques et industrielles, 253.) Roy. 8vo. Pp. 24. (Paris : Hermann et Cie, 1935.) 7 francs.*

Blaschke, Wilhelm. Vorlesungen über Integralgeometrie. Heft 1. (Hamburger mathem. Einzelschriften, Heft 20.) Roy. 8vo. Pp. 47. (Leipzig und Berlin : B. G. Teubner, 1935.) 4 gold marks.

Cartan, E., Bouligand, G., Giraud, G., et **Delens, P.** Exposés de géométrie. 6 : Le problème de la dérivée oblique en théorie du potentiel. (Actualités scientifiques et industrielles, 219.) Roy. 8vo. Pp. 78. (Paris : Hermann et Cie, 1935.) 18 francs.*

Colerus, E. Vom Punkt zur vierten Dimension : Geometrie für Jedermann. Pott 8vo. Pp. 445. (Berlin : Zsolnay-Verlag, 1935.) 3 gold marks.

Crowther, J. A. A Manual of Physics. (Oxford Medical Publications.) Fourth edition. Cr. 8vo. Pp. xxii +585. (London : Oxford University Press, 1936.) 14*s.* net.

Curie, Mme. Pierre. Radioactivité. Roy. 8vo. Pp. 563. (Paris : Hermann et Cie, 1935.) 150 francs.

Deming, Frank R., and **Nerden, Joseph T.** Science in the World of Work. Demy 8vo. Vol. 1 : Applied Mechanics. Pp. x +206. 7*s.* 6*d.* Vol. 2 : Applied Physical Science. Pp. x +282. 8*s.* 6*d.* (New York and London : McGraw-Hill Book Co., Inc., 1936.)

Department of Scientific and Industrial Research : Illumination Research. Technical Paper No. 18 : The Transmission of Light through Window Glasses. Roy. 8vo. Pp. iv +18 +8 plates. (London : H.M. Stationery Office, 1936.) 9*d.* net.*

Doherty, Robert E., and **Keller, Ernest G.** Mathematics of Modern Engineering. Vol. 1. Med. 8vo. Pp. xxi + 314. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1936.) 17*s.* 6*d.* net.*

Dubrisay, René. Phénomènes colloïdaux. (Collection Armand Colin : Section de physique, No. 185.) Fcap. 8vo. Pp. 186. (Paris : Armand Colin, 1936.) 10.50 francs.*

Ewing, the late **Sir J. A.** Thermodynamics for Engineers. Second edition. Demy 8vo. Pp. xv +389. (Cambridge : At the University Press, 1936.) 21*s.* net.*

Fritsch, V., und **Jelinek, F.** Beiträge zur Physik der Wünschelrutenfrage. Roy. 8vo. Pp. 189. (Diessen : Huber Verlag, 1936.) 4 gold marks.

Heitler, W. The Quantum Theory of Radiation. (International Series of Monographs on Physics.) Roy. 8vo. Pp. xi +252. (Oxford : Clarendon Press ; London : Oxford University Press, 1936.) 17*s.* 6*d.* net.*

Mitton, R. G. Mechanics and Hydrostatics. (Dent's Modern Science Series.) Cr. 8vo. Pp. ix +275. (London : J. M. Dent and Sons, Ltd., 1936.) 3*s.**

Persico, Enrico. Trattato generale di fisica a cura del Consiglio Nazionale delle Ricerche : Fondamenti della meccanica atomica. Roy. 8vo. Pp. iii +510. (Bologna : Nicola Zanichelli, 1936.) 80 lire.*

Ribaud, G. Mesure des températures. (Collection Armand Colin : Section de physique, No. 190.) Fcap. 8vo. Pp. 224. (Paris : Armand Colin, 1936.) 10.50 francs.*

Schneider, Erich. Physikalisches Denken—Technisches Schaffen. 8vo. Pp. 303. (Leipzig : Dörner Verlag, 1935.) 6.80 gold marks.

Science Museum. Very Low Temperatures : their Attainment and Uses : a Survey of the Physical Principles underlying the Attainment of Extremely Low Temperatures and of their Technical and Scientific Applications, as illustrated in a Special Exhibition held in the Science Museum, March–May 1936. Roy. 8vo. Pp. 32. (London : H.M. Stationery Office, 1936.) 6*d.* net.*

Siddons, A. W., Snell, K. S., and **Dockeray, N. R. C.** Elementary Mechanics. Cr. 8vo. Pp. xii +312 +23. (London : Edward Arnold and Co., 1936.) 6*s.**

Thompson, Alexander John. Logarithmetica Britannica : being a Standard Table of Logarithms to Twenty Decimal Places. (Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the *Arithmetica Logarithmica, 1624.*) Part 7 : Numbers 70,000 to 80,000. (Tracts for Computers, No. 20.) Demy 4to. Pp. vi +102. (London : Cambridge University Press, 1935.) 15*s.* net.*

Weichart, Fr. Die physikalischen Grundlagen der Rundfunktechnik. Vierte verbesserte Auflage. 4 Teilen. Pott 8vo. Teil 3. Pp. 180. (Berlin : Weidmann Verlag, 1936.). 2.70 gold marks.

Williams, Kenneth P. The Mathematical Theory of Finance. Demy 8vo. Pp. xii +280. (New York : The Macmillan Co., 1935.) 12*s.* net.

Witting, A. Repetitorium und Aufgabensammlung zur Differentialrechnung. (Sammlung Göschen, Band 146.) Pott 8vo. Pp. 138. (Berlin und Leipzig : Walter de Gruyter und Co., 1935.) 1.62 gold marks.

Young, Vincent W., and **Young, Gilbert A.** Elementary Engineering Thermodynamics. Med. 8vo. Pp. xii +220. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 15*s.*

Engineering

Bauer, Edward E. Plain Concrete. Second edition. Med. 8vo. Pp. xiii +364. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 24*s.*

Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water. Fifteenth Report of the Committee of the Institution of Civil Engineers : being a General Description of the Experimental Work carried out by the Committee to Date. Edited by S. M. Dixon and H. J. Grose. Roy. 8vo. Pp. xvi +138 +80 plates. (London : H.M. Stationery Office, 1935.) 12*s.* 6*d.* net.*

Ehrismann, A. Transportable Rundfunk-Empfänger für Reise und Heim. (Deutsche Radio-Bücherei, Band 70.) 8vo. Pp. 19. (Berlin : J. Schneider, 1936.) 1.50 gold marks.

Goupillière, Haton de la. Cours d'exploitation des mines. Quatrième édition revue et considérablement augmentée par J. de Berc. Roy. 8vo. Tome 3. Pp. 778. Tome 4. Pp. 763. (Paris : Libr. Dunod, 1936.)

Griveaud, L. Traité pratique de construction et aménagement des usines. Tome 1 : Projet et exécution des travaux, dispositions générales, installations accessoires et bâtiments annexes, moyens de manutention. 8vo. Pp. 418. (Paris : Ch. Béranger, 1936.) 95 francs.

Günther, H. Fernsehen in praktischen Versuchen. Sup. Roy. 8vo. Lieferung 1. Pp. 32. (Stuttgart : Franckh'sche Verlagsbuchhandlung, 1935.) 1.20 gold marks.

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Steeksma, John. Philosophical Inquiry. (London: The C. W. Daniel Co., 1936.) 5*s.*

Sternberg, K. Das Problem des Ursprungs in der Philosophie des Altertums. Roy. 8vo. Pp. 481. (Breslau: Marcus Verlag, 1935.) 28 gold marks.

Walters, J. E. Individualizing Education by means of Applied Personnel Procedures. Med. 8vo. Pp. xvi +278. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 12*s.* 6*d.* net.*

Weisenburg, Theodore; Roe, Anne, and **McBride, Katharine E.** Adult Intelligence: a Psychological Study of Test Performances. Roy. 8vo. Pp. xiii +155. (New York: The Commonwealth Fund; London: Oxford University Press, 1936.) 6*s.* net.*

White, Wendell. The Psychology of Dealing with People: Appealing to the Want for a Feeling of Personal Worth. Ex. Cr. 8vo. Pp. xiv +256. (New York: The Macmillan Co., 1936.) 10*s.* 6*d.* net.

Young, Paul Thomas. Motivation of Behavior: the Fundamental Determinants of Human and Animal Activity. Med. 8vo. Pp. xviii +562. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20*s.* net.*

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Fiebiger, J. Die tierischen Parasiten der Haus- und Nutztiere, sowie des Menschen: ein Lehr- und Handbuch mit Bestimmungstabellen für Tierärzte, Ärzte und Studierende. Dritte umgearbeitete Auflage. Roy. 8vo. Pp. 374. (Wien und Berlin: Urban und Schwarzenberg, 1936.) 17.50 gold marks.

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Barnard, Cyril C. A Classification for Medical Libraries: with Introduction, Local List, Index of Parasites and General Index. (Being a Thesis approved for the Diploma with Honours of the Library Association, 1931.) Roy. 8vo. Pp. 142. (London: Percy Lund, Humphries and Co., Ltd., 1936.) 10*s.* 6*d.* net.*

Bridges, T. C. The Book of Invention. (Harrap's Modern Readers.) Imp. 16mo. Pp. 255 +16 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1936.) 2*s.* 6*d.*

Crowther, J. G. Soviet Science. Demy 8vo. Pp. x + 342 +16 plates. (London: Kegan Paul and Co., Ltd., 1936.) 12*s.* 6*d.* net.*

Fielding, William Richard. An Introduction to General Science. Cr. 8vo. Pp. 262. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1936.) 3*s.*

Fox, R. Fortescue, Edited by. Official Handbook of the British Health Resorts Association: British Health Resorts; Spa, Seaside, Inland, including those of Australia, Canada, New Zealand, South Africa and the British West Indies. Roy. 8vo. Pp. 288. (London: J. and A. Churchill, Ltd., 1936.) 1*s.* net.*

Friend, Julius W., and **Feibleman, James.** The Unlimited Community: a Study of the Possibility of Social Science. Demy 8vo. Pp. 383. (London: George Allen and Unwin, Ltd., 1936.) 15*s.* net.*

Guthrie, James B. Elementary Science. Ex. Cr. 8vo. Part 4: Astronomy, Geology, Biology. Pp. viii + 110. (London and Edinburgh: W. and R. Chambers, Ltd., 1935.) 2*s.* 6*d.*

Institut International de Documentation. Universal Decimal Classification. Vol. 1. English edition of the "Classification decimale universelle" of the Institut International de Documentation. Cr. 4to. Pp. 40. (London: Simpkin Marshall, Ltd., 1936.) 3*s.* 6*d.* net.

Lane, S. F. B., Poem by. The Tree. (The Saint George Series.) Cr. 8vo. Pp. 16. (London: Alexander Moring, Ltd., 1935.) 1*s.*

Lowell, A. Lawrence. Biography of Percival Lowell. Demy 8vo. Pp. x +212 +5 plates. (New York: The Macmillan Co., 1935.) 12*s.* 6*d.* net.*

Martin, Ida D. "Ethiopia Calling." Cr. 8vo. Pp. 8. (London: Thynne and Co., Ltd., 1936.) 3*d.*

Price, Harry. Confessions of a Ghost-Hunter. Demy 8vo. Pp. 396 +16 plates. (London: Putnam and Co., Ltd., 1936.) 10*s.* 6*d.* net.*

Price, Harry, and **Lambert, R. S.** The Haunting of Cashen's Gap: a Modern 'Miracle' Investigated. Cr. 8vo. Pp. x +211 +8 plates. (London: Methuen and Co., Ltd., 1936.) 6*s.* net.*

Ruddiman, Edsel A., and **Nichols, Adley B.** Incompatibilities in Prescriptions: for Students in Pharmacy and Medicine, Practicing Pharmacists and Physicians. Sixth edition, rewritten and reset. Demy 8vo. Pp. viii + 337. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 13*s.* 6*d.* net.*

Smiles, Samuel. Life of a Scottish Naturalist, Thomas Edward. (Open-Air Library.) Gl. 8vo. Pp. xx +202. (London and Toronto: J. M. Dent and Sons, Ltd., 1936.) 3*s.* 6*d.* net.*

Spratt, H. Philip. Libraries for Scientific Research in Europe and America. Demy 8vo. Pp. 227. (London: Grafton and Co., 1936.) 10*s.* 6*d.* net.*

Wardale, W. L. Albrecht van Borgunnien's Treatise on Medicine (Sloane MS. 3002, British Museum). (St. Andrews University Publication, No. 38.) Roy. 8vo. Pp. xlvii +80. (London: Oxford University Press, 1936.) 10*s.* 6*d.* net.*

with matters for which they are intended, yet might be quite meaningless when applied outside their legitimate limits. Thus it is possible, and indeed probable, that many of the questions propounded might be really quite meaningless; and therefore it is unlikely that any sensible answers can be found for them. It was here that Mr. Carington urged the more extensive use of a mathematical type of language in which the symbols employed do not suggest any relationships other than those deliberately assigned to them. In conclusion, Mr. Carington briefly referred to his recent studies of trance personalities, where, through statistical methods, a clearer understanding is being achieved and light is being thrown on the problem as to how these secondary or multiple personalities differ or not from other communicating personalities, which operate through the so-called mediumistic trance.

Air Mask to Protect Workers

AN air mask which will provide the rock driller, painter or chemical worker with fresh air and protect him from poisonous gases, smoke and dust is described in a recent report by Science Service, of Washington, D.C. The mask is literally a film or curtain of air completely covering the user's face but leaving the eyes, nose and mouth free. When it is intended for use as the conventional gas mask, the new mask is a shield similar to an eye shade and worn on the forehead. The visor of the shield contains an air chamber, provided with numerous outwardly slanting openings at its lower edge. When air under pressure is forced into the chamber, streams of air issue outwardly and downwards from the openings, and form a transparent air screen or curtain completely covering the face but at some distance from it. With this air film for protection, the user could pass through dust, smoke, gas or paint fumes without any of them coming in contact with his face. The inventor also claims that there would be no trouble in breathing, the air curtain furnishing a continual supply of fresh air.

The *New Guinea Agricultural Gazette*

THE editors of the *New Guinea Agricultural Gazette* are to be congratulated on the first number (1, No. 1, October 1935. Pp. 50. Rabaul: Department of Agriculture) containing articles on the cultivation or marketing of five crops of economic importance to New Guinea, besides others on entomology and meteorology. The appearance of the journal is another indication of the indispensability of at least a little science to every planter or agriculturist. Many of the most isolated countries in the world now issue semi-scientific agricultural periodicals which, since they can scarcely be financially profitable, must be produced in response to a demand for knowledge. The *Agricultural Gazette* shows that the New Guinea planters and Agricultural Department are fully alive to the fact that science is as necessary to the prosperity of a small colony as of a highly developed country.

Fruit Tree Pests

THE classification of insects by the damage they cause is not, perhaps, scientific, but is of great practical use to the gardener. Mr. G. Fox Wilson outlines such a classification of fruit tree pests (*J. Roy. Hort. Soc.*, December 1935). Feeding habits of different types of fruit tree pests are discussed, and the structure of the mouth parts is considered in relation to their effects on the plant. The work of Nierenstein on gall formation is passed under review, and the effects of 'honeydew' are discussed. Very little new knowledge is contained in the paper; its main value lies in the convenience of its outlook from a horticultural point of view.

News Value of Science

IN an address to the Georgia Press Institute and the Henry W. Grady School of Journalism, University of Georgia, on February 19, Mr. Watson Davis, director of Science Service, discussing the news value of science, suggested that though we have largely left the stage in which the man of science was regarded as a mysterious being or magician, possessed of powers for good or ill, and regarded him as a person who could provide us with many of the wonders of our daily life, we have yet to reach the stage in which science is regarded as a guide for personal conduct and political affairs. That will come as fast as education in the scientific habit of thinking, particularly through the Press, allows it to come. Great improvements have been witnessed in the fifteen years since Science Service was first formed for the reporting and interpretation of science, and the co-operation established in this way between journalists and men of science in the United States has already had very valuable results. Science is receiving much more serious attention from the daily Press, and already a number of science editors are on the staffs of American newspapers. The combination of journalistic ability and scientific attainment which is essential in a good interpreter is, however, not easy to find, and Mr. Davis also emphasised the danger which the very popularisation of science may offer to the maintenance of scientific standards. Inaccuracy must not be the price of more effective distribution of scientific knowledge to the public.

Freezing of Niagara Falls

FROM the office of the High Commissioner for Canada a special bulletin has been received dealing with the freezing of Niagara Falls. This was prepared by Mr. G. H. Wood, assistant engineer, Dominion Water Power and Hydrometric Bureau, Department of the Interior, Ottawa, and states that the American falls became completely frozen over on January 25 this year and remained so at least up to the date of the bulletin (February 20), a length of time never previously recorded. Freezing was rare in the early days before the diversion of much of the water for power purposes and the present low cycle of discharge from Lake Erie, and did not occur once between the earliest recorded occasion in 1848 and the next occasion on February 14, 1909. It appears that there

is no record of the Canadian falls (Horseshoe falls) having ever been frozen over; but the channel leading to the American falls is shallow and carries only five per cent of the flow over the cascades, and, becoming obstructed by ice at times, may then be frozen over. Such an event is always due to ice jams at the head of Goat Island, which occur when thick ice on Lake Erie is broken up by strong south-westerly gales, and large quantities of floe ice are driven into the Niagara River and carried down-stream. The level of Lake Erie is stated to be close to its minimum recorded level, and the discharge of the river very low in consequence. The comparative frequency with which the falls have been frozen over (for a short time) since 1922 is clearly, therefore, no evidence for an increase in the average severity of American winters; in fact, temperature records show just the reverse in spite of the occurrence of a few isolated spells of unusual cold within the last few years.

Determination of Hydrogen Ion Concentration of Soils

THE British Drug Houses have recently brought out a new type of soil-testing outfit for determination of *p*H values, in which barium sulphate is used as a clarifying agent. This enables the determination to be made with a greater degree of precision than has hitherto been possible, particularly in the case of clay soils. The outfit has been designed in response to a persistent demand for means of estimating *p*H values conveniently and accurately in the field, and is fitted up in a compact oak cabinet of readily portable form. The cost of the complete outfit is £1 1*s*., and prices are also quoted in the descriptive pamphlet (issued by British Drug Houses) for the individual items, should need arise for their replacement.

Directory and Buyers' Guide, 1936-37

THE *Engineer* is the oldest and one of the most influential journals in Great Britain dealing with the progress of engineering. In the interests of the firms advertising in the paper, the proprietors publish every two years a useful directory of about 250 pages. The first 38 pages give an index and vocabulary in French, German, Italian and Spanish of the technical words used in the book. The next 156 pages give an alphabetical list of the manufacturers together with their telephone numbers and telegraphic addresses. The next section gives their telegraphic addresses and the codes they use. Finally a carefully selected list is given of the numbers and titles of British Standard Specifications. The guide has been carefully prepared, and should prove useful to consulting engineers and contractors. It is issued free of charge by the proprietors of the *Engineer*. To qualify for inclusion under appropriate headings, it is necessary to advertise in the columns of the *Engineer* to the extent of £25 a year.

The Original Use of the Word "Solute"

DR. P. LECOMTE DU NOÜY, writing from the Institut Pasteur, Paris, asks if it is known who is responsible for the coining of the useful word 'solute'. The word is not to be found in old text-books, but the "Oxford English Dictionary" gives a quotation from Sir William Dampier's "Recent Developments of Physical Science" in which the word is used in its present sense. Upon referring the point to Sir William, however, he informs us that the Dictionary is wrong in implying that the first use of the word is in that volume, which was first published in 1904. In his "Theory of Solution", published two years earlier, he says (p. 49), "It is customary to distinguish between the medium or *solvent* and the dissolved substance or *solute*". On the other hand, in his "Solution and Electrolysis", published in 1895, Sir William uses the word 'solvend' instead of 'solute'. Apparently, therefore, the word 'solute' was introduced between 1895 and 1902, but who was responsible for the coining of it remains undecided. Perhaps some of our readers can throw light upon the question.

Heavy Water and the Colour of Hydrated Salts

IN connexion with his communication on the influence of heavy water on the colour of hydrated salts (NATURE, March 28, p. 534), Dr. James Bell writes that it appears that the observation that copper sulphate pentadeuterate solutions and crystals are more green in tint than those of the pentahydrate had already been made. H. Perpérot and F. Schacherl, in an account of an investigation of the vapour tensions of the different deuterates of copper sulphate (*J. de Physique et le Radium*, vii, **6**, 439; Oct. 1935), mention this difference in colour, and state that they have undertaken an examination of the absorption spectra of the solutions. As it is unusual for work on this field to be published in that journal, and an abstract has not yet been available, this paper was inadvertently overlooked.

Award of Goethe Medal

IT is announced that Herr Hitler has conferred the Goethe Medal on Dr. Max Uhle, of Berlin. Dr. Uhle, who is an honorary fellow of the Royal Anthropological Institute, has a world-wide reputation as one of the foremost authorities on South American archæology. During a residence there of many years he explored a large number of prehistoric sites in Peru, some of his work in the field being supported by grants from the Phœbe B. Hearst benefaction of the University of California. His studies, more particularly of the pottery, are the basis of generally accepted views on the character and chronology of Pre-Inca civilisation.

International Association on Quaternary Research

THE third International Conference of the International Association on Quaternary Research will be held in Vienna, on September 1–7. After the conference, excursions will be made to the East Austrian Alps and their forelands. These excursions will start on September 9 and continue until September 25. Those who propose to attend the conference and excursions should write at once for further details and approximate cost to the president, Prof. Dr. Albrecht Penck, c/o Inqua, Rasumofskygasse 23, Vienna III, Austria.

Announcements

THE Council of the Linnean Society has awarded the Linnean Gold Medal for 1936, the highest award in the gift of the Society, to Prof. J. Stanley Gardiner, professor of zoology and comparative anatomy in the University of Cambridge.

THE Lord President of the Council has decided that, pending the appointment of a successor to the late Sir Joseph Petavel, the office of director of the National Physical Laboratory shall be held by Sir Frank Smith, the secretary of the Department of Scientific and Industrial Research. Correspondence should be addressed as hitherto to the Director, National Physical Laboratory, Teddington, Middlesex.

THE following appointments have recently been made by the Secretary of State for the Colonies: H. E. Harbour, to be veterinary officer, Tanganyika Territory; C. L. Smith, to be chemical assistant, Sponge Fishery Investigations, Bahamas; J. R. P. Soper (agricultural officer, Zanzibar), to be agricultural officer, Straits Settlements and Federated Malay States; A. Foggie (assistant conservator of forests, Cyprus), to be assistant conservator of forests, Gold Coast.

THE University of Jena will celebrate the seventh centenary of its foundation on May 20–24.

THE eighth International Congress of Theoretical and Applied Limnology, which was to have been held in Paris this year, has been postponed until 1937, when the world exhibition will take place.

THE First National Prize for Science, which is the highest distinction conferred by the Argentine Republic, has been awarded to Dr. Julio Diez for his work on the surgery of the lumbar sympathetic.

THE fifth International Congress against Rheumatism will be held at Lund on September 3–8, under the presidency of Prof. Sven Ingvar. Further information can be obtained from the secretary, Prof. G. Kahlmeter, Birgerjarisgatan 36, Stockholm.

THE third International Conference on Social Work will be held at Bedford College, London, on July 12–18, when the subject for discussion will be social work and the community. Further information can be obtained from the general secretary, Mr. Alexander Farquharson, Le Play House, 35 Gordon Square, W.C.1.

THE eleventh International Congress of Psychology will be held in Madrid on September 6–12, under the presidency of Prof. E. Mira. Further information can be obtained from the Bureau of the Congress at the Instituto Nacional de Psicotecnia, Alberto Aguilera 25, Madrid.

THE British Health Resorts Association has recently issued the 1936 edition of its official handbook, edited as previously by Dr. R. Fortescue Fox, and with a foreword by Sir Kingsley Wood, Minister of Health ("British Health Resorts Spa, Seaside, Inland. Including those of Australia, Canada, New Zealand, South Africa and the British West Indies". London: J. and A. Churchill. 1*s*. net). Year by year the details included become amplified, and we now have a very full and complete guide to all the spas and health resorts in the British Isles, together with those of the overseas Dominions. Medical indications of the spas and the 'qualities' of the sea-coast health resorts are summarised. This, together with a guide to hotels and accommodation for visitors, complete a useful and inexpensive handbook.

WE are asked by Messrs. H. K. Lewis and Co., Ltd., to state that they are the London agents for the *Proceedings of the Prehistoric Society*, referred to in NATURE of April 11, p. 629.

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

An assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, 10 Whitehall Place, London, S.W.1 (April 27).

An assistant (Grade III) in the Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7—The Director (April 30).

A civilian technical officer (engineering or physics) in an Admiralty establishment in Scotland—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (May 1).

A mechanical draughtsman (temporary) at the War Office in connexion with research work in air survey—Under-Secretary of State (C.5), War Office, London, S.W.1 (May 4).

A junior scientific officer (physicist) at the Fuel Research Station, Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 8).

A chemist for the Admiralty Chemical Pool—Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (May 8).

Assistants (Grades II and III) for the Admiralty Scientific and Technical Pools—Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (May 8) (quote C.E. 2329/36).

An assistant in cereal breeding at the Scottish Plant Breeding Station, Edinburgh—Mr. John Stirton, 8 Eglinton Crescent, Edinburgh (May 9).

An assistant superintendent of the Archæological Survey of India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 15).

An assistant engineer for the Posts and Telegraphs Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/3967).

Executive engineers (Grade IV) for Public Works Department, Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/4228).

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 708.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Value of Carbon Dioxide in Counteracting Oxygen Lack

THE recent paper by Childs, Hamlin and Henderson[1] has again centred attention upon the old observations of Mosso[2], who showed that in low-pressure chamber experiments the presence of small concentrations of carbon dioxide (2–5 per cent) increased the resistance of his experimental subjects to lowering of the barometric pressure. Similar observations were reported by Margaria[3], and Talenti[4], who found that the resistance against the lowering of the barometric pressure was increased in the presence of carbon dioxide, provided that the gas mixture in the chamber was pure oxygen. The attempts, however, to prove that carbon dioxide had a similar beneficial effect on oxygen lack when air was diluted by nitrogen gave paradoxically negative results (Margaria[5]). In view of the contradictory character of these earlier studies, and since it has been shown that oxygen lack produces quantitatively measurable effects on the human central nervous system (Gellhorn and Spiesman[6], and Gellhorn and Kraines[7]), it seemed to be of considerable interest to investigate whether the effects of oxygen lack on the human central nervous system could be alleviated or altered by the presence of carbon dioxide and, furthermore, to ascertain what the mechanism of this reaction might be.

In the first series of experiments, the distinction threshold of the human eye for differences in brightness was investigated by means of Masson disks. It was invariably found that oxygen want, produced by breathing concentrations of 8–9 per cent oxygen in nitrogen, decreased the sensitivity to brightness considerably. On repetition of the same experiment carried out in the presence of 3 per cent carbon dioxide there was either no change in the threshold for brightness distinction or a small reduction, which frequently disappeared even while the subject continued to breathe the same gas mixture. The experiments indicate that under the influence of carbon dioxide the effect of oxygen lack on this visual function is either completely absent, or the slight decrease in sensitivity which may occur is restored while the subject is still exposed to oxygen lack.

Experiments carried on with a brain stem reflex in the rabbit (stimulation of the vestibular apparatus with a low-voltage constant current) gave similar results. Whereas under the influence of oxygen lack the number of nystagmic movements decreases, no change may be observed in the presence of carbon dioxide. In these cases, however, a slightly higher concentration than that which has been shown to be effective in man had to be used (5–6 per cent).

Various mental functions were investigated in experiments in which the so-called number-cancellation-test, the summation of two numbers using the method of Kraepelin, and the association test devised by Kent-Rosanoff, were carried out. The time necessary to cross out a certain number in a given set of numbers, or to add two subsequent numbers, was regularly increased under oxygen lack. The association test produced, under oxygen lack, apparently senseless associations (dissociations), a stereotype character of responses to the stimulus word (perseverations) and relative increase in the number of individual responses. These changes are similar to those observed in some mental diseases. Moreover, unusual misspellings are frequent. If, however, these tests were carried out in the presence of carbon dioxide, it was found that the oxygen want had no deleterious effects upon the responses studied. Of particular interest are the effects on writing. Fig. 1

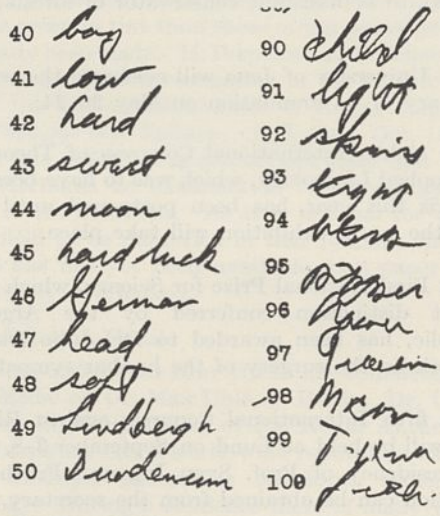

FIG. 1. Part of an association experiment as an example of the influence of oxygen lack on handwriting. The responses to numbers 40–50 were obtained after breathing 8·5 per cent O_2 + 3 per cent CO_2 for 7 minutes, whereas the responses to numbers 90–100 were obtained by the same person breathing 8·5 per cent O_2 (without CO_2) for the same time.

gives an example in which it is shown that under the influence of oxygen lack the writing may become entirely illegible, whereas it remained unaltered in spite of the oxygen lack if 3 per cent carbon dioxide is inhaled at the same time.

We believe that the mechanism by which carbon dioxide alleviates the symptoms of oxygen lack or even prevents their occurrence is based on its effect on respiration and thereby, in turn, on circulation, leading to an increase in tissue oxygen tension. The effects on circulation are particularly marked when the effect of oxygen lack with and without carbon dioxide is studied on the systolic blood pressure in the erect position in the human. Whereas 8–9 per cent oxygen lack may not cause any changes in blood pressure and only slight alteration in pulse

rate in healthy young individuals in the recumbent position, the effects are very marked in erect position, and consist, after an initial rise in systolic blood pressure, in a considerable drop which may lead to syncope. The pulse rate may show a similar change or may remain increased during the whole experiment. In the presence of carbon dioxide, however, the drop in blood pressure is prevented and may be maintained normal or may even be elevated. Obviously, carbon dioxide, by increasing respiration and by its effect on the circulation, provides a better blood supply to the brain, which is apparent in the erect position, because under these conditions the effects of oxygen lack become more severe, since a temporary cerebral anæmia frequently results from maintaining an erect position under oxygen lack.

ERNST GELLHORN.

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University of Illinois, Chicago.
Feb. 22.

[1] S. B. Childs, H. Hamlin and Y. Henderson, NATURE, **135**, 457 (1935).
[2] A. Mosso, "Life of Man on the High Alpes" (London, 1898).
[3] R. Margaria, *Arch. Sci. biol.*, **11**, 425 (1928).
[4] C. Talenti, *Arch. Sci. biol.*, **14**, 125 (1930).
[5] Margaria, *Arch. Sci. biol.*, **11**, 453 (1928).
[6] E. Gellhorn and I. Spiesman, *Amer. J. Physiol.*, **112**, 519, 620 and 662 (1935).
[7] E. Gellhorn and S. Kraines, *Science*, 1936, in the press.

Plasticity of Bismuth Crystals

MUCH evidence of a conflicting nature has been advanced on the subject of the plasticity of bismuth: the following brief account of some new experiments may therefore be of interest.

In an investigation carried out at the National Physical Laboratory on the behaviour of two single crystals of bismuth when subjected to alternating torsional stresses[1], it was found that the crystals deformed entirely by twinning without any slip. The non-occurrence of slip in these tests appeared to be at variance with the conclusions drawn by other workers as to the behaviour of bismuth[2]; but it appeared possible that the difference might be due to the special nature of the applied stresses. Accordingly a third single crystal of bismuth was tested under cycles of reversed direct stresses (tension and compression). This specimen also deformed only by twinning; the final fracture was by cleavage parallel to the plane 111 (0001 in hexagonal co-ordinates), but the only visible signs of movement that could be termed slip were a few faint bands parallel to this plane (111) in the neighbourhood of the fracture. The ratio of the shear stress to the normal stress on the plane 111 of this crystal was approximately unity, so that the rule suggested by Georgieff and Schmid—that slip should occur before cleavage if this ratio is greater than 0·7—was not confirmed. Still more recently, a portion of this third crystal has been tested under static compression force applied parallel to the same axis as in the alternating direct stress tests. In this test the crystal deformed almost entirely by slip parallel to the plane 111, no regular system of twin bands being produced.

The appearance of the slip bands produced by the slip deformation is shown in the accompanying photographs (Fig. 1) It may be noted that these slip bands are not very like the bands produced by slip in aluminium, silver, iron, etc., and that in fact they appear much more like twin bands; comparison may be made with the twin bands (on the planes of the type (011)), which are also shown in the bottom right-hand photograph. Although it was not practicable in the compression test to deform the specimen sufficiently definitely to establish the shear nature of the deformation, there is very little doubt that the deformation as a whole was pure shear parallel to the plane 111. Berg[3] has suggested that the occurrence of slip in single crystals of bismuth may depend to some extent upon the applied stress conditions and upon the manner in which the single crystals are grown. The results of our tests confirm that slip may be produced in bismuth under certain types of stress system; but it appears that deformation by twinning may often occur more easily.

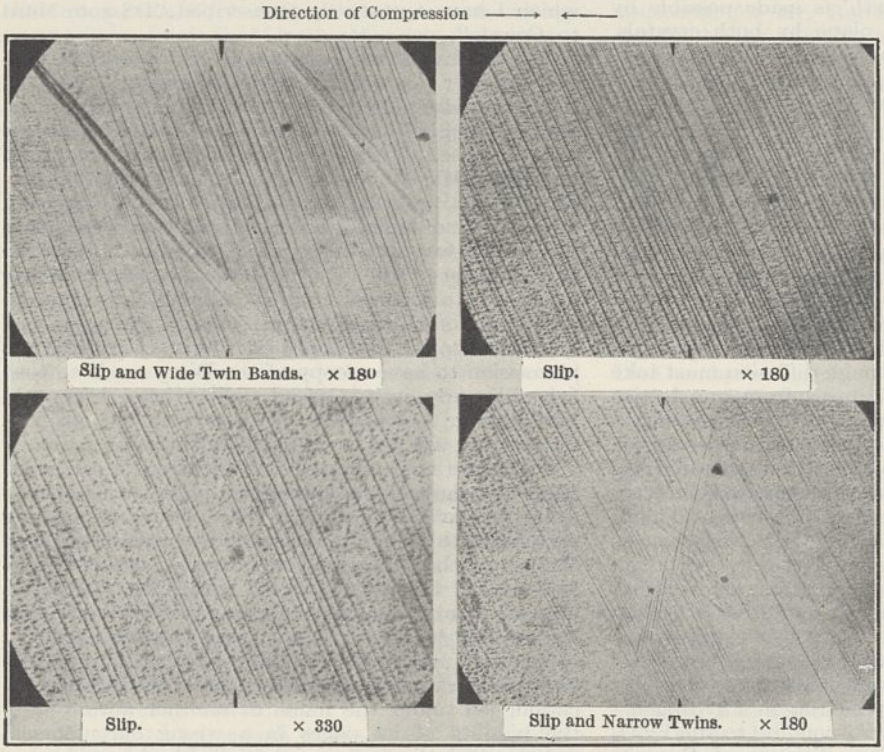

FIG. 1. Bismuth single crystal after compression test at 0·4 ton per sq. in.

H. J. GOUGH.
H. L. COX.

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[1] H. J. Gough and H. L. Cox, *J. Inst. Met.*, **48**, No. 1 (1932).
[2] M. Georgieff and E. Schmid, *Z. Phys.*, **36**, 759 (1926).
[3] W. F. Berg, NATURE, **133**, 831 (1934).

Orientation of Oxide Films on Iron

SINCE the publication of a previous note on the orientation of FeO (wüstite) films on α-iron[1], the complete series of oxide layers on iron has been studied. In the X-ray photograms of the FeO films on single crystals of iron, some reflections were identified as coming from Fe_3O_4, resulting from the partial decomposition of the wüstite phase. The pattern showed that this Fe_3O_4 was identically oriented with the FeO, with all planes of the same indices in the two cubic lattices parallel. The same orientation relationship held when an FeO film was grown by reduction on a large natural crystal of magnetite (Fe_3O_4).

Plots of the atom arrangement on the interfacial crystallographic planes of the Fe, FeO, and Fe_3O_4 lattices show that the orientation relationships described above are quite reasonable when considered on the basis of matching of atom positions. In the Fe and FeO lattices, the geometric configurations of the iron atoms on the matching cube planes are identical, and the spacings agree to within six per cent. In the matching cube planes of the FeO and Fe_3O_4 lattices, the configurations of the iron atoms in the two are nearly identical, and those of the oxygen atoms are exactly so, with the interatomic spacing agreeing to within about three per cent.

The orientation relationships existing in overgrowths of Fe_3O_4 with Fe_2O_3 were reported many years ago by a number of mineralogists as consisting in a parallelism of the basal hexagonal plane of the hematite and the octahedral plane of the magnetite, with the [110] direction in the match plane of magnetite normal to the [10·0] direction in that of hematite. Grüner[2] has studied this relation, and concludes that the oriented 'intergrowth' is made possible by the sharing of one oxygen plane by both crystals. This theory is in complete accord with the FeO–Fe_3O_4 orientations found in the present work. It is interesting that the oxygen atoms determine the orientation relationship in the case of Fe_2O_3 on Fe_3O_4, and iron atoms in the case of FeO on Fe, while the two possibilities would produce the same result in the intermediate case of Fe_3O_4 with FeO.

In 1922, Tammann[3] suggested that fixed orientation relationships between a polycrystalline metal and its adhering oxide layer would, by controlling the orientation of the oxide layer on each grain, lead to differences in the rate of oxidation from grain to grain, on the basis that diffusion through the oxide lattice is anisotropic. But though diffusion must take place by the movement of atoms from one lattice point to another and is thus anisotropic on a microscopic scale, it cannot be anisotropic on a macroscopic scale if the lattice is cubic, as demonstrated by calculations by the authors based on lattice symmetry considerations. All the existing experimental data show that diffusion in cubic metals is isotropic, as pointed out by Mehl in a recent lecture[4]. Although more or less self-evident, the calculations showed that diffusion in non-cubic lattices is not necessarily isotropic. To eliminate the effect of possible anisotropic diffusion through the thin external layer of hexagonal Fe_2O_3, specimens of high-purity iron were oxidised to the temper colour stage by heating in a hydrogen – water vapour atmosphere corresponding to the Fe_3O_4 phase field on the equilibrium diagram of Emmett and Shultz[5]; differences in rates of oxidation on different faces were again exhibited even though cubic oxide alone was formed. It is possible that the explanation of this phenomenon lies in the distortion of the oxide lattice at and close to the interface, caused by a tendency of lattices which match imperfectly mutually to adjust their lattice spacings, like that found by Finch and Quarrell[6] for zinc oxide films on zinc.

Fixed oxide – metal orientation relationships may also provide the explanation of the observed discontinuity of the rate of oxidation of iron at the A_3 point[7]. Since the oxide lattices themselves undergo no transformation at this temperature, the rate at which oxygen is supplied to the oxide – metal interface should not vary discontinuously with temperature. It seems reasonable to suppose that the abrupt changes in oxidation rates result from the substitution of the crystallographic mechanism of oxidation of γ-iron for that of α-iron.

R. F. MEHL.
E. L. MCCANDLESS.

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[1] NATURE, **134**, 1009 (1934).
[2] *Amer. Mineralogist*, **14**, 228 (1929).
[3] *Stahl u. Eisen*, **42**, 617 (1922).
[4] Annual Institute of Metals Lecture, Amer. Inst. Min. Eng. (1936).
[5] *J. Amer. Chem. Soc.*, **52**, 4268 (1930).
[6] NATURE, **131**, 877 (1933).
[7] Fischbeck and Salzer, *Metallw.*, **14**, 733, 753 (1935).

Hooke and his Editors

PROF. E. N. DA C. ANDRADE is to be congratulated in the interpretation of some of the more difficult passages in the manuscript Diaries of Robert Hooke (NATURE, March 7, p. 378). I hope that he may be equally successful with the entry for Dec. 28, 1689, which I have tentatively transcribed "DS com Mard to Counts".

But Prof. Andrade begins with the statement that Dr. Gunther "considers himself aggrieved" that Mr. Robinson was allowed to publish the part of the Diary belonging to the City of London. The reverse was the case. I was very pleased that anyone, and especially Mr. Robinson, should have secured permission to transcribe and publish it. Mr. Robinson, however, had himself informed me that permission to publish was not being given to him, but to the Royal Society, and Prof. Andrade can find evidence for this in a letter from the Guildhall Librarian to *The Times* of February 15 last year. I was aggrieved in 1930 because the Guildhall Librarian refused me permission to have a copy of the Diary made so that I could study it in Oxford, and I have been told that similar applications for studying the original manuscript are to be refused in future.

Still more misleading is Prof. Andrade's continuation, "it behoves us to examine a little Dr. Gunther's claim to have a right to be the editor of anything pertaining to Hooke". I have never made any such claim: on the contrary, I have invited others to edit his work. I have expressed indignation that his original manuscript materials should have been kept for so many years unknown and unknowable both to scholars and to the general public. Concealment happened in several ways: by part of his Diary being catalogued under the name of another author; by the binding of its pages in a wrong chronological order so that the first page, initialled by himself, came in the middle of the volume; by the refusal of owners to permit his manuscripts to be copied.

Through delay in publication, many valuable years have been lost and, what is even more regrettable,

a scrapbook containing most important items relating to Hooke has been broken up and dispersed, with loss of some of the contents. Earlier publicity would have averted this calamity.

In 1930 I desired to assist Mr. Robinson to issue his work, and to this end I wrote to the Carnegie Institution of Washington. In reply, the secretary wrote that the Institution could not provide him with the financial assistance he required and added: "We are interested in knowing of the issue of your edition of Hooke's Life and Works in four volumes . . . it is of course quite evident that the circumstances of such publication should be given adequate consideration in connection with any proposal or arrangement for issue of an edition of the Hooke Diary". (Dec. 29, 1930.)

It may be worth mentioning that a printer's proof copy of my transcript was submitted to the authorities at the British Museum, who used it for rearranging the leaves of the original Diary, and reported that they had not detected any serious discrepancies in the text. This verdict encouraged me in the belief that the advantages of proceeding with the publication would be greater than those of further delay.

R. T. GUNTHER.

Museum of the History of Science,
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March 14.

I AM glad to add Dr. Gunther's congratulations to the many others which I have received on my review, but, unlike my private correspondents, he seems to have misread what I wrote much as he misread what Hooke wrote. What was in question was not my interpretation of "some of the more difficult passages", but Dr. Gunther's own failings as an editor. I note that Dr. Gunther does not traverse a single one of my corrections, and I have a further long list of elementary blunders.

If Dr. Gunther does not consider himself aggrieved that Mr. Robinson was allowed to edit the Guildhall Diary, he is singularly unfortunate in the expression of his thoughts. Concerning this Diary he states in his preface to the British Museum Diary: "Had the permission to make a copy been granted to me when requested, the Royal Society would not have been put to so great an expense, the Public would have had the complete Diary in their hands four years ago, many of the outstanding architectural problems would have been solved, the text now printed would have been more correct, and the whole work would have been accessible by a single index". His distinction, in the second paragraph of his letter, between the Royal Society and the Royal Society's librarian is ingenuous. He apparently considers that the Society can act without human agency and edit diaries of its own mere motion. In view of this delicate distinction, it is remarkable that he should confuse between permission to make a copy so that he could study it in Oxford, and permission to do what he states in the preface he desired to do, namely to "add a transcript to this edition of Hooke's Collected Works". If Dr. Gunther is so liable to confuse things totally different, it is scarcely surprising that librarians should go warily with him.

In the third paragraph of his letter Dr. Gunther raises the question of concealment. The British Museum Diary, which is the one now edited by Dr. Gunther, was miscatalogued and unknown. It was discovered in the Museum by Mr. H. W. Robinson, a fact which has never, to my knowledge, been disputed (see NATURE, **126**, 244; 1930: "part of a diary recently discovered in the British Museum by Mr. H. W. Robinson. . . . The record . . . was thought to be the diary of James Petiver, an apothecary friend of Hooke. Mr. Robinson has been able to prove that it was written by Hooke"). Dr. Gunther has forgotten to mention this fact both in his present letter and in his preface to the Diary in question. In the face of his statement that he has invited others to edit Hooke's work, it seems strange not only that he should never have asked Mr. Robinson whether he, Mr. Robinson, desired to edit the manuscript which he had discovered, but also that he should have left it to a third party, who had discovered the matter by inquiry at the Museum, to inform Mr. Robinson that Dr. Gunther had the work nearly ready for publication. It may be added that Mr. Robinson had then for some time been at work on a photostat copy of this diary which he possesses, and that a large part of it was already transcribed when he learnt of Dr. Gunther's activity.

Mr. Robinson informs me that he knows nothing of Dr. Gunther's having written to the Carnegie Institution on his behalf, and that Dr. Gunther never consulted him before doing so. Perhaps Dr. Gunther's letter to the Carnegie Institution was as unfortunately worded as his preface, and the authorities of the Institution did not understand from it that Dr. Gunther was trying to assist Mr. Robinson. From the single sentence which Dr. Gunther quotes from the Institution's reply, it would look as if Dr. Gunther had been urging that the Institution should support his efforts to get the Guildhall Diary included in the Guntherian edition. It is particularly surprising that Dr. Gunther should have tried to obtain financial assistance for Mr. Robinson, behind his back, and should be so indignant when the Royal Society actually provided financial assistance. Why is it proper that the Carnegie Institution, which has no connexion with Hooke, should provide the money, and improper for the Royal Society to do so? Or is it possible that Dr. Gunther's remark in his preface, "the Council of the Royal Society has, however, made a charitable grant of £100 to the worthy firm of Messrs. Taylor and Francis, printers, towards *their* expenses in printing a work, the copyright of which is claimed by the Guildhall Librarian" is really a note of approval of the grant? Dr. Gunther is so unfortunate in his wording.

I hope that the British Museum will deal with Dr. Gunther's suggestion that the Museum authorities gave his gallimaufry their blessing. For my part I am content to take my leave of Dr. Gunther with the request that, if he ever intends to help me by writing letters on my behalf, he will first inform me of his intentions and secure my permission.

E. N. DA C. ANDRADE.

Conservation of Momentum in the Process of Positron Annihilation

IT is well known that when positrons are annihilated, γ-rays with quantum energy of about 500 ekv. are emitted. This seems to prove that annihilation occurs with a loosely bound electron as a partner of the disappearing positron, the process involving mainly low energy positrons. Klemperer, using a coincidence method, was able to show that the annihilation is really accompanied by the simultaneous emission of two quanta. Our experiments were designed to test

whether these two quanta are really emitted in opposite directions.

For this purpose a source of positrons was disposed between two pairs of photon counting tubes. Two counters were placed on each side of the source in order to double the probability of detecting the quantum. To increase the sensitivity to γ-rays the counting tubes were coated inside with lead 0·2 mm. thick. Two runs were made: the first with the distance from the source to the centres of the nearest counters of each pair being 3·5 cm., and the second 2·5 cm. The ratios of the number of quanta coming across each pair of counters to the whole number emitted by the source were 1/18 and 1/13 respectively.

In each run measurements were taken first with both pairs of counters lying in the same plane with the source. This was followed by control measurements with one pair of counters rotated around the source through 90° from the initial position (*J*-position). Radio-phosphorus obtained by bombardment of aluminium with α-particles (500 mc. radon tube) was used as a source of positrons. After 10 minutes' irradiation, the aluminium sample was put into a brass tube (2·5 mm. walls) and coincidences between the two pairs of counters were counted during 3-minute intervals. The resolving power of the amplifying and coincidence-selecting circuit was 2×10^{-6} min.

The results obtained in these measurements are given in the accompanying table.

	Number of spontaneous kicks in one pair of counters (3 min.)	Number of kicks in one pair of counters in the presence of the positron source (3 min.)	Observed number of coincidences (3 min.)	Number of chance coincidences and coincidences due to cosmic rays (3 min.)	Expected number of coincidences (3 min.)
Run 1					
Correct position	510	935	4·7 ± 0·47	1·3 ± 0·2	5·7 ± 0·5
J-position	490	890	2·8 ± 0·6	2·7 ± 0·75	2·5 ± 0·3
Run 2					
Correct position	516	1095	7·6 ± 1·0	1·1 ± 0·3	6·5 ± 0·7
J-position	510	870	2·6 ± 1·0	3·6 ± 0·6	2·7 ± 0·3

Data in the last column were obtained by a computation based upon a direct measurement of the efficiency of the counters used. This was done by comparing the number of positrons emitted by the source (about 1×10^5 per minute) with the number of annihilation quanta recorded by the counters.

The efficiency of a pair of counters was found to be about 1/80. A correction of 20 per cent for the absorption of the γ-quanta in the brass surrounding the source and in the walls of the counters was allowed for in this computation.

Analysing the data given in the above table, one is led to the following conclusions:

(1) In the process of positron annihilation there is really an emission of two quanta in opposite directions, as required by the law of conservation of momentum.

(2) As in our experiments (Run 1) only those pairs of quanta could be recorded in which the angles between both quanta were in the range 180°–150°, it can be deduced that positron annihilation occurs at energies lower than 80 ekv.

A. I. ALICHANIAN.
A. I. ALICHANOW.
L. A. ARZIMOVITCH.

Physico-Technical Institute,
Leningrad. March 15.

Dissolved Carbon Dioxide and the Ripening of Tomatoes

THE phenomenon of climacteric rise in respiration of ripening fruits is not fully understood. Blackman and Parija[1] explained the rise in respiratory activity in apples on the assumption that in the senescent stage a lowering of "hydrolysis-resistance" occurs leading to a greater production of effective substrate for respiration. Kidd and West[2] have attributed the initial increase in carbon dioxide output during senescence to the action of some "protoplasmic factor". Gustafson[3] has demonstrated that the rate of respiration is very greatly influenced by the *p*H of the cell-sap, lower values of *p*H being usually associated with higher rates of respiration, and in a later communication[4] suggests that the climacteric rise is probably due to a lowering of *p*H of the cell-sap.

In the course of some biochemical studies on ripening in tomatoes, the data obtained indicated that increasing amounts of carbon dioxide accumulate in the fruit tissue during ripening. Evidently in massive structures like ripe tomatoes the superficial tissues offer a great resistance to the diffusion of gases. In view of the above, it occurred to us that the climacteric rise in ripening tomatoes may, in all probability, be in part due to either (1) the establishment of a steep gradient between the carbon dioxide inside the fruit and that in the outside atmosphere, or (2) a lessened resistance of the superficial tissues to the diffusion of gases. To elucidate this point, the carbon dioxide dissolved in the fruit sap and the ratio carbon dioxide to oxygen were determined at regular intervals during the stages of ripening and senescence.

Fruits were submerged in boiling 95 per cent alcohol in a closed container[5] placed in a bath the water in which was heated to 90° C., and the dissolved carbon dioxide in the sap was removed by evacuation[6]. The carbon dioxide evolved was trapped in caustic soda and titrated against standard acid. The respiratory quotient (R.Q.) was measured by enclosing the material in air-tight respiration chambers, the gaseous samples removed from which were analysed from time to time by means of an adaptation of Haldane gas-analysis apparatus[7]. The respiration chamber was maintained in a water bath at a temperature of 27 ± 0·2° C. The values obtained both for dissolved carbon dioxide and the R.Q. are presented in the accompanying table.

Colour of the fruit	Carbon dioxide liberated (ml. (N.T.P.)/kilo/hr.)	Dissolved carbon dioxide (ml. (N.T.P.) per kilo)	R. Q.
Green	17·7	19·7	1·11
"	19·3	20·3	1·08
Yellow-green	20·3	20·1	1·07
" "	26·7	21·7	1·01
Green-orange	30·3	26·2	1·00
" "	29·2	27·1	0·99
Orange-red	27·3	30·6	1·01
" "	20·7	33·3	1·23
Red	13·9	37·9	1·27
"	11·7	37·1	1·29

From the data it is evident that considerable amounts of carbon dioxide accumulate in the fruit tissue during ripening, and that the ratio of carbon dioxide to oxygen starts with a value somewhat

higher than unity, comes down to unity during the climacteric phase, and again rises gradually to 1·29. The suggestion is made (1) that the process of senescence in tomatoes is initiated by the accumulation of increasing amounts of carbon dioxide in the fruit tissue; and (2) that during senescence the resistance offered by the superficial tissues to the movement of gases—carbon dioxide outwards and oxygen inwards—is lessened, thus augmenting not only the rate of carbon dioxide production but also that of oxygen intake. The causes underlying this increased facilitation of gaseous exchange during ripening naturally suggest themselves as a sequel to this investigation.

B. N. SINGH.
P. B. MATHUR.

Benares Hindu University.
March 3.

[1] Blackman and Parija, *Proc. Roy. Soc.*, B, **103**, 412 (1928).
[2] Kidd and West, *Proc. Roy. Soc.*, B, **106**, 93 (1930).
[3] Gustafson, *J. Gen. Physiol.*, **2**, 617 (1920).
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[5] Willaman and Brown, *Plant Physiol.*, **5**, 535 (1930).
[6] Maquenne, *C.R.*, **119**, 100 (1894).
[7] Singh and Mathur, "An Adaptation of Haldane's Gas-Analysis Apparatus" (in the press).

Rate of Growth of *Cardium edule*

IN September 1932 the New Brighton (Wallasey) Corporation began an excavation of the sandy foreshore near high-water mark, which was completed and filled with sea-water in May 1933 to form an artificial marine lake. Water is retained in the lake by a sea-wall, which is, however, covered on good spring tides (that is, 29 ft. or more), when the water in the lake is refreshed and partially renewed. The bottom of the lake was originally sand, but had acquired a considerable deposit of mud by February 1935, when the water was run out for removal of encroaching blown sand. At this time, the cockle, *Cardium edule*, was found in considerable numbers (33–459 per sq. metre), as determined by M. Davies, E. Norman, G. E. Williams, P. E. Travis, K. C. Fulton and one of us (J.H.O.) in the sand and mud in the exposed bed, the cockles having entered the lake after the final filling on May 9, 1933.

It was found that the cockles were all of small size, and gave the size distribution for two summers' growth shown in Fig. 1, having mostly one good winter ring, but in many cases additional rings best interpreted as disturbance rings[1]. In addition to this group, only occasional seed cockles of the 1934 year had survived. In February this year (1936) the lake was again emptied and samples of the cockles (which ranged from 32 to 110 per sq. metre) gave the size distribution curve shown in Fig. 1 for three summers. The increment in growth in length in the third summer is mainly about 4 mm. The bivalves now show two good winter rings, but many also again show the small disturbance rings. No seed cockles of the 1935 year have yet been found, and appear to be absent.

There can be no doubt that at least the bulk of the cockles represents a heavy spatfall in 1933, which survived in the newly formed lake, and offers the result of a large-scale fortuitous experiment on the rate of growth of this useful economic mollusc; from the high tidal level of the lake, the uniformity of samples and wide distribution in high concentration of *C. edule*, it is improbable that any other than small seed cockles have been washed into it, for example, on high spring tides. The failure of spatfalls in 1934 and 1935 may be due to absence of spat, but more likely to the failure to survive of such spat as fell in the lake from a variety of causes, among which predatory attacks by crabs, *Carcinus mœnas*, and fishes, and the unfavourable environmental conditions (for example, silty muddy bottom, decreasing purity of water) are probably important. It is interesting that fifty per cent of the cockles were of legal size[2] after two summers' growth, but in poor condition in February 1936.

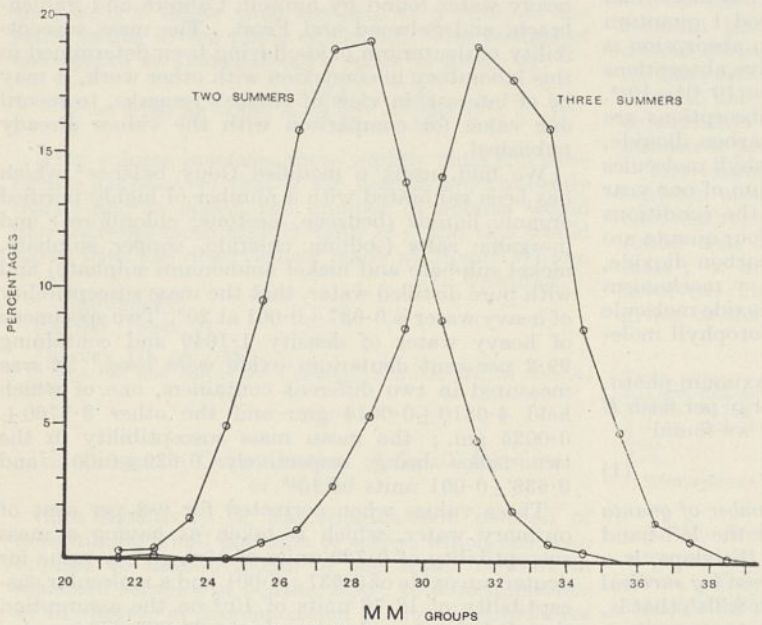

FIG. 1. Percentage length distribution in mm. groups of 1119 *C. edule* taken at random from New Brighton Marine Lake, March, 1935, aged two summers, and 1004 random *C. edule* from the same situation February, 1936, aged three summers.

The survival of *C. edule* in this peculiar habitat, that is, totally immersed, is noteworthy, and the size attained is of special interest in comparison with that found by one of us in a contemporaneous experiment (begun in 1933) with a perforated box fixed on the natural cockle beds in the middle of Morecambe Bay[3]. In both habitats the legal size (that is, retained on $\frac{13}{16}$–$\frac{3}{4}$ inch square hole respectively) was attained in about fifty per cent of the population in two summers, and in almost the entire population in three summers. Comparison of the material from the two localities confirms their similarity.

Complete recovery of a depleted bed may therefore occur in three summers and partial recovery in

two summers with survival of a good spatfall. The New Brighton material has considerable scientific value and will be discussed along with that of greater value from Morecambe Bay in detail in the future.

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A. ESLICK.
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March 9.

[1] J. H. Orton, *Mar. Biol. Assoc.*, **14**, 251 (1926).
[2] J. H. Orton, Superintendent's Report, Lancs. and Western S.F.C., March, 1935.
[3] J. H. Orton, James Johnstone Memorial Volume, Liverpool, p. 97, 1934.

Number of Chlorophyll Molecules acting as an Absorbing Unit in Photosynthesis

IN view of Gaffron and Wohl's[1] general discussion of the photosynthetic mechanism of the green plant, the following unpublished, supporting experiment, carried out last spring at Harvard by W. A. Arnold and me, is of interest.

We measured manometrically the photosynthesis (oxygen produced) per flash of light by a thin suspension of the green alga *Chlorella pyrenoidosa*[2]; source, neon discharge tube; spectral region 6250–6950 A.; 1 flash $= 10^{-4}$ sec.; 15 flashes per sec. Thus the Blackman (temperature sensitive) reaction was eliminated[2], the mean lifetime of which at 23·5° C. is 0·02 sec.; also, carbon dioxide was not a limiting factor. Assuming the average quantum to correspond to 6500 A., we studied the yield per flash as a function of quanta per flash.

(1) At 99 per cent light saturation, not more than 1 in 100 chlorophyll molecules absorbed 1 quantum per flash, that is, the probability of an absorption is 10^{-2}. The probability of four consecutive absorptions by one chlorophyll molecule is therefore $(10^{-2})^4 = 10^{-8}$. If we assume that four consecutive absorptions are necessary to reduce one molecule of carbon dioxide, then, since there were *circa* 10^{16} chlorophyll molecules present, it should have taken a minimum of one year to produce 1 c.mm. of oxygen under the conditions of our experiments*. Therefore, since four quanta are necessary[3] to reduce one molecule of carbon dioxide, we must postulate the existence of a mechanism which can reduce a particular carbon dioxide molecule with quanta absorbed by different chlorophyll molecules.

(2) Let M be the fraction of the maximum photosynthesis per flash, obtained at the energy per flash E (in quanta per cm.^{2}). Experimentally we found

$$\log_e (1-M) = -A \times E \quad . \quad . \quad . \quad . \quad (1)$$

Regarding this expression from the *number of quanta to kill* type of analysis[4], we recognise the left-hand member as the *log survival ratio*. A, the slope, is a constant. The linear relationship between *log survival ratio* and E indicates that one quantum 'kills', that is, activates one unit. In other words, the quantum absorbing unit does photosynthetic work after a *single* absorption.

(3) The slope A measures the 'blackness' of the absorbing entity. Because A is determined by the work done, that is, by the number of effective absorptions, we may call it (1) the functional molecular absorption coefficient of chlorophyll, or (2) the absorption coefficient of one photosynthetic absorption unit. The value of A was $9{\cdot}7 \times 10^{-14}$ (cm.^{2}/quanta). This is 360 times greater than the maximum value (6200–7000 A.) of the molecular absorption coefficient of chlorophyll dissolved in ether[5]. Therefore, since the total absorption by intact *Chlorella* cells and by an extract of these cells is approximately equal[6], it appears that more than 360 chlorophyll molecules comprise an absorption unit within the plant. The unit, used in this sense, means a mechanism which makes available the energy of an absorbed quantum; it is not assumed that this is a rigid structure.

Previously, we had found 2,000 to be the minimum number of chlorophyll molecules present per molecule of carbon dioxide reduced per flash[7]. Since four quanta are necessary to reduce one molecule of carbon dioxide, this corresponds to an absorption unit of 500.

HENRY I. KOHN.

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Drottninggatan-116a,
Stockholm.
Feb. 27.

* The actual time was about three minutes.

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[2] R. Emerson and W. A. Arnold, *J. Gen. Physiol.*, **15**, 391 (1932).
[3] O. Warburg and E. Negelein, *Z. phys. Chem.*, **106**, 191 (1923).
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Diamagnetic Susceptibility of Heavy Water

MR. F. E. HOARE has directed attention[1] to the divergence in the mass susceptibility values for heavy water found by himself, Cabrera and Fahlenbrach, and Selwood and Frost. The mass susceptibility of deuterium oxide having been determined in this laboratory in connexion with other work, it may be of interest, in view of Hoare's remarks, to record our value for comparison with the values already published.

We find, using a modified Gouy balance[2] which has been calibrated with a number of highly purified organic liquids (benzene, acetone, chloroform) and inorganic salts (sodium chloride, copper sulphate, nickel sulphate and nickel ammonium sulphate) and with pure distilled water, that the mass susceptibility of heavy water is $0{\cdot}637 \pm 0{\cdot}001$ at 20°. Two specimens of heavy water of density 1·1049 and containing 99·2 per cent deuterium oxide were used. It was measured in two different containers, one of which held $4{\cdot}0810 \pm 0{\cdot}0014$ gm. and the other $3{\cdot}7760 \pm 0{\cdot}0025$ gm.; the mean mass susceptibility in the two tubes being respectively $0{\cdot}639 \pm 0{\cdot}001$ and $0{\cdot}638 \pm 0{\cdot}001$ units of 10^{-6}.

These values when corrected for 0·8 per cent of ordinary water, which is taken as having a mass susceptibility of 0·720 units of 10^{-6}, give a value for deuterium oxide of $0{\cdot}637 \pm 0{\cdot}001$ and a molecular susceptibility of 12·76 units of 10^{-6} on the assumption that D_2O has a molecular weight 20·027. This value is in complete agreement with that of Cabrera and Fahlenbrach.

V. C. G. TREW.
JAMES F. SPENCER.

Bedford College,
London.
March 25.

[1] NATURE, **137**, 497 (1936).
[2] *Trans. Faraday Soc.*, Dec. 1933.

Heavy Water of Crystallisation

IN connexion with the interesting letter by J. Bell[1], we wish to state that we are engaged in measurements of the dissociation pressures of $CuSO_4$, $5D_2O$ and other salts containing heavy water of crystallisation, and also intend to study the crystal angles of these compounds. As is well known, measurements of dissociation pressures of salt hydrates, much work on which has been published by one of us, are somewhat difficult, but some preliminary results will shortly be communicated.

J. R. PARTINGTON.
K. STRATTON.

Queen Mary College,
London.
March 31.

[1] NATURE, **137**, 534 (1936).

Relativity Theory and the Universe

SINCE the relativity theory can be adequately interpreted in the space of Lobachevsky[1], may I be permitted to say a few words in connexion with a communication of Sir James Jeans[2].

In the finite space of positive curvature, the number of nebulæ at great distances would increase less rapidly than x^3. However, observations made at Mount Wilson "seem to indicate the exact reverse". This would speak in favour of the supposition that space is of infinite dimensions and of negative curvature. The area of the circle with radius x in Lobachevsky's plane is expressed by

$$A = \pi\, sh^2\, x = \pi\,(x^2 + \frac{x^4}{3} + \ .\ .\ .)\,;$$

that is, it is larger than the area of a circle of the same radius in the plane of Euclid. The volume of the sphere in Lobachevsky's space is given by

$$V = \pi\,(sh\ 2x - 2x) = \pi\left(\frac{4}{3}x^3 + \frac{4}{15}x^5 + \ .\ .\ .\right).$$

This volume increases more rapidly than the cube of the distance, so that if the nebulæ are uniformly distributed in space, the number of nebulæ would also increase more rapidly than x^3; and this would agree with the observations made at Mount Wilson.

V. VARIĆAK.

University,
Zagreb. Feb. 21.

[1] NATURE, **114**, 820 (1924).
[2] "The Size and Age of the Universe", NATURE, **137**, 20 (Jan. 4, 1936).

Ebulliometric Determination of Small Amounts of Water*

THE sensitivity of the ebulliometric method of determining small amounts of water, which has been applied to measurements of the water content in standard samples of benzoic acid[1], to determinations of the degree of decomposition of organic substances on heating[2], and to measurements of adsorption of vapours on solid metallic surfaces[3], may be considerably increased by the use of the azeotropic mixture *n*-propanol/toluene instead of ethanol/benzene used formerly.

The method[1] is based on the fact that the lowering of the condensation temperature of a binary azeotropic mixture such as ethanol/benzene is proportional to the amount of water introduced into the apparatus. With the aid of the ebulliometer with several sections, it has been found possible to obtain a lowering of 0·033° C. per mgm. of water. This lowering depends on the dephlegmating power of the apparatus and on the nature of the ebulliometric liquid that is used.

Measurements of the lowering of condensation temperature caused by the addition of 1 mgm. of water to different azeotropic mixtures were carried out in the same apparatus. When the ebulliometer was filled with a constant-boiling mixture of ethanol and benzene, a lowering of 0·010° C. per mgm. of water was obtained, but when the azeotropic mixture *n*-propanol/toluene was used, there was obtained a lowering of 0·080° C. per mgm. of water.

The above data prove that the application of the azeotropic mixture *n*-propanol/toluene increases the sensitivity of the method about eight times in comparison with that obtained when the mixture ethanol/benzene is used.

M. WOJCIECHOWSKI.
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National Bureau of Standards,
Washington, D.C.
Jan. 22.

[1] W. Swietosławski, M. Wojciechowski and S. Miernik, *Bull. intern. acad. Polonaise*, A, 59 (1935).
[2] W. Swietosławski, NATURE, **135**, 829 (1935).
[3] M. Wojciechowski, NATURE, **135**, 830 (1935).

* Publication approved by the Director of the National Bureau of Standards of the U.S. Department of Commerce.

Kinetics of a Bimolecular Association in Benzene Solution and in the Gaseous State

FOR the further development of the theory of reaction kinetics and polymerisation in the condensed state, it is important to compare the rate of an association reaction, of the type $a + b \rightarrow c$, in solution and in the gas phase. In this communication experiments are reported from which such a comparison is possible.

The example studied is the Diels-Alder reaction between acrolein (*a*) and *cyclo*pentadiene (*b*) to give endomethylene-tetrahydrobenzaldehyde (*c*)[1]. It was found that in benzene solution, as in the gaseous state[2], a homogeneous bimolecular association is involved. The results of the kinetic measurements are given in the accompanying table.

	Benzene solution	Gaseous state
Temp. range	5·7° – 76·5°	107·9° – 209·8°
k (l./gm.-mol.-sec.)	$3{\cdot}3 \times 10^{-4}$ (t=40°)	$3{\cdot}3 \times 10^{-2}$ (t=160°)
E (kgm.-cal.)	13·7 ± 0·5	15·2 ± 1
Z (l./gm.-mol.-sec.)	$1{\cdot}3 \times 10^6$	$1{\cdot}5 \times 10^6$
$Z_{max.}$	5×10^6	4×10^6
$Z_{min.}$	$0{\cdot}3 \times 10^6$	$0{\cdot}6 \times 10^6$
Measurements by :	Wassermann	Kistiakowsky and Lacher[2]

In the first line of the table the temperature range over which the measurements were carried out is given. The rate constant k was calculated, taking into account all the experiments within this temperature range. E is the activation energy, and Z in the fourth line was calculated from k and E according to the Arrhenius equation $k = Ze^{-E/RT}$. The Z values of the last two lines have been calculated in order to demonstrate the influence of the experimental error: $Z_{max.}$ corresponds to an activation energy 0·9 kgm.-cal. larger, and $Z_{min.}$ to one 0·9 kgm.-cal. smaller than 13·7 kgm.-cal. or 15·2 kgm.-cal.

It will be observed that both the activation energy and the non-exponential term Z are substantially independent of the presence of the solvent.

If Z is split up in the usual way into a steric factor and a collision frequency, then it can be seen that the collision frequency in the gas phase is of the same order as the 'apparent' collision frequency in solution. A full discussion of the experiments reported in this and in a previous note[3] will be given elsewhere.

ALBERT WASSERMANN.

University College,
London.
March 21.

[1] Diels and Alder, *Annalen*, **460**, 119 (1927); Alder and Stein, *ibid.*, **514**, 197 (1934).
[2] Kistiakowsky and Lacher, *J. Amer. Chem. Soc.*, **58**, 123(1936).
[3] NATURE, **137**, 497 (1936).

Velocities of Ultra-sonic Sounds

A SHORT time ago Pitt and Jackson[1] measured the velocities of ultra-sonic waves at the temperatures of liquid air and liquid hydrogen, using a vibrating quartz plate as a source. When an attempt was made to continue the experiment in liquid helium, it was found impossible to get the plate to oscillate vigorously; this led to the suspicion that quartz might show an anomaly in its piezo-electric effect at the temperature of liquid helium.

Experiments have now been carried out by both statical and dynamical methods to test this point; the piezo-electric effect was measured at room temperature, the temperature of liquid air, and at various temperatures from 14° K. down to 4·2° K.

The constant at liquid air temperature was found to be 1·3 per cent less than that at room temperature; this decrease agrees with that reported by Onnes and Beckman[2]: "Thus we may conclude that the cooling from 290° K. to 80° K. causes a decrease of 1·2 per cent in the piezo-electric modulus. A further cooling from 80° K. to 20° K. causes a much smaller change. . . . The importance of this result is perhaps that the change in the piezo-electricity by cooling to low temperatures seems to take place chiefly above the temperature of liquid air."

In our experiments a further reduction in temperature to 4·2° K. produced a reduction of 12·4 (± 0·7) per cent, the greater part of this reduction occurring between 5·5° K. and 4·2° K. This result is remarkable since we should expect the elastic content of the quartz to be increased.

E. F. BURTON.
A. PITT.
D. W. R. MCKINLEY.

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Toronto.
Feb. 19.

[1] Pitt and Jackson, *Canad. J. Research*, **12**, May, 1935.
[2] Onnes and Beckman, *Leiden Comm.*, No. 132*f* (1912).

Points from Foregoing Letters

THE presence of 3–5 per cent of carbon dioxide in the air prevents or alleviates the untoward effects of a low oxygen content (8–9 per cent) on brain stem reflexes and also on vision, muscular co-ordination and mental processes, according to experiments by Prof. E. Gellhorn. The results are interpreted as being due to an improvement in respiration and circulation which leads to a better oxygenation of the brain.

Photomicrographs of bismuth crystals showing 'slip' deformation following upon compression are submitted by Dr. H. J. Gough and H. L. Cox, who point out at the same time that deformation by twinning is more frequent.

When positrons are annihilated (by combining with electrons), two quanta of energy are emitted in opposite directions as required by the law of conservation of momentum, according to experiments reported by Prof. A. I. Alichanian, A. I. Alichanow and L. A. Arzimovitch. The positrons were obtained from radio-phosphorus produced by bombardment of aluminium with alpha particles.

Prof. B. N. Singh and P. B. Mathur find that during the ripening of tomatoes considerable amounts of carbon dioxide accumulate in the fruit tissues. They suggest that the process of senescence is initiated by the accumulation of carbon dioxide, and that the accumulation in its turn is favoured by the greater oxygen intake and carbon dioxide production due to the greater permeability of the superficial tissues.

Curves showing the distribution in the size of cockles after one and two summers' growths in an artificial marine lake at New Brighton (Wallasey) are given by L. E. Bunting, A. Eslick, J. W. Jones and Prof. J. H. Orton. The rate of growth of the continuously submerged cockles is comparable with that observed experimentally under normal tidal conditions and shows that the legal size is reached by about half the shells in two summers.

Measurements of the oxygen liberated by a green alga in intermittent light, made by W. A. Arnold and H. I. Kohn, are reported by the latter. It appears that the absorption unit within the plant is equivalent to about 500 chlorophyll molecules, and that quanta absorbed by a number of such units are pooled in order to reduce one molecule of carbon dioxide. The term unit does not imply a rigid structure.

Using a modified, carefully calibrated Gouy balance, Dr. V. C. G. Trew and Prof. J. F. Spencer find that the mass (diamagnetic) susceptibility of heavy water is 0·637 at 20°, in agreement with the results of Cabrera and Fahlenbrach.

The fact that the number of nebulæ increases more rapidly that the cube of the distance is readily explained according to Prof. V. Varićak, if one uses Lobachevsky's geometry, according to which there are two parallel lines to a given line, meeting it at infinity, and hence a line has two distinct points at infinity and not one only as in ordinary geometry.

Dr. M. Wojciechowski reports that in detecting small amounts of water from its effect upon the boiling point of constant boiling (azeotropic) mixtures, a higher sensitivity is obtained by using *n*-propanol and toluene instead of an alcohol-benzene mixture.

The rates of combination of acrolein and *cyclo*-pentadiene in the liquid and in the gaseous state (at various temperatures) are compared by A. Wassermann. He concludes that the reaction in both cases is bimolecular and homogeneous, and no chain reaction is involved; consequently it is possible to estimate the collision frequency in solution.

Research Items

Excavations at Tall Chager Bazar, 1935

THE results of the excavations of the British Museum and the British School of Archæology in Iraq, conducted by Mr. M. E. L. Mallowan at Tall Chager Bazar during 1935, are briefly outlined by Mr. R. D. Barnett in the *British Museum Quarterly*, 10, 3. The plain of the Upper Habur River corresponds in part to the kingdom of Mitanni. After a preliminary reconnaissance in 1934–35, the mound of Tall Chager Bazar, typical of the district about thirty-five kilometres south of Nisibin, and once an important road junction, was selected for excavation. The mound was found to be formed solely by human occupation and to consist of fifteen layers. It was abandoned about 1500 B.C. It has not yet been identified with any historical site known by name in the records. The topmost and latest level, dating from 2000 B.C. to 1600 B.C., contained solidly built houses of Babylonian type. In one room, possibly a kiln, were clay models of horses, which recall the fondness of the Mitannians for horse-breeding. The pottery, highly polished black and a coarse painted ware, is rare but known elsewhere as Hurrian. Levels II–IV contain well-built houses with a surprising number of child burials under the floors. Level V, 3000 B.C.–2500 B.C., contained houses much destroyed, but below them were rich graves containing bronze daggers, silver beads, etc., which show direct connexion of trade with southern Mesopotamia and resemble objects from the Royal Tombs of Ur. Previous to this the hill had been continuously deserted from the close of the rich prehistoric civilisation, characterised by the 'Tel Halaf' ware recently investigated at Arpachiyah. It is here developed through six habitation levels, in which the first use of metals was achieved. Here was found the earliest known cylinder seal. On virgin soil was the highly polished black pottery ornamented with white-filled incised markings hitherto known only from Sakje-Gözü, north-east of Aleppo and Ras Shamra and resembling that from Knossos. It belongs to the end of the stone age.

Sinkyone Festivals

THE Sinkyone (Kaikomas) are an Athabascan tribe living in southern Humboldt and north-western Mendocino counties, California, to whom two visits were paid in 1928 and 1929 by Miss Gladys Ayer Nomland (*Univ. California Pub. Amer. Archæol. Ethnol.*, 36, 2). Their territory extends from the Pacific Ocean eastward to the Nongatl, Lassik and Wailaki western boundaries, while the southern boundary adjoins Kato and coast Yuki and the northern boundaries adjoin Mattole. Their culture is closely allied to that of the surrounding Athabascans and to the general non-Athabascan type of culture of northern California. One of the most interesting features here recorded is that of the first-salmon rites. During the salmon run, usually lasting about two months, the tribe camped on the banks of the streams. In fishing, unlike hunting, there were no restrictions against women taking part or on sex-relations. Anyone might catch the first salmon; but after its capture, the shaman began the ceremony. The first-salmon rite is a characteristic north-western trait, the southern extension of which meets the Californian culture in Sinkyone territory. This is probably the farthest southerly occurrence of the rite. The prayer with which the shaman begins the ceremony is clearly the same as that of the characteristic first-acorn ceremony, the older acorn formula having been transferred to the newer introduced salmon ceremony. After the first prayer, the shaman danced around a small fire for a short time and then ceremonially scaled and cleaned the salmon with a special obsidian knife, split it open, and roasted it on hot coals at the side of the stream, where it was brought out of the water. The shaman tasted the first morsel, then each person present must taste a bit of the flesh to ensure the increase of salmon for the next year, as well as personal and tribal safety.

Fauna of the Marquesas

THE human population of the Marquesas has fallen from more than 50,000 to about 2,000 owing almost entirely to introduced diseases, especially tuberculosis, and yet a surprisingly small number of the protozoan diseases of the tropics has occurred there. In a survey of the non-marine invertebrate fauna of the islands (excluding the insects), A. M. Adamson shows that large numbers of endemic species are known amongst the Arthropods and Mollusca (*Bernice P. Bishop Museum Occasional Papers*, 10, No. 10; 1935). But while the degree of endemism of land snails in many central Pacific Islands is almost 100 per cent, relatively fewer species of this group would appear to have evolved on the Marquesas, where out of 92 species of land and fresh-water snails 72 (about 78 per cent) are endemic. On the whole, it is apparent that there is a general affinity between the Marquesan fauna and that of the islands to the south-west, Cook and Society Islands and in lesser degree Austral Islands, and thence with the Indo-Malayan fauna. The non-marine invertebrates, however, do not show any direct relationship with those of Hawaii, except as regards one genus of spiders and some of the mites. There is also little evidence of American influence in this island fauna.

Nematodes of the Belgian Coast

DR. J. H. SCHUURMANS STEKHOVEN, jun., in his "Additional Notes to my Monographs on the Free-living Marine Nemas of the Belgian Coasts. I and II written in collaboration with W. Adam and L. A. de Coninck, with some Remarks on the Ecology of Belgian Nemas" adds several new species and new records to his former lists (Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Mémoire No. 72, 1935). The study of many mud and sand samples afforded the opportunity for important ecological studies in which several localities are compared. It is found by the author, that, generally speaking, the richness in quantity of the nemic population depends on the amount of mud and detritus present in the habitat. There is a great deal of shifting due to tides, which apparently explains the comparative richness of the nematode fauna often found in shell sand, for the worms swept by waves find a hold between the

sand particles; but the food is scarce here, and most of the species do not reproduce but move to the more fertile and muddy places for feeding and breeding. A survey of each sample studied shows the number of nematodes present and the composition of the soil, with mention of the more important animal or plant life occurring there. The largest number of individuals, consisting of twelve species, occurred in a sample from Zeebrugge "in yellow-brown sulfur-ion containing mud with an enormous number of *Cyanophyceæ*".

A Simple Test for Seed Viability

DR. KOZO HASEGAWA, of the Forest Experimental Station, Imperial Household, Asakawa near Tôkyô, claims to have had very reliable results in seed testing, with a colour reaction with a one per cent solution of sodium tellurate (*Japanese J. Bot.*, **8**, No. 1; 1936). A darkening of the living embryonic tissues takes place within forty-eight hours (at 16° C.) and this colour change then remains constant. It is claimed that the depth and extent of the colour change can be correlated with the vitality of the embryo. The author further states that no damage is done to the vitality of the embryo by this treatment. This simple method of testing viability will undoubtedly be given a trial in many laboratories where seed viability is a problem of first importance.

Light Intensity and Sporulation of Fungi

MANY species of fungi which produce spores liberally in the open air are poor spore-formers in artificial culture. Mr. W. A. R. Dillon Weston has shown that in the fungi *Helminthosporium avenæ* and *Alternaria solani*, paucity of sporulation is due to lack of sufficient light intensity (*Trans. Brit. Mycol. Soc.*, **20**, Pt. 2, January 1936). The account follows a previous announcement in these columns (NATURE, **131**, 435; 1933) that sporulation was induced by irradiation with a quartz mercury vapour lamp. Further experiments have shown that it was the relatively high intensity of the visible part of the spectrum which produced the effect, and that light below a wave-length of about 400 mμ actually did not induce sporulation. Cultures of *H. avenæ* exposed to high light intensity spored about eighteen hours after irradiation, and continuation of such exposure increased the pigmentation of the fungus.

Decay of Timber

THE *Transactions of the Botanical Society of Edinburgh*, **31**, Part 4, 1935, contains an interesting discussion of the main fungus agencies associated with the decay of timber in buildings, especially under Scottish conditions. It is pointed out that the ravages of different species have been lumped together frequently as due to 'dry rot', *Merulius lachrymans*. In connexion with this organism it is apparently necessary to distinguish between *M. domesticus*, only known on sawn timber, and *M. silvester*, which occurs in the forest. There have been no records of the latter in Scotland until it was found recently on Corsican pine in East Lothian. *Coniophora cerebella* has frequently been confused with dry rot, but the fructifications are different and this fungus only attacks house timber under very damp conditions, when, however, there is some evidence it may pave the way for a subsequent attack of true dry rot. Species of *Lenzites*, *Lentinus* and *Trametes* are also described as occasionally found in building timbers. *Trametes serialis* needs higher temperatures probably than usually prevail in Scotland, but was found in joists around hot-water pipes in an unventilated space.

Wetting Agents in Insecticides and Fungicides

THE full effective action of insecticidal and fungicidal spray solutions is only obtained when the solution thoroughly wets the insect or fungal surface, and this is frequently secured by the addition of wetting agents or 'spreaders', a procedure which may involve difficulties where combined direct and protective washes are used. Evans and Martin (*J. Pom. and Hort. Sci.*, **13**, 4, 261) have made a survey of various wetting agents, the amount of spray retention on several standard surfaces being determined by the use of an apparatus designed to apply known amounts of spray solutions. Wetting properties are defined by the ability of the liquid to form a persistent liquid-solid interface when excess of liquid is drained from the surface, and the various physical properties examined, namely, spray retention, area of spread, contact angles and surface tension, all arrange the materials tested in the same general order of wetting activity. A classification is made of wetting agents on a structural basis, and it is suggested that the behaviour of materials of similar molecular structure may possibly be predicted by certain properties determined in the laboratory.

The Peru Coastal Current

THE Peru coastal current which sometimes bears Humboldt's name has been the subject of much speculation and investigation since Humboldt in 1802 attributed it to cold water from Antarctic latitudes. In a lecture to the Royal Geographical Society on March 9, Mr. E. R. Gunther discussed recent investigations in this current made by the R.R.S. *William Scoresby*. Humboldt's suggestion was queried by Bougainville in 1837 and replaced in 1844 by de Tessan's theory of the upwelling of lower layers. Of this there is no doubt. Maury in 1844 applied the law of deviation due to the rotation of the earth, and Witte in 1880 showed how a northerly current must lag to the west as it reaches latitudes of higher rotation, and thereby induce lower layers of water to well up and take its place. These processes Mr. Gunther admits, but he combats the conception that the surface layers are derived from the coast by offshore winds. This idea was contemporaneous with that of the trade wind belt girdling the earth, which is now known to be untrue; the prevalent winds between lat. 5° and lat. 40° S. blow more or less parallel with the coast. However, the effect is produced by aspiration, that is, by surface drift away from the coast owing to the south-east winds in the open ocean. Mr. Gunther also discusses the small inshore counter currents in the nature of cyclonic eddies. As regards nomenclature, he prefers the name Peru, and argues that Humboldt's name should be dropped since it was associated with an abandoned theory.

Pre-Cambrian Rocks of North America

DETAILED knowledge of the geology of the Lake Superior region has been greatly augmented since the official monograph on the area was issued by the United States Geological Survey in 1911. In Professional Paper 184 of this Survey, C. K. Leith, R. J. Lund and A. Leith have assembled the new

information and presented a revised map, with cross-sections, based on the details of some 150 local maps. The result is a most welcome review of the Pre-Cambrian rocks of one of the world's standard areas. The most noteworthy of the new correlations suggested are (*a*) the correlation of the major iron-formations of the Mesabi, Gogebic, Marquette and Menominee ranges as of Middle Huronian age; and (*b*) the correlation of the iron-formations of the Cuyuna, Iron River, Florence and Crystal Falls districts as of Upper Huronian age. While the Knife Lake series is regarded as probably pre-Lower Huronian, the possibility of its being Lower Huronian is not overlooked. Three great periods of granite intrusion are recognised—Laurentian, Algoman and Killarney. The last of these is defined as cutting the Keweenawan series (550 million years), but there is also a post-Huronian granite of much greater age (800 million years) than the Keweenawan which is probably the equivalent of the type Killarnean granites of Killarney. This difficulty is clearly brought out by recent lead- and helium-ratios. If the post-Keweenawan granites could be given some other name than Killarnean much confusion would be avoided.

The Trent River Bore

AN account by the late H. H. Champion and R. H. Cockran of the bore or 'eagre' which forms in the River Trent has recently appeared (*Proc. Roy. Soc.*, A, March, 1936). Observations were made of the water-level throughout the tidal cycle, at several stations on the river, and a detailed examination was made of the rapid rise of level which constitutes the bore. The tide in the Humber estuary was available from Admiralty tide tables. The observations allowed the authors to draw profiles of the water surface at short intervals, showing the formation of the steep-fronted eagre at a point a few miles from the mouth of the Trent, and its subsequent progress upstream at a speed of about 10 m.p.h. The amplitude of the front increases during the next twenty miles of the progress, and then falls off. The data provide material which could be used for a theoretical analysis of the phenomenon.

Effects of γ-Radiation on the Chick Embryo

IN a paper contributed to *Acta Radiologica* (**16**, 719; 1935) Mr. C. W. Wilson, of the Strangeways Laboratory, Cambridge, discusses some effects of γ-radiation upon the developing chick embryo. Previous investigations had dealt with the action of radiations on chick tissues grown *in vitro*; in the present communication the work is extended to the more complex conditions of growth in the presence of a circulation. Earlier work had indicated that the sensitivity of the chick embryo, as measured by the lethal dose, was dependent upon the age of the embryo at the time of exposure. In the present experiments embryos of 1–6 days' incubation were submitted *in ovo* to uniform γ-radiation from 145 mgm. radium element. The results obtained with exposure for 3 hours suggest that this exposure is somewhere near the border line which permits the complete recovery of an irradiated embryo, with subsequent hatching. Exposures of longer than 3 hours were invariably fatal; shorter exposures, such as 2 hours, permitted a practically normal development in a large number of cases. It was found that radiosensitivity decreased regularly for the first 3 days of incubation, decreased more rapidly from 3 to 5 days and then remained fairly stationary. There appears to be a maximum dose of radiation from which embryos may recover and hatch, and it is suggested that this dose probably produces some irreversible changes through the blood circulation.

Artificial Radioactivity of Thulium

THE rare earths have been repeatedly tested for induced radioactivity, with the sole exception of thulium. Elisabeth Neuninger and Elisabeth Rona (*Wien. Anz.*, **72**, 275 (1935). *Mitt. Inst. Radiumforsch.*, 375*a*.) have examined a thulium preparation which contained, according to spectroscopic analysis, 7·5 gm. Tm_2O_3, 2·3 gm. Y_2O_3, a minute quantity of cassiopeium and traces of erbium. The induced activity of thulium caused by bombardment with neutrons, retarded in paraffin, has a half-period of several months or more and is very intense. The half-value thickness for the electrons is 0·15 mm. in aluminium. The other rare earths contained in the preparation were tested separately for artificial radioactivity, the results showing that besides values already known, ytterbium has a faint activity with a half-period of about 40 hours.

Strength of Synthetic Resin Materials

RAPIDLY growing experience in the preparation and manufacture of the materials grouped under the designation 'plastics' has led to their use in increasingly important applications, a notable example being that of the material for air screws. The advantages from the manufacturing point of view which enable these materials to be made up into intricate forms with a good finish are offset by their low ultimate strength, limit of proportionality and Young's modulus, and as a result they are generally more favoured for ornamental purposes than for parts upon which serious stress is imposed. In the case of air screws, cotton fabric is impregnated with phenol formaldehyde resin, and it is not a little surprising that two such dissimilar materials—one pliable and extensible, the other extremely brittle—should combine to produce one having an ultimate tensile strength of 14,000 lb. per sq. in. with a proportionality limit of 2,000 lb. per sq. in. Owing to the rapid disintegration of the material after this last figure has been reached, Messrs. Aero Research, Ltd., of Duxford, Cambridge, have undertaken an investigation into the possibility of raising its value. In this interesting commercial research it was established that the properties of the combination depended upon the proportion of fabric present and upon the degree to which the fabric is initially in tension and the resin in compression. A tensile load can be applied with safety up to the point at which the initial compression in the resin is eliminated, after which Hooke's law ceases to apply and creep, due to failure of resin and fabric to hold together, begins. Experiments showed that the stress at which departure from Hooke's law occurs is that at which the resin was hardened, and therefore as most commercially obtainable materials are treated at a pressure of one ton per square inch they begin to show creep at about 2,000 lb. per sq. in. Working from this basis, improved methods of manufacture have been devised, and by suitable proportions of fabric and resin, combined under the right conditions, a material having a proportionality limit of 6,500 lb. per sq. in. has been obtained, at, of course, the expense of reduced ultimate strength.

The Egyptian Exploration of the Red Sea

By Dr. Cyril Crossland, Biological Station, Ghardaqa, Red Sea District

A SIX weeks' cruise in the northern Red Sea was undertaken by the University of Egypt and the Fisheries Research Department with the R.E.R.S. *Mabahith* last winter, as a preliminary to a much more extended exploration planned for the present winter, but this has been postponed owing to the political and financial situations. The main items of our programme were :

(1) The structure of the Red Sea Rift.
(2) Hydrography.
(3) The bottom fauna.

Sagh Mahmud el Meligi, of the coastguards service, was in command of the ship. Lines of soundings *transverse* to the axis of the sea were recorded by Lieut. A. M. Badr of the Royal Yachts, and also off the slopes of certain reefs and islands. The geology of islands was undertaken by Nasri Mitri Shukri under the superintendence of G. Andrew of the University of Egypt. Chemistry was undertaken by Abd el Fattah Mohamed, assisted by Ibrahim Eff. Abu Samra of the Fisheries Research Laboratory and others, who were continuously busy on board ship and whose results are still being worked out. In biology, I was assisted by Dr. Mohamed Kamel el Sabi of the Fisheries, who took charge of the biology on those cruises on which I was unable to be present, with the assistance of H. A. F. Gohar, my assistant in the Biological Station, and Abd el Halim Nasr of the University. Abd el Hafiz Eff. Radwan, instrument maker of the University, was indefatigable in keeping the sounding machine in order, a quite essential help.

The Rift Valley structure of the Red Sea needs special methods of investigation. In the first place, the *Mabahith* is fitted with a Hughes echo sounder, which records the depth beneath the ship every two seconds, drawing a curve representing the form of the bottom as the ship passes above it. In this sea this curve is scarcely ever flat, even the plains which do occur generally showing undulations two to three hundred feet high. The two main features brought out by the sections run transversely to the longer axis of the sea are : (1) the steps by which the bottom descends to its greatest depth, such as would be expected on the sides of a faulted valley and which were postulated as foundations for the Barrier reefs by me in 1907[1]; (2) the occurrence of steep submarine hills, some of which reach the surface, such as the well-known Brothers Islets and Daedalus reefs on which lighthouses have been placed. As there is no trace of vulcanism in this part of the Red Sea, these hills must be block mountains resulting from the rifting, as the Brothers and such islands as Zeberged certainly are. These features are illustrated in Figs. 1 and 2, in which the vertical scale is about five times the horizontal, but it is to be borne in mind that echo sounding reduces the slope, and that abrupt summits of scarps, if they occur, are rounded off.

It was hoped that samples of the original rocks of the valley might be obtained, as was done by the John Murray Expedition off the faulted south coast of Arabia, but the whole bottom is buried in a yellow mud. Bottom samples are still under examination, but riddling gives quantities of pteropod shells, etc., or, in shallower water, broken lamellibranchs. Consolidation of this material, especially where it is coarser, near the tops of slopes, is frequent, resulting in either loose friable masses or hard rock. Consolidation was found even in the deep area near the Arabian reefs in lat. 25° 20′, for which we propose the name "Mabahith Deep", at 1,200 fm. and similar depths.

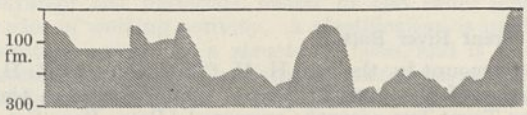

FIG. 1. Section from a point off Ghardaqa, long. 27° 18′ N., lat. 33° 51·9′ E., to the south end of Shadwan Island, showing submarine hills, which, in shallower water, would bear coral reefs. The larger eastern hill bore dead pieces of the reef coral *Montipora*, the encrusting foraminiferan *Gypsina* and Lithothamnioneæ. The latter was found as deep as 52 fm., below which only sand and calcrete were found. The vertical scale is about five times the horizontal.

The irregularity of the bottom, and in shallow water its rocky nature, made dredging and trawling difficult, and frequently resulted only in torn nets, even in the case of the triangular dredge with its specially strong net. Some successful hauls were made, but much of our collecting was done by the

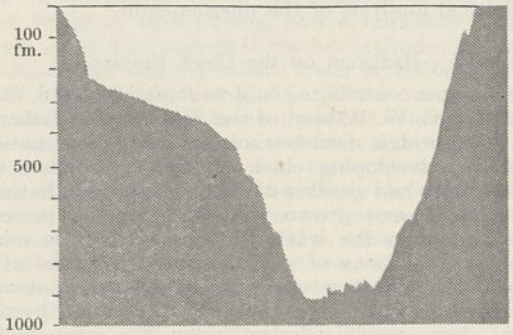

FIG. 2. Section across the deep trough in the Gulf of Aqaba at lat. 28° 50′ E., showing a fault shelf on the west and large irregularities even at the greatest depth. The vertical scale is about five times the horizontal.

grab, which was successful in depths so great as 600 fm. We find that the fauna in deep water consists of few species sparsely occurring, and that no area, even in the Mabahith Deep, is free from life. It will be of great interest to discover the origin of this fauna, since, in the present age, the deep fauna of the Indian Ocean is cut off by the shallow sill at the straits of Bab el Mandab, and the temperature of the bottom waters of the Red Sea, 20° C., is so

much higher than that of similar depths in the oceans. The numerous large quantities of mud obtained by the grab were almost, but not quite, devoid of life.

The coral cappings on those of the submarine hills which reach the surface or nearly so would seem to be similarly situated ecologically to the atolls of the Indian and Pacific oceans, and, as coral growth round their rims is in full vigour, it was expected, in accordance with the theories of growth of atolls, that their slopes would be covered by fallen coral debris. This was found to be the case only to a quite inconsiderable extent; indeed throughout our exploration, recognisable coral debris is confined to quite shallow water. It was also surprising to find that several shoals examined by the grab are not, as would be expected in a sea so full of coral growth, growing towards the surface, but, though small living corals are present, are evidently in process of decay, as shown by the dead and decayed masses of coral brought up: boring organisms are much more abundant in these masses than in the surface reefs. The decay appears to be rapid, since our soundings are deeper than those recorded only sixty years ago. This state of things corresponds with surface reefs in this neighbourhood, some of which are in full vigour, others stationary or in decay; some shoals visible from above are covered completely with growing corals, on others are few or none. Our knowledge of coral ecology is still very imperfect. Between the reefs down to 50 fm. at least, the bottom is in many places rough and rocky, the nature of the rock being at present unknown. Dead and partly living corals only were secured.

The southern part of the Gulf of Aqaba was also explored. The difference between this and the Gulf of Suez is well known; against the average depths of 30–40 fm. of the flat-bottomed Gulf of Suez we have in Aqaba soundings up to 700 fm., but by making courses transverse to the Gulf we discovered a deep trough 900–1,000 fm. deep, well over to the eastern side. This narrow gulf, only about 14 miles wide, thus has a depth nearly as great as that of the Red Sea, which itself is deeper in proportion to breadth than any other. From this depth of water the mountains rise sheer, making one of the most wild and desolate coasts in the world, beside which the deserts and mountains of the Gulf of Suez are a mild and smiling landscape. The maritime plain, so characteristic of the Red Sea shores, where it is generally up to 20 miles wide, is here almost absent, but represented even on some of the most abrupt mountain shores by patches of sedimentary rocks clinging to their bases just above water-level. The immense quantities of alluvial gravels which must have resulted from the denudation of the hills in the past disappeared before the Miocene sedimentary rocks were laid down, showing that the rifting of the valley was in two stages, separated by considerable geological time.

[1] Crossland, C., *J. Linn. Soc.*, **31**, 26 and 284.

Methods of Estimating Underground Oil Reserves

MR. V. BILIBIN'S report on his method of estimating underground oil reserves has been accepted by the Organisation Committee of the International Geological Congress, and will be considered at the seventeenth session of that Congress to be held in Moscow in 1937. In the meantime, it is being circulated by the Committee with the view of obtaining criticisms and further contributions to this somewhat complicated problem of accurate assessment of oil reserves.

According to Mr. Bilibin's method, the first step is to divide up a general geographical map of the country to be surveyed into various groups of areas by means of colours, the division being based on corresponding available data and geological reasoning. It is suggested that the total surface area be divided into groups of areas as follows: those which have already been exploited for oil; those which, tested by deep drilling, are known to be economically oil-bearing; those considered potentially economically oil-bearing as a result of geophysical and prospecting work; those for general geological reasons considered favourable but which have not been tested, or have been insufficiently tested; those for which no estimate of reserves is available; and those considered as non-oil-bearing.

The total surface area of each of the first four groups is used as a basis of calculation. Distinction is then made between the different types of reserves available in each group. Five categories of reserves are suggested, namely, prepared reserves obtainable from producing wells; explored reserves obtainable from new wells in a prospected horizon and within its fixed boundaries; possible reserves obtainable either from parts of prospected horizons, the boundaries of which have not been fixed, or from discovered, but insufficiently tested horizons; supposed reserves obtainable from the first two groups of areas from horizons proved to be oil-bearing by geological data, or estimated to be so by geological considerations; and possible reserves obtainable from areas where prospecting has been favourable. Reserves falling within the different categories are then estimated either by a method of relation curves based on initial production, well-spacing and number of wells per horizon, or by a saturation method which is a mathematical calculation of the ultimate product obtainable from a given horizon, dependent on the volume of the bed, porosity, saturation and recovery factors.

It will be noted that in this method of estimating underground reserves of economic importance, only those are included which are obtainable by wells from each horizon by modern methods of exploitation. Those obtained by so-called secondary methods are not included as it is not at present possible to find out definitely to which horizons these methods can be effectively applied; nor are there sufficient data to show how exploitation can be increased by using these methods.

Utilisation of Tropical Australia

IN discussions relating to white settlement in Australia, reference is often made to the scant population in the Northern Territory in comparison with the dense population of Java, though portions of Java are said to possess similar soil and climatic conditions to the Northern Territory. Sir David Rivett, on behalf of the Commonwealth Council for Scientific and Industrial Research, and with the assistance of the British Consul at Batavia, has made an inquiry into this matter and has been supplied with information by Dr. J. G. B. Beumée, Chief of the Agriculture and Fishery Service, Batavia. Dr. Beumée reports as follows :

"The driest regions of Eastern Java and the Lesser Sunda Islands are only comparable to the more rainy stations from your table [information supplied from Australia]. The rainfall is quite insufficient for an intensive native agriculture. In the district as far as situated on the Islands of Bali and of Lombok, extensive areas are suitable for the growing of paddy, as the rivers from the high volcanoes, which receive much more rain throughout the year, contain sufficient quantities of water for irrigation purposes.

"Only in the dry district of Java where one river brings only sufficient irrigation water, sugar-cane is grown by one European firm, otherwise the scanty native population get a living by cultivating maize, millets, cotton, several drought-resisting beans, and locally by an extensive raising of cattle and horses. The climatic conditions are not suitable for introducing agriculture along Western methods."

Java and Madura are about twice the size of Tasmania, approximately 50,000 square miles in area, and contain about thirty-eight million inhabitants who are pressing on the means of subsistence. This density, which averages about 750 to the square mile, is exceeded in the northern and fertile portion of the island. Several regions have a dry climate and most of these are situated on the lesser Sunda Islands (and the eastern end of Java).

Eight districts are indicated where the rainfall varies from about 50 to 90 inches per annum, but with a period of relatively dry months similar to the conditions in the Northern Territory and parts of coastal Queensland.

In a subsequent letter, dated March 2, 1936, Dr. Beumée furnishes a table showing the population in these dry areas, so far as practicable, and writes as follows :

"The influence of the abundance of irrigation-water on the denseness of the native population is very striking. The districts 2 and 3 on the lower southern slopes of the volcanoes on Bali have the densest population by far. Since very long times the natives there have made and kept in perfect order the necessary arrangements for the distribution of the water as to obtain the highest profit from irrigating their paddy-fields.

"District 8 also has a rather dense population (the average for the whole of Java and Madura being 310 per square kilometer) which population as a matter of fact can get their living there only by the availability of irrigation water."

Some of these are supplied with water by irrigation from the volcanoes of Bali, and they carry a large population. But in other districts the population per square mile varies from 65 to 200, whereas in the dry districts which have irrigation it rises to 750.

It is obvious that even with this enormous population pressure, the dry areas cannot be densely peopled. In Northern Australia, apart from coastal Queensland where the rainfall is not as good and there can be no irrigation, anything like a dense population is out of the question—especially when the population pressure is limited to less than seven million people.

Copelata of the *Terra Nova* Expedition

SUPPLEMENTING his report on the Doliolids (see NATURE of July 21, 1934) Prof. Garstang now deals with the Appendicularians (Report on the Tunicata. Part 2, Copelata. Prof. W. Garstang and Dr. Elizabeth Georgeson. British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. 4, No. 8, 1935. British Museum (Natural History), price 1*s*. 6*d*.). These are from the Atlantic, South Pacific, north-west of New Zealand and the Antarctic, and are all Oikopleurids. Out of 2,000 specimens from thirty-four stations, not less than 1,900 belong to the two species *O. longicauda*, dominating the warm waters of the Atlantic and South Pacific, and *O. valdiviæ*, dominating the Antarctic waters. *O. longicauda* is of world-wide value as a warm-water indicator, and its dominance in the Atlantic and South Pacific samples and absence in the antarctic stations bears this out.

In the recent report of the Tunicata from the Great Barrier Reef (F. S. Russell and J. S. Colman, *Scientific Reports*, 2, No. 7) the authors find also that two species predominate, one being *O. longicauda*, the characteristic species for the warm-water region of the Atlantic, Pacific and Indian Oceans, abundant both in coastal waters and the open sea, and *O. rufescens*, which is a true tropical form, scarcer in the open ocean than in the coastal region, and more frequent in the Indian Ocean than in the Atlantic. In *O. valdiviæ* a very small proportion are mature before the final stage of growth, and the records suggest a short breeding season late in the Antarctic summer. A new species of *Folia* (*F. gigas*) is created for a single specimen from the Antarctic, taken in a net towed (nominally) at a depth of 80 metres, differing in several anatomical points as well as in much greater size from Lohmann's *Folia gracilis*. This had probably drifted into Antarctic waters from the tropical Pacific. The *Stegosomas* are now recognised as essentially epiplanktonic and tropical. Three specimens of *Pelagopleura magna* are interesting, and the presence of food-remains in them seems to prove Lohmann's view that it is a natural inhabitant of antarctic deep water, to which it appears to be confined.

Transformation in the Copper-Gold Alloy, Cu_3Au

OF the papers of a theoretical nature read at the Spring Meeting of the Institute of Metals, that by Sykes and Evans on the transformation in the copper–gold alloy corresponding to the composition Cu_3Au will probably be found by most readers to be of the greatest interest. The conclusions reached are as follows.

It has been shown that the general character of the transformation in Cu_3Au is very similar to that predicted by W. L. Bragg and Williams. In particular, the transformation takes place continuously from the critical temperature to very low temperatures, and the equilibrium condition when produced after long annealing is displaced by a change in temperature, that is, the equilibrium is a dynamic one. The authors have found a large change in resistivity at the critical temperature, not previously established, which is in agreement with theory.

The simple hypothesis put forward in order to describe the relaxation to the equilibrium state is inadequate, and it is not yet possible to state whether a formula of the type :

$$\frac{d\theta}{dt} = \frac{\theta - T}{\tau}$$

is an accurate representation of the experimental facts, even if applied to a uniformly ordered structure. Further relaxation experiments on alloys ordered throughout on the same simple cubic lattice are desirable. We should expect a formula of the type

$$\tau = Ae^{W/\kappa T}$$

to hold in any case for relaxation at constant temperature, so that measurements of τ by both methods, that is, at constant temperature and during cooling, are desirable.

The marked difference in properties of the alloy containing nuclei as distinct from those ordered throughout on the same simple cubic lattice is of considerable interest, and previous work on transformations of this type should be reconsidered in view of these results.

The performance of different samples of the same alloy is accurately reproducible. This is perhaps remarkable in view of the large range of properties which can be obtained by heat treatment, and must be attributed to the fact that the transformation is an intracrystalline phenomenon almost independent of grain boundary effects.

Educational Topics and Events

LONDON.—The degree of D.Sc. has been awarded to F. D. Miles (Imperial College—Royal College of Science) in regard to twenty-two works on physical chemistry, and the degree of D.Sc. (Engineering) to S. J. Davies, reader at King's College, in regard to six works on internal combustion engines and hydraulics, and seven conjoint papers.

ON August 31–September 12 this year, Harvard will celebrate the tercentenary of its foundation in 1636, when the general court of the Massachusetts Colony voted £400 toward "a schoale or colledge". First named "Newetowne", the name was changed to Harvard in 1639 when John Harvard, an immigrant Puritan minister, bequeathed to the College, on his death, half of his estate (£780) and 260 books. According to Science Service, of Washington, D.C., seventy-five of the world's leading men of science and other scholars will gather at Cambridge, Mass., in a conference seldom equalled in America in respect to distinguished speakers and the breadth of subjects. No less than fourteen Nobel Prize winners will be among those giving addresses ; they include Albert Einstein (physics), United States ; Niels Bohr (physics), Denmark ; Hans Fischer (chemistry), Germany ; Arthur H. Compton (physics), United States ; Sir Frederick Gowland Hopkins (physiology and medicine), England ; Robert A. Millikan (physics), United States ; Friedrich Bergius (chemistry), Germany ; August Krogh (physiology and medicine), Denmark ; The Svedberg (chemistry), Sweden ; Otto Warburg (physiology and medicine), Germany ; Karl Landsteiner (physiology and medicine), United States ; Hans Spemann (physiology and medicine), Germany ; E. D. Adrian (physiology and medicine), England ; and Werner Heisenberg (physics), Germany. Symposia will be held upon recent investigations in mathematics, astronomy, physics, chemistry, geology and biology, and also on broader problems such as "Factors Determining Human Behavior", "Authority and the Individual" and "Independence, Convergence and Borrowing in Institutions, Thought and Art", which will draw upon the social sciences and humanities.

THE Carnegie Trust for the Universities of Scotland has published this year, in its thirty-fourth annual report, particulars of its seventh quinquennial allocation, covering the period 1936–40, of grants to universities and other institutions for teaching and research. The grants amount in the aggregate to £257,300 for the whole period. This represents about half the Trust's income, the other half being devoted to assistance in payment of class fees of students. Of the £30,000 allocated for grants during the quinquennium to institutions other than universities, one half goes to the Royal Technical College, Glasgow, Robert Gordon's Colleges, Aberdeen, and the Heriot-Watt College, Edinburgh. The three agricultural colleges at those places, the Rowett and Macaulay research institutes at Aberdeen, the Veterinary Colleges at Glasgow and Edinburgh, St. Mungo's College, Glasgow, and the School of Medicine of the Royal Colleges in Edinburgh all come in for grants of £1,000 or more. The allocation was based on recommendations prepared after exhaustive inquiries by a Committee of Visitation. This quinquennial stocktaking and comprehensive review of the needs of the country in the field of higher education and research greatly enhance the importance of the Trust's services. Appended to the report are speeches broadcast in celebration of the first centenary of Andrew Carnegie's birth.

APPLICATIONS for Ramsay Memorial fellowships for chemical research, one of which will be limited to candidates educated in Glasgow, will be considered by the Ramsay Memorial Fellowship Trustees in June. The value of each fellowship will be £250 per annum, to which may be added a grant for expenses not exceeding £50 per annum. Full particulars as to the conditions of the awards are obtainable from the Secretary of the Ramsay Memorial Fellowships Trust, University College, London (Gower Street, W.C.1).

Science News a Century Ago

Lardner on the Theory of Railways

AT a meeting of the Royal Society held on April 28, 1836, Lardner read a paper "On Certain Parts of the Theory of Railways; with an Investigation of the Formulæ Necessary for the Determination of the Resistances to the Motion of Carriages upon Them". In the course of his paper, he treated of the motion of trains on the level, on ascending and descending inclines and around curves. He confined himself to the analytical formulæ expressing various mechanical effects of the most general kind. He had, however, he said, made extensive experiments in the last few years, and had procured the results of experiments by others, and had made numerous observations in the ordinary course of transit by railways, and he announced his intention of placing the results of these experiments before the Society later.

Darwin in Mauritius

ON April 29, 1836, H.M.S. *Beagle* arrived at Mauritius, where she remained until May 9. Darwin in his "Journal of Researches" gave a short account of the island. On May 1, he took a short walk along the sea-coast, finding the country pleasant but without the charms of Tahiti or the grandeur of Brazil. The next day he ascended La Pouce, 2,600 ft. high. "The centre of the island," he wrote, "consists of a great platform, surrounded by old broken basaltic mountains, with their strata dipping seawards. The central platform, formed of comparatively recent streams of lava, is of an oval shape, thirteen geographical miles across, in the line of its shorter axis. The exterior bounding mountains come into that class of structures called 'Craters of Elevation', which are supposed to have been formed not like ordinary craters, but by a great and sudden upheaval. There appears to me to be insuperable objections to this view; on the other hand, I can hardly believe, in this and some other cases, that these marginal crateriform mountains are merely the basal remnants of immense volcanos, of which the summits either have been blown off, or swallowed up in subterranean abysses."

Since England has taken possession of the island, Darwin said, the export of sugar had increased seventy-five fold, while one of the causes of its prosperity was the excellent state of the roads. Although the French residents must have profited by the prosperity, the English Government was far from popular.

Baron von Ludwig and Sir John Herschel

IN one of a series of "Letters from a Cadet" published in the *Athenæum* of April 30, 1836, the writer gave an account of his visits to Baron von Ludwig and Sir John Herschel at the Cape of Good Hope. The former was a Dutch gentleman of ample fortunes which enabled him "to indulge his taste for natural history, while his enlightened liberality throws open his magnificent gardens to all strangers on the simple condition of sending in their names . . . his garden is that of a philanthropist as well as a philosopher; his fertile mind teems with projects for the improvement of the colony in which he is settled".

The writer had the pleasure of spending the morning with Herschel, finding him engaged in a course of astronomical researches which, he said, had already afforded some most interesting results. "He had made himself universally respected by his amiability, his readiness to assist the distressed, and his anxiety to join in all local schemes of improvement, whether in education, agriculture, commerce or scientific discovery. It is really a touching sight to behold this man, deservedly ranked among the first of his age, leaving an infant school, which has, in great measure, sprung up under his fostering care and influence, to draw up at the desire of the Cape Literary and Philosophical Society, a body of admirable instructions for the gentlemen composing the scientific expedition at present engaged in exploring the pathless wilds of Southern Africa."

Agassiz and the Geological Society

AGASSIZ (*Notizen a. d. Gebiet. d. Natur. u. Heilkunde*, April 1836), on the occasion of his visit to London, speaks in the following high terms of praise of the Geological Society: "The Geological Society of London is one of the institutions which have been founded on the most liberal principles and by its influence supports everything which even indirectly can contribute to the progress of science. It is to the generosity of the president and council of this society that I have been able to carry out a work in London which would have been impossible without the support and authorization of a society which enjoys a high reputation unparalleled in the history of the natural sciences. As I found that the collections of the three kingdoms possessed an enormous amount of material important for my work I wondered how I could best avail myself of it, and it was only through the liberality of the English men of science that I was able to take away with me the specimens which appeared to throw a new light on fossil fishes. On the application of Messrs. Greenhough, Sedgwick, Murchison and Lyell, I had permission to examine all these treasures in a room at Somerset House, where Mr. Lonsdale, the conservator of the Society's collections, helped me to arrange 2,000 specimens of fossil fish which I had selected from about 8,000 in England, Scotland and Ireland."

Societies and Academies

DUBLIN

Royal Dublin Society, February 25. T. J. NOLAN, J. KEANE and P. A. SPILLANE: The chemical constituents of lichens found in Ireland. (*a*) *Buellia conescens*. (2). The lichen contains atranorin, chloratranorin, diploicin, for which the formula $C_{16}H_{10}O_5Cl_4$ has been confirmed, and a substance closely related to diploicin and having the formula $C_{16}H_{11}O_5Cl_3$. Diploicin is a depsidone containing one methoxyl and one phenolic hydroxyl group, and is most probably derived from the condensation of two molecules of dichlor-orsellinic acid with the elimination of one molecule of carbon dioxide. T. J. NOLAN, J. KEANE and M. MOHAN: (*b*) *Lecanora gangaleoides*. (2). The lichen contains atranorin, chloratranorin, gangaleoidine, for which the formula $C_{18}H_{14}O_7Cl_2$

has been confirmed, and a substance of formula $C_{26}H_{21}O_{10}Cl_3$ containing one methoxyl group and apparently a tridepside. Gangaleoidin is shown to be closely related to diploicin and is a depsidone containing one phenolic hydroxyl, one methoxyl and one carboxylic ester group. T. J. NOLAN, J. KEANE and G. KENNEDY: (*c*) *Lecanora sordida*. (1). The observations of Zopf concerning the constituents of this lichen are confirmed in certain respects. It contains 4 per cent rocellic acid, a dextrorotatory dicarboxylic fatty acid for which the formula $C_{17}H_{32}O_4$ is confirmed, 0·7 per cent of a mixture of atranorin and chloratranorin and 0·02 per cent of an acid resembling Zopf's thiophanic acid and containing 14·1 per cent of chlorine. J. BELL and W. A. GILLESPIE: The hydrolysis of urea hydrochloride. Determination of the hydrolysis constant of urea hydrochloride in aqueous solution by electrometric methods gave results in agreement with the original values obtained by Walker and Wood, using catalytic methods. J. LYONS and M. O'SHEA: Factors influencing the loss of butter fat in churning. The lesser the proportion of small fat globules in the cream, and the lower the temperature to which the cream is chilled, the more efficient the churning: cream of medium richness, effectively cooled after pasteurisation and agitated in a fairly full container, churns best.

PARIS

Academy of Sciences, March 16 (*C.R.*, **202**, 885–992). ERNEST ESCLANGON: The abnormal solution of a problem of mechanics deduced from the principle of relativity. DIMITRI RIABOUCHINSKY: Contribution to the theory of gaseous jets. LUC PICART was elected a non-resident member in succession to the late Victor Grignard, and MAURICE NICLOUX a *Correspondant* for the Section of Chemistry. CHARLES PISOT: A characteristic property of certain algebraic integrals. TH. MOTZKIN: Transformations which do not augment the number of variations of sign. PAUL VINCENSINI: Certain series of Laplace. ALFRED ROSENBLATT and STANISLAW TURSKI: The conformal representation of plane domains. W. STERNBERG: The integral equation of the first species. STANISLAW MAZUR and WLADYSLAW ORLICZ: Rational functionals. ARNAUD DENJOY: Homographic groups. V. FROLOW: The movements of the mean level of the sea at Brest and at Marseilles. JEAN LEGRAND: Analysis of the oscillations of the mean annual sea-level at Brest. CHARLES JAEGER: Theory of knocking in forced mains with multiple characteristics. The resonance of the fundamental and the harmonics. PIERRE ERNEST MERCIER and JEAN CROSET: A graphical method of solving hyperstatic systems. F. LINK: The photometric consequences of Einstein's deviation. MLLE. MARIE ANTOINETTE BAUDOT: The new electrodynamics. JEAN LOUIS DESTOUCHES: The electronic nature of light. LA GOLDSTEIN: The shocks of slow electrons in pure oxygen. Electronic affinity. JEAN CAYREL: The Devaux reaction concerning the modification of a superficial film of cupric sulphide by copper. MARCEL PAUTHENIER and MME. MARGUERITE MOREAU-HANOT: Remarks on the measurement and production of high potentials. A method of absolute measurement is described in which a sphere is charged to the potential to be measured, and a small disk of platinum of the same curvature is lifted by the repulsion, and falls off the sphere. The authors describe the number of thin disks used as a box of weights for potentials. ANDRÉ EGAL and ROBERT CHEVALIER: A meter with compensated thermocouples for measuring the calories given out by a hot water central heating installation. BERNARD KWAL and JACQUES SOLOMON: A consequence of the new non-linear electrodynamics. JEAN SAVORNIN: The theory of diffraction by a metallic screen with a rectilinear edge. MICHEL DUFFIEUX and LÉON GRILLET: A new band of nitric oxide. YVES LE GRAND: Two properties of sources of polarised light. OTAKAR VIKTORIN: The emission of ultra-violet radiation in the Reboul effect. A description of experiments showing clearly that an ultra-violet radiation of a wave-length between 2600 and 2000 A. accompanies the Reboul effect. SALOMON ROSENBLUM: The existence of the α_5 line and the decomposition of the magnetic spectrum of thorium C into two series. JEAN AMIEL: Contribution to the quantitative study of the slow combustion of benzene and of some hydrocarbons: The results are shown in curves, and a formula, admittedly empirical, is given which agrees well with the author's experiments. HENRI MURAOUR and ALBERT MICHEL-LÉVY: Metal spectra obtained by waves of shock. MME. MARIE ELISA P. RUMPF: The existence of chlorotitanic acid, H_2TiCl_6. The Raman spectrum. RENÉ FREYMANN: The measurement of dielectric constants for very short waves with the aid of a recording apparatus. The accuracy of the apparatus described is of the order of 0·5 per cent. The results of its application to pyrrol and to some amines are given. MARCEL PRETTRE: The influence of pressure, concentration and temperature on the slow oxidation velocity and aptitude to spontaneous inflammation of mixtures of oxygen and normal pentane below 300° C. RAYMOND QUELET: The chloro-alkylation of anisol: the synthesis of vinylanisols. F. BLONDEL and J. BONDON: The manganese of the Siroua (South Morocco) region. LÉON AUFRÈRE: The *Cervus Somonensis* of the National Museum of Natural History. ALBERT ROBAUX: The distribution of the Flysch in the subbetic along the Londa transversal (Andalusia). ARMAND RENIER: The Armorican chain and Varisque chain. Contribution to the study of the inflections of bundles of folds. CLAUDE GAILLARD: A giant bird in the Eocene deposits of Mont-d'Or Lyonnais. The portions found indicate a bird of the size of the black cassowary of Australia. PAUL ROUGERIE: The relation between the solar activity and the daily amplitude of the north-south telluric currents recorded at the Ebre Observatory. EDMOND GILLES: The ultra-violet absorption of cellophane and of plant tissues and organs. RENÉ SALGUES: Leaf cyanogenesis in Photinia. HENRI COLIN and MLLE. ANDRÉE CHAUDUN: The diastatic degradation of the intercellular cement. MLLES. EUDOXIE BACHRACH and MADELEINE SIMONET: Diatoms and blue pigmentation. JACQUES MAWAS: An undescribed epithelial organ, the infra-orbital paraganglion. PAUL BECQUEREL: The latent life of some Algæ and lower animals at low temperatures and the conservation of life in the universe. MME. ANDRÉE DRILHON: Some chemical and physicochemical constants of the internal medium of *Carcinus mœnas*. MME. PAULETTE CHAIX and CLAUDE FROMAGEOT: New experiments on the action of sulphur derivatives on the fermentation of glucose by propionic bacteria. THÉOPHILE CAHN and JACQUES HOUGET: The final destination of the glucides in the muscle extracts of normal and diabetic dogs. RAYMOND POISSON: *Dermomycoides armoriacus*, a cutaneous parasite of *Triturus palmatus*.

The structure of the zoospore. ETIENNE SERGENT: The preparation of an active serum against scorpion poison. W. KOPACZEWSKI: The lactogelification of the seric proteins in cancer.

Moscow

Academy of Sciences (*C.R.*, 1, No. 1; 1936). F. GANTMACHER: Non-symmetrical nuclei of Kellogg. V. KUPRADZE: Dispersion of electromagnetic waves in a non-homogeneous medium. I. I. ISLAMOV and J. M. TOLMACHEV: Colour of corundum. G. M. KOVALENKO: Resistance of gaseous mixtures to electric penetration. N. A. SHISHAKOV: Anomalous structures of fine crystalline silica. K. S. TOPCHIJEV: Action of carbon disulphide on methyl-pyridonimmin. N. TUDOROVSKAJA: Some peculiarities in the variations in the refraction index of glass at temperatures below 300° C. V. I. BODYLEVSKIJ: Concerning traces of the Upper Volga stage in the west Siberian plains. G. C. LAEMMLEIN: The sequence of the deposition of silicates from magma and their crystal grid energies. D. KOSTOFF: Studies on polyploid plants. (11) Amphidiploid *Triticum timopheevi*, Zhuk. × *Triticum monococcum*, L. M. L. KARP: Number and distribution of genes in the third chromosome of *Drosophila melanogaster*, affecting the number of sternital bristles. N. P. KALABUCHOV and L. B. LEVINSON: Effect of low temperature upon trypanosomes (*Trypanosoma equiperdum*) in mammals (see NATURE, Oct. 5, 1935, p. 553). A. N. SVETOVIDOV: A new herring from the Caspian Sea, *Caspialosa caspia salina* subsp.n.

Rome

Royal National Academy of the Lincei (*Atti*, 22, 181–273) G. SCORZA: Varieties of Veronese. L. PUCCIANTI: Electrical and magnetic inductivity in relation to the new electrical metrology. L. PUCCIANTI: General considerations on magnetic moment and magnetic poles, intensity of magnetisation and susceptibility, and on the corresponding measurements in a system with four fundamental units. G. A. MAGGI and B. FINZI: A question relating to electro-magnetic harmonic waves. G. PALOZZI: Projective linear element and projective applicability of new lattices of ordinary space. S. CHERUBINO: Series of powers of one variable in one algebra. T. BOGGIO: Some systems of differential equations. B. HOSTINSKÝ: Integration of linear substitutions. A. TERRACINI: Projective deformability of rectilinear congruences. G. MARLETTA: Observations on differential projective geometry. G. ASCOLI: Asymptotic behaviour of integrals of linear differential equations of the second order. L. SONA: Translo-circulatory current which attacks a bilateral lamina (2). M. PASTORI: Problem of Clebsch (2). Application to coupled tensors. L. ALLEGRETTI: Measurements of anomalous dispersion of the first doublets of Sr^+ and of Ba^+. The ratio of the anomalous dispersion coefficients N_1/N_2 for the first doublet of the principal series of Sr^+ and of Ba^+ has the values 2·07 and 2·16, respectively. D. GHIRON: Borovanadates. The existence of two series of borovanadates $2Me^{II}O$, V_2O_5, $3B_2O_3$ and $Me^{II}O$, V_2O_5, B_2O_3 has been shown. M. FRERI: Anomalous action of nitrous acid on hydrazides of organic acids. The action of nitrous acid on the hydrazide of citraconic acid is described. L. PERETTI: Outcrop of pre-Triassic gneiss near Acqui. V. PUNTONI: *Proteomyces infestans*, Moses and Vianna, and its relation to the genus *Trichosporon* (Behrend, 1890).

Forthcoming Events

Monday, April 27

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Lieut.-Colonel D. L. R. Lorimer: "Life in Hunza" (film).

ENGINEERS' GERMAN CIRCLE, at 6.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—E. Kurzel-Runtscheiner: "Das Technische Museum in Wien".

Tuesday, April 28

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Louis Souchon: "Mauritius".

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Sir Joseph Barcroft, F.R.S.: "The Genesis of Respiratory Movements in the Fœtal Sheep".

INSTITUTION OF CIVIL ENGINEERS, at 6.—E. J. Buckton and H. J. Fereday: "Demolition of Waterloo Bridge".

Friday, May 1

INSTITUTION OF ELECTRICAL ENGINEERS (METER AND INSTRUMENT SECTION MEETINGS), at 7.—Clifford C. Paterson: "Uniformity as the Gauge of Quality".

ROYAL INSTITUTION, at 9.—Major W. S. Tucker: "Direction Finding by Sound".

Official Publications Received

Great Britain and Ireland

Researches published from the Wards and Laboratories of the London Hospital during 1935. 28 papers. (London: H. K. Lewis and Co., Ltd.) 7*s*. 6*d*. net. [263

The Work of the Heterogeneity of Steel Ingots Committee. Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation reporting to the Iron and Steel Industrial Research Council. Being a Review of the Work to date (December 31, 1935) compiled at the request of the Committee by Dr. W. H. Hatfield. (Special Report No. 12.) Pp. iv+43. (London: Iron and Steel Institute.) [263

Report of the Rugby School Natural History Society for the Year 1935. Pp. 52. (Rugby: George Over, Ltd.) [273

Sea-Fish Commission for the United Kingdom. Second Report: The White Fish Industry. (Cmd. 5130.) Pp. 113. (London: H.M. Stationery Office.) 2*s*. net. [273

Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 637: Soils of Orleans County, New York, in their relation to Orchard Planting. By A. T. Sweet. Pp. 32. Bulletin 638: Ten-Year Report of Studies in Child Development and Parent Education. By Ethel B. Waring. Pp. 69. Bulletin 639: Soil, Field-Crop, Pasture and Vegetable-Crop Management for Delaware County, New York. Part 1: Soils and Field Crops, by A. F. Gustafson; Part 2: Pastures, by D. B. Johnstone-Wallace; Part 3: Vegetable Crops, by F. O. Underwood; Part 4: Soil Map and Soil-Type Descriptions, by C. S. Pearson, F. B. Howe and A. F. Gustafson. Pp. 88. Memoir 181: Intercellular Humidity in relation to Fire-Blight Susceptibility in Apple and Pear. By Luther Shaw. Pp. 40. Memoir 182: Wholesale Prices in Cincinnati and New York. By H. E. White. Pp. 42. (Ithaca, N.Y.: Cornell University.) [14

Proceedings of the American Academy of Arts and Sciences. Vol. 7, No. 7: Compressibilities and Electrical Resistance under Pressure, with Special Reference to Intermetallic Compounds. By P. W. Bridgman. Pp. 285–318. 75 cents. Vol. 70, No. 8: The Specific Volume of Steam in the Saturated and Superheated Condition together with Derived Values of the Enthalpy, Entropy, Heat Capacity and Joule Thomson Coefficients. Part 4: Steam Research Program. By Frederick G. Keyes, Leighton B. Smith and Harold T. Gerry. Pp. 319–364. 1 dollar. Vol. 70, No. 9: Philippine Phoridae from the Mount Apo Region in Mindanao. By Charles T. Brues. Pp. 365–466. 1.50 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [14

Records of the Geological Survey of India. Vol. 70: Quinquennial Review of the Mineral Production of India for the Years 1929 to 1933. By the Director and Senior Officers of the Geological Survey of India. Pp. iv+453+lxxvi+7 plates. (Delhi: Manager of Publications.) 6.4 rupees; 10*s*. [14

Indian Central Cotton Committee: Technological Laboratory. Cotton Research in India: being an Account of the Work done at the Indian Central Cotton Committee Technological Laboratory, 1924–1935. By Dr. Nazir Ahmad. Pp. vi+100+12 plates. (Bombay: Indian Central Cotton Committee.) 2 rupees. [14

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 18–1: How Communities can Help. Pp. vii+77. (Washington, D.C.: Government Printing Office.) 10 cents. [14