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Industrial Recruitment and Educational Policy

THE valuable section in the final report of the Balfour Committee on Industry and Trade, which considered education as a factor in industrial and commercial efficiency, emphasised the urgent need for each great industry to make its own educational needs the subject of thorough and systematic examination, "particularly because the changing forms of organisation and mechanical equipment and the subdivision of occupations which characterise some of the more important industries are continually modifying the nature and extent of their educational needs, and these changed needs can only be fully known to those actually engaged in industry".

The five years which have elapsed since this report was presented in March 1929 have subtracted nothing from the cogency of its argument. On the contrary, the growing intensity of international competition supplies a strong insistent force, which was previously lacking, impelling those engaged in industry and commerce to consider how they should improve the efficiency of their personnel as well as of themselves. It has become clear, too, that those personal qualities, on which we have relied in the past far more than on specialised knowledge, are by themselves inadequate to meet modern demands for leadership and must be supplemented by greater knowledge and a wider outlook. Finally, the chaotic conditions to which the economy drive of the last two years have reduced education in Great Britain are causing misgivings in the minds of the most stubborn regarding the capacity of the next generation—whether in rank and file or in leadership—to maintain our higher standard of living in the face of modern competition.

Suggestions for co-operation between industry and educational authorities have frequently been put forward, and were indeed worked out in detail in the report of the Malcolm Committee, which recommended that the Board of Education should establish a small special body representative of the views of employers, workers, local education authorities and teachers to undertake national negotiations. In the report on Trade Schools on the Continent, which was issued in 1932, two inspectors of the Board of Education directed attention to the danger to our industrial efficiency which is presented by the growing vertical immobility of labour, as well as to the necessity of organising our institutions for technical educa-

tion less in response to a demand from below and more in response to the actual requirements of industry as seen by its leaders. In his recent book on "Education for Industry and Commerce in England", Mr. A. Abbott makes an even more emphatic plea for a complete review of our methods of industrial recruitment, training and promotion. He urges that each industrial organisation should consider carefully first what types and grades of workers it needs and in what numbers: and secondly, from what types and grades of schools these should be drawn.

The relation between industrial recruitment and educational policy and development has been overshadowed by the unemployment question, but the growing extent of juvenile unemployment is once again focusing attention on this problem. If only as a means of checking continuous recruitment into occupations where juvenile employment is already disastrously high, steps must be taken to afford the youth of the country suitable training for those industries which can offer them a reasonable prospect of employment and advancement in their chosen work; they must not be left to enter those which are merely exploiting wholesale their defenceless situation.

As a first step to this end, it is obvious that each industry must be able to formulate its own requirements and to do so continuously, so that with the selection of recruits there is associated a definite plan of training and promotion. In spite of the discussions which have centred round training for management, and the care which is now taken in some industries in the training of recruits, whether drawn from the universities, from technical schools or from secondary and elementary schools, the bearing of the developments in post-primary education recommended under the Hadow scheme on industrial recruitment and promotion is as yet scarcely realised by industry. The net result of educational selection at the age of eleven years for post-primary or other schools with a leaving age above fourteen, will be that the members of the selected group will greatly outstrip those of the unselected group in competition for the more responsible and attractive posts of industry. Its responsible officers will to an increasing extent come from a group of individuals picked out at an early age for prolonged education, and its rank and file will come from the larger group of individuals not so selected.

It is accordingly desirable not merely that industry shall formulate its requirements as to the training to be given before and after recruitment, the standard and type of education desirable in its recruits, whether for the rank and file or for the more responsible positions. It is equally important that the whole methods of recruitment should be reviewed and modified or replaced by better methods desirable. Recruiting policy must take account of the changed conditions of education and not be content to follow blindly the methods of generations ago, regardless of their suitability or unsuitability.

There is little doubt that a re-examination of recruitment policy would speedily result in enlisting a considerably higher proportion of students who had received a good previous education in part-time classes of the technical schools, and thus tend to raise the general standard of the rank and file of industry. The quantitative aspect of recruitment is, however, equally important. Each industry should be able to give a reasonably accurate estimate of the number of recruits it expects to require during a period of years from each class of school—those with students at a leaving age of fourteen years: the post-primary schools and the technical schools giving a full-time education up to eighteen: and those coming from the universities or technical colleges of university rank.

Industrial planning on this scale is long overdue. The mischief which has been done by extravagant statements regarding the demand for chemists or other classes of scientific workers, for example, causing an influx of students to such courses in numbers far exceeding the capacity of the industry to absorb them, is difficult to assess but has been widespread in the last decade. Similar or even more vicious conditions are to be found among every category of student from the elementary school upwards. Even at the present time such industrial planning cannot be dismissed as impracticable or visionary. Such books as Prof. G. C. Allen's "Industrial Organisation in Great Britain" have demonstrated the imperative need for industry to face the facts, if any, if our lost prosperity is to be recovered or indeed our standard of life maintained.

One incidental result of such an estimate would be to bring out into clear relief those industries which are making little use of men with a wide and thorough scientific training, or relying entirely on relatively untrained sources for the recruitment of their rank and file. Lack of efficiency, because those responsible for the direction of an industry

did not possess sufficient knowledge and training to make use of the facts now available for them, would be speedily correlated with its true cause, and the community would be in a strong position to refuse to allow palliatives in place of remedial measures.

On this ground alone some opposition may be expected to any proposals for the planning of a policy of technical education and industrial recruitment. The advantages which such a policy offers, however, are too solid to be thwarted by mere reactionary or prejudiced views. There is first the imperative necessity of securing for the service of industry competent workmen and skilled foremen, who possess the ability to meet the demands of this age for a new kind of skill based on considerable intelligence, a sound general education, a willingness to develop fresh interests and a capacity for adaptation to fresh tasks. Secondly, there is the advantage of securing the staffing of industry generally with university graduates, or men with wide scientific knowledge and training, not merely for the purpose of research but also for securing that full advantage is taken, in every sphere, of the new tools which science is constantly forging, whether for new production, increased efficiency, or the safeguarding of life and health.

We here touch on perhaps the most fundamental need of all. It is probably true to-day that most, though not all, industries have a research organisation in one form or another which is adequate to their present needs, and there are indeed a number of industries in which new knowledge is being gained more rapidly than it is utilised. There are, moreover, many branches of industry in which there is no real hope of applying the new knowledge gained by the various research organisations until the qualifications of the men at the top have been improved.

This is largely a matter of training for management, of seeing that those recruits for industry who are destined ultimately for its management or administrative staff should have had a broad general education on which they have built a first-rate scientific education. Apart from the absolute necessity of adequate scientific knowledge for sound and prompt decisions as to whether and how a new piece of knowledge can be utilised, whether its utilisation is likely to be permanently profitable, its reaction on other production and development, whether a difficulty encountered in works practice should be solved on the spot or more wisely referred to a research organisation or department, the significant check to the vertical mobility of labour makes the old haphazard habit of recruitment for management inadequate. We can no longer expect that recruits of the requisite calibre will continue to work their way up from the bottom, or that those who do raise themselves to some extent will possess the wide knowledge and breadth of vision required of those in administrative or managerial posts.

Technical knowledge is, of course, only one of the factors required in the higher management of industry. It is equally important that a policy of industrial recruitment should take full account of the various institutions, such as the Department of Business Administration at the London School of Economics, of Industrial Administration at the University of Manchester, or the Institute of Industrial Administration, which are specifically directed towards training for management. The training given in those courses must be regarded rather as fitting the students to take fuller advantage of their industrial experience, and to qualify themselves ultimately for the more efficient discharge of administrative duties. The courses are not a substitute for wide technical and scientific training. They are rather complementary, and require planning in close relation to industrial requirements and opportunities, if mobility of staff on the technical side is not also to be discouraged.

The demand which a policy of industrial recruitment makes for co-operation between industry and educational authorities is obvious. It is less apparent, however, that its achievement demands a widespread interest in the community, and particularly a general conviction that technical education is a most powerful instrument for maintaining and increasing technical efficiency. Unless public opinion regards technical education not as an attempt to train well-disposed and ambitious individuals for higher posts but as a definite effort to train an industrial army, officers and rank and file alike, which by its *moral* and technique will safeguard and strengthen the economic life of the State, there is unlikely to be forthcoming the support which will undoubtedly be necessary if the opposition of such backward industries as the cotton industry to a planned policy is to be overcome.

There are at any rate signs that a considered policy is within the bounds of possibility. The alarming position of juvenile unemployment in Lancashire has already focused attention on the

exploitation of juvenile labour in the cotton trade in the absence of a recruiting policy, and has led the Lancashire authorities to initiate their own plan for raising the school age and working the Hadow scheme. A definite policy with regard to the recruitment of laboratory assistants for scientific laboratories, who in the past have provided an unhappy example of a blind alley education, has already been adopted by some industrial firms and promises to mitigate or avoid this difficulty. In addition, there is a growing tendency for professional organisations of scientific workers, such as the Institute of Chemistry, to interest themselves in technical education, whether in post-graduate classes, or in the training for higher positions in evening or part-time classes of those already engaged in industry.

The association of scientific workers is an essential element in the elaboration of an adequate policy. The task of educating public opinion as to the bearing of technical education on industrial efficiency, whether among the leaders or the rank and file, must fall largely on them. On their researches and investigations the continuous development of technical education depends. In their personal capacities, whether in industrial or educational posts, they must make important contributions to the detailed elaboration of policy. There are few fields in which larger demands for public service are made on the profession of science than in just this field of technical education, upon which the industrial future of Great Britain now so closely depends.

The solution of our problems of education for industry and commerce, and the elaboration of adequate and harmonious relations in regard to recruitment between industry and education, depend largely upon the capacity of the organised scientific industrial and commercial professions to exert deliberately and continuously the same liberalising influence on standards of education as the so-called liberal professions have exerted less consciously and actively in past centuries. Technical education from one point of view is the training of industrial personnel, and this is an essential factor in the permanent recovery of industrial prosperity. From another point of view it is the use of applied science as a means of higher education; and to demonstrate our ability to use applied science as an agent of education as previous generations used the classics may well prove to be one of our greatest achievements in this century.

African Folk-Lore

Myths and Legends of the Bantu. By Dr. Alice Werner. Pp. 335+31 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1933.) 15*s*. net.

DR. WERNER is best known in the field of African philology, for her knowledge of Bantu tongues is probably unique, and beyond doubt these acquirements have greatly facilitated her researches into the mythology of the people dealt with in this work. Such a patient and discerning investigation must therefore command great respect.

Folk tales have, through the ages and all over the world, always had an attraction for mankind, otherwise they could not have survived, but it is only during the last fifty years or so that they have received attention from analytical minds. Thanks to the researches of E. B. Tylor, Sir James Frazer and others, the study of the legendary lore of primitive folk has been accorded a definite place in anthropological science, and its importance is now fully recognised. As the author remarks in her preface, it now seems incredible that Moffat in 1842 could state that a description of the manners and customs of the Bechuana would be "neither very instructive or edifying", and another distinguished missionary referred to the "absurd and ridiculous fictions" of the tribe. This attitude persisted in East Africa to much more recent times, but information dealing with beliefs, customs and arts has of late years poured in from all quarters.

We have in the work before us a *corpus* of mythological material the wealth of which is staggering, and it is only owing to its painstaking division into classes by the author, that the student can obtain a grip of the essentials.

As will be well known to most, the term Bantu has little racial significance, for it refers solely to a language group of people. That is to say, over a vast extent of Africa we find masses of people, often of diverse physical characteristics, all speaking languages referable to the same original tongue. The persistent uniformity of structure in the various branches of Bantu speech over such a vast area is a remarkable phenomenon, when we consider that it was adopted by many racial groups which must have had languages of their own, and of which there is now but little trace.

Besides the language relationship, there is another remarkable fact, namely, that those to

whom a Bantu language has become the mother tongue have, generally speaking, the same religious beliefs. All are monotheists, although the idea of a high god is often not clearly distinguished from the sun, the sky and even the first ancestor of the tribe. The basic fact in their religion is, however, the belief in the power and influence of the dead, whence it follows that they believe in survival after death, for they are convinced of the intervention of the spirits of the departed in the affairs of the living. This fact is relevant to the origin and survival of their mythology, for if this belief had not existed, much of it could never have been born. The folk tales give an invaluable insight into the workings of this belief, for it would appear that although they rarely see the dead in the flesh, the spirits reappear in the guise of birds, sometimes as snakes and even as children. The spirits of the dead sometimes exercise a moral influence and there are several cases where a murderer is detected by the intervention of a spirit personified in the shape of a bird. They may inflict punishment, too, if neglected, or as a judgment on some undiscovered lapse in tribal law.

The unfettered power of metemphycosis which is believed to be possessed by the spirits of the dead has played a great part in the development of the folk-lore of Africa, and for that reason the connexion between the religion of these people and their mythology should not be lost sight of, even if it does not explain all.

The belief in heroes and demi-gods flourishes among the Bantu-speaking peoples, quite in accordance with the legendary myths of the classics and of the Norse lands. The lives of the famous Ryang'-ombe, Liongo and others may be quoted. The birth of the hero often occurs in unusual circumstances and he skips adolescence, acquiring mature strength with miraculous rapidity; his precocity is such that any attempt to kill him is at once detected. Around some of these figures quite a *saga* of legends has accreted, and although many of the happenings are impossible, there may be a basis of historical fact. Belief in these characters persists among the people of Africa even to-day.

Next comes the folk-lore, in which animals play a great part. Included in this group of legends are the stories in which the special feature is a swallowing monster, which is eventually killed by a hero and then all is well, for its victims emerge unharmed. We have here reminiscences of the 'Giant Killer' and Jonah of whale fame so familiar to all of us.

In the animal group we have, too, a multitude of stories which fall into what may be called the "Brer rabbit" class, made famous throughout the civilised world by "Uncle Remus". Needless to say, in Africa the rabbit is really the hare, for there are no rabbits. The general motif of the stories is that a small beast, physically weak but blessed with cunning, defeats slower witted but stronger beasts such as the lion, elephant, etc. According to local taste or for some recondite reason, the place of the hare is sometimes assumed by the chameleon—which, by the way, is blamed for the introduction of death—the jackal, and as for the tortoise, he comes into a group of stories of his own. It is the "old man Tarrypin" of the Uncle Remus collection.

The occurrence of the triumph of small defenceless creatures which is such a feature of these stories, excites curiosity. The author considers that it is stressed owing to a natural sympathy for the 'under dog'; others are inclined to emphasise the African tendency to exalt low cunning. Both reasons may have an influence.

The detection of similarities in mythical stories from parts of the world remote from each other has for long given rise to astonishment and has often led to controversy. Diffusion throughout the Bantu-speaking language group has obviously occurred, but so far as can be ascertained, the myths do not appear to afford much argument for their dispersion from that much-favoured centre—Egypt. It is true that, in her final chapter, the author identifies a limited number of legendary stories as being, for example, similar to such well-known folk-tales as Cinderella, to stories from Assam, the Buddhist Jatakas, even the medieval "Gesta Romanorum", and so on. Truly folk tales may be said to have travelled even more extensively than ancient beads.

It is, of course, impossible here to do more than refer to a few of the most striking examples of legendary lore which are set forth in this volume. While expressing appreciation of this work, may one say that it is impossible to avoid a regret that the learned writer did not give us her views regarding the genesis of the mythical material, and also discuss the mental processes which have produced such an amazing mass of legendary matter. The work is well produced and is illustrated by a series of excellent photographs of an apposite character. C. W. H.

Science and Railways

A British Railway behind the Scenes: a Study in the Science of Industry. By J. W. Williamson. Pp. x+213+25 plates. (London: Ernest Benn, Ltd., 1933.) 5*s*. net.

THIS book is a study in the application of science to industry, as exemplified in the organisation, operation and development of the London Midland and Scottish Railway. The author discusses the design, building and repair of locomotives and rolling stock, the construction and maintenance of the permanent way, signalling, operation and control of traffic, 'rationalisation' and costing, and scientific research. There is also a brief chapter on the many interests of the undertaking which are ancillary to its main business of transport.

The London Midland and Scottish Railway was incorporated ten years ago, under the Railways Act of 1921, through the merging of eight constituent and twenty-seven subsidiary companies with an aggregate authorised capital of approximately £424,000,000. Interesting details are given which indicate the remarkable range and diversity of this gigantic corporation's activities. For example, we are told that in 1932, transport facilities were provided for 407½ million passengers, and 117 million tons of freight. As an employer, the undertaking rivals the Post Office, with a staff of approximately 225,000 persons. In addition to rail transport, it controls and operates docks, steamships, canals, motor and horse-drawn vehicles. It also incorporates the largest hotel business in Europe; whilst staff duties range from engineering to weed-killing, and from scientific research to the provision of dance bands.

Few industrial trends are so full of promise as the adoption of scientific research and the scientific method by modern business corporations. In 1930 the L.M.S. Railway, inspired and encouraged by Sir Josiah Stamp, appointed a research committee with Sir Harold Hartley as director of research. The activities of the committee are closely linked to the company's costing system, which discloses the desirability of making investigations. Research is thereupon initiated, the primary object of which is to effect economies in working, whilst also aiming at greater efficiency and safety throughout the system. Sir Harold Hartley is quoted as saying that "the outlay has already been repaid by results achieved, and we look forward with confidence to the cumulative effect of continuous scientific study and research". There is no central research laboratory, since it is considered better policy to take full advantage of facilities provided by the research organisations of the Department of Scientific and Industrial Research, the universities and industrial research associations. The undertaking has chemical laboratories of its own at Derby, Crewe, Horwich and St. Rollox, and specialised laboratories dealing with paint, textiles, metallurgy and the mechanical testing of materials.

It would manifestly be impossible to give more than a bare outline of the company's far-reaching activities within the limits of this book. The outline provided, however, is one that conveys to the reader a satisfactory impression of the undertaking as a whole and as a going concern. Considerable difficulty must have been experienced by the author in selecting his material, and he is to be congratulated upon the successful manner in which he has accomplished this task. The book is agreeably written, it is competently planned and the balance of the chapters is well maintained.

Although ostensibly limited to an exposition of how this great railway functions, the book may also be regarded as a contribution to the study of industrial administration. It is not that there is anything strikingly novel about the administrative methods discussed. There is already an extensive literature on railways in general, and a literature at least equally voluminous dealing with subjects such as simplification, standardisation, processing, planning and costing. In particular a vast amount of theory, hypothesis and (may we whisper it?) 'hot air' has been evolved in recent years to which the name 'rationalisation' has been applied.

It is well for the student of industry, who is increasingly compelled to follow scientific method in his studies, to leave this somewhat rarified atmosphere from time to time and turn to the contemplation of theory in process of successful application to practical business affairs. "The great benefit which a scientific education bestows," said T. H. Huxley, "is dependent upon the extent to which the mind of the student is brought into immediate contact with facts." Immediate contact may be supplemented to advantage—at least where industrial processes are concerned—with the indirect contact afforded by books such as that under review. Therein lies their chief value to all students of industrial organisation and management.

Oil and its Uses

Earth Oil. By Dr. Gustav Egloff. (A Century of Progress Series.) Pp. xi+158. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 5*s.* 6*d.*

THE word oil is a household one to-day, since the ingenuity of man has found a myriad uses for it. As 'petrol' in England, 'gasoline' in America, 'essence' in France, it serves as the source of power to propel cars for work and for play, while as a social influence it may be claimed to have altered the habits of nations. It behoves us, therefore, to know something of oil, perhaps of its history and the methods of locating it, but certainly about the methods of mining or drilling for it, its storage, transportation and refining, including those modern developments of the oil technologist and oil chemist such as cracking and hydrogenation. Even the subject of oil resources has its interest, whilst it is of great economic and strategic importance. It is to fulfil such requests that this little book has been written. The author, Dr. Gustav Egloff, who is a deservedly popular leader among petroleum technologists, is able with his pen, aided by numerous illustrations, to portray for us almost in moving picture form the oil story, and well he does it.

It is certain that the uses for oil will increase and that it is almost an ideal material for the internal combustion engine. It is a strange reflection on international economics that those countries which lack oil are seeking to replace it by substitutes and protect these by taxation. The world's use of oil to-day is far below the producing capacity of the actual wells, of which 330,000 are producing in the United States alone at an average rate of seven barrels per well per day. Vast reserves both known and undiscovered are left underground; further, the newer methods of production and refining all give far higher yields of product from a ton of crude oil. There is thus no fear of an oil shortage, but every encouragement to go on to make more use of it.

The past summer has seen the holding of the first International Conference of Petroleum Technologists at South Kensington, at which all matters pertaining to oil were discussed among experts. Its outstanding success indicates the certainty of further progress in every direction.

One aspect still baffles us, namely, the origin of oil. It is a subject for the geologist to tackle in addition to his task of locating oil—this last a subject in which enormous strides have been taken as a result of the co-operation of the physicist. Crude oil sometimes has much, at others little, sulphur and the same applies to nitrogen. Different crudes vary in almost every respect—some are nearly all gasoline, as in California, some are practically solids. No one theory of petroleum production is in any way satisfactory. The earth is generous to mankind: perhaps oil is one of her greatest gifts and those lands which have it are specially favoured.

The book is issued in connexion with the Chicago Century of Progress Exhibition: few would dispute the claim of the oil industry to be in the forefront of such progress. E. F. A.

Short Reviews

Lehrbuch der ökologischen Pflanzengeographie. Von Prof. Dr. Eug. Warming und Prof. Dr. P. Graebner. Vierte Auflage. Lieferung 5 (Schlusslieferung). Pp. viii+961–1157. (Berlin: Gebrüder Borntraeger, 1933.) 18 gold marks.

THE publication of the fifth part completes the fourth edition of Warming and Graebner's "Lehrbuch der ökologischen Pflanzengeographie". The sclerophyllous vegetation of districts with winter-rain, subxerophilous grass formations, and deserts are here considered. A final chapter deals with the struggle between plant communities. Title-page, preface, contents and index are also included.

The new edition is a most important work of reference and gives an excellent summary of world vegetation and of the causal or correlated physical and biotic factors. It is written in relatively simple language without undue stress on technical terms. Most of the illustrations are adequate and some are excellently reproduced and very instructive, but no attempt is made to illustrate the distribution of the communities or 'formations' by maps. The most unfortunate feature is the bibliography. Only an appendix to the literature listed in the third edition is given, and to trace most of the papers quoted, reference to this earlier edition is necessary. So many important post-War English and American books and papers have been overlooked that a false impression is given that ecological and phytogeographical studies are not being pursued with any intensity outside Central Europe.

The death of Prof. Graebner, while this last part of the "Lehrbuch" was in press, is recorded with deep regret. W. B. T.

The Book of Chemical Discovery. By Leonard A. Coles. Pp. 288+31 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1933.) 7*s.* 6*d.* net.

EVERY book that makes the achievements of science and its problems known to a wider circle of the public is to be welcomed. Mr. Coles gives a judicious blend of the past, the present and the future—wisely in our opinion, for he who would understand the future must venerate the past. The story of the dawn of chemistry, of the age of alchemy, is far more interesting than that of the lives of the contemporary kings and queens and their favourites, if only we could persuade the public to read the former instead of the latter. Even the daily Press now takes notice of atoms, molecules and electrons: with the transmutation of the elements a fact, the wheel of progress has taken a full turn.

Mr. Coles is happy in his treatment of the industrial section, though it might perhaps be a little more up to date, even if the latest wonders of synthetic production are a little more difficult to explain. His final chapter on problems will leave his readers thoughtful, conscious of the progress which is being made and of how much remains to be done.

The book is far more accurate than many similar efforts, and as it wisely confines its ambit, it is able to cover the subject very completely: it is an ideal school prize or present. E. F. A.

Handbuch der landwirtschaftlichen Bakteriologie. Von Prof. Dr. F. Löhnis. Zweite, neu bearbeitete Auflage. Band 1, Teil 1: *Futtermittelbakteriologie.* Von Prof. Dr. F. Löhnis. Pp. 105. 10.50 gold marks. Band 2, Teil 1: *Düngerbakteriologie.* Von Prof. Dr. G. Ruschmann. Pp. 158. 15 gold marks. (Berlin: Gebrüder Borntraeger, 1933.)

THE old "Handbuch" of the late Prof. Löhnis has been enlarged, these parts being the first of the second edition to appear. The price may seem high for paper covers, but the fund of information supplied is very rich, so that the work will be of great value on library shelves: individual workers will appreciate the new edition, though few may be able to buy it as a whole.

Without slighting the text, it may be said that the extensive running bibliography—which frequently occupies more than half of the page—will be the feature most sought after. The plan of Band 1, Teil 1, includes discussions on bacteriological aspects of the preparation and self-heating of hay; silage; decomposition processes, and their control, in various types of fodder; technique of examination; and an especially interesting section on the rôle of micro-organisms in animal digestion. The plan of the larger part ("Farmyard Manure") is comparable. The work is generally up to date, though no description of the A.I.V. ensilage process is given.

The Outlook of Science: Modern Materialism. By R. L. Worrall. Pp. v+203. (London: John Bale, Sons and Danielsson, Ltd., 1933.) 8*s.* 6*d.* net.

IN this useful and provocative work, the author denounces the idealistic tendencies of modern science and pleads for a revival of philosophical materialism. It is true that the extensive mathematisation of science has carried away from reality some of our most prominent men of science. A series of well-chosen quotations from leading physicists and biologists are taken as a basis by the author for a searching criticism of their idealistic point of view. The sympathy one may feel for the author's critical endeavours, however, can scarcely be lavished on his constructive conclusions. Inspired by the crude materialism of the Russian thinkers, the author gives as a keynote of his philosophy the very controversial assertion that mind is derived from matter. The elaboration of a tempered dualism would have saved him from many pitfalls. T. G.

The Handbook to the Roman Wall: a Guide to Tourists traversing the Barrier of the Lower Isthmus. By the late Dr. J. Collingwood Bruce. Pp. x+221+1 plate. Ninth edition. (Newcastle-on-Tyne: Andrew Reid and Co., Ltd.; London: Longmans, Green and Co., Ltd., 1933.) 3*s.* 6*d.* net.

A FAMOUS handbook, written seventy years ago and now in its ninth edition, would call for little comment, if it were not that it is claimed by the editor, Mr. R. G. Collingwood, than whom no one is more competent to pronounce an opinion, that it is now the most complete account of the Wall that has appeared since 1867. Much matter of antiquarian interest that would now be considered irrelevant has been excised, the information has been brought fully up to date, and a bibliography appended. The utility of the handbook has been enhanced while its attractiveness as an account of the Wall is unimpaired.

Earth-Lore: Geology without Jargon. By Prof. S. J. Shand. Pp. viii+134+4 plates. (London: Thomas Murby and Co., 1933.) 5*s.* net.

IN his latest book Prof. Shand outlines the major facts of geology and touches lightly on some of its unsolved problems. The subjects dealt with include: earth sculpture, the sea floor, the age of the earth, the problem of the mountains, and drifting continents.

The book appears to be intended for those of the thinking public who may wish to know what geology is and what geologists are thinking about to-day. The use of 'jargon' has been very largely avoided and simple explanations have been furnished for such technical terms as are used.

"Earth Lore" should appeal not only to the wider public for which it seems to have been expressly written, but also to students of geology who require an up-to-date conspectus of their own subject.

Sheffield Steel

THE intimate association of Sheffield with the steel industry is probably even better known and appreciated than the proverbial relationship between coals and Newcastle. In the former case the industry has developed practically from its very birth within this city to its present unshakable and unique position in the industrial world, and although steel-making in England is now rather more decentralised than was formerly the case, Sheffield still holds pride of place in respect of both historical associations and present-day importance.

The rise of Sheffield as a metallurgical centre may be attributed in part to certain natural advantages and to the gradually accumulated skill of generations of craftsmen of the city, but pre-eminently it must be ascribed to the important contributions made to steel metallurgy by such men as Huntsman, Bessemer and Sorby. It was here that Benjumin Huntsman, in the years between 1730 and 1740, conceived the idea of melting the carburised bars of Swedish wrought iron in crucibles, and persevered with his experiments until the practical difficulties associated with this novel procedure were surmounted. The Huntsman method of melting and casting proved a great advance on the methods then in use for the production of shear steel by hammering the bars of carburised wrought iron, and gave a much more uniform and coherent product. From this time onwards to the middle of the nineteenth century, the crucible process of steel-making developed rapidly in Sheffield, and the tool steel produced acquired that reputation for quality and reliability which has characterised all Sheffield products down to the present day.

Some time after the rise of the Huntsman process, it was found possible to combine carburisation and fusion into one operation by melting together a mixture of Swedish wrought iron and charcoal, and, eventually, attempts were made to substitute English wrought iron. The latter procedure was eventually made commercially practicable by the introduction of manganese into steel-making, due to Heath, who in 1839 took out a patent covering the addition to cast steel of manganese in the form of a carbide, prepared by roasting manganese dioxide with carbonaceous matter.

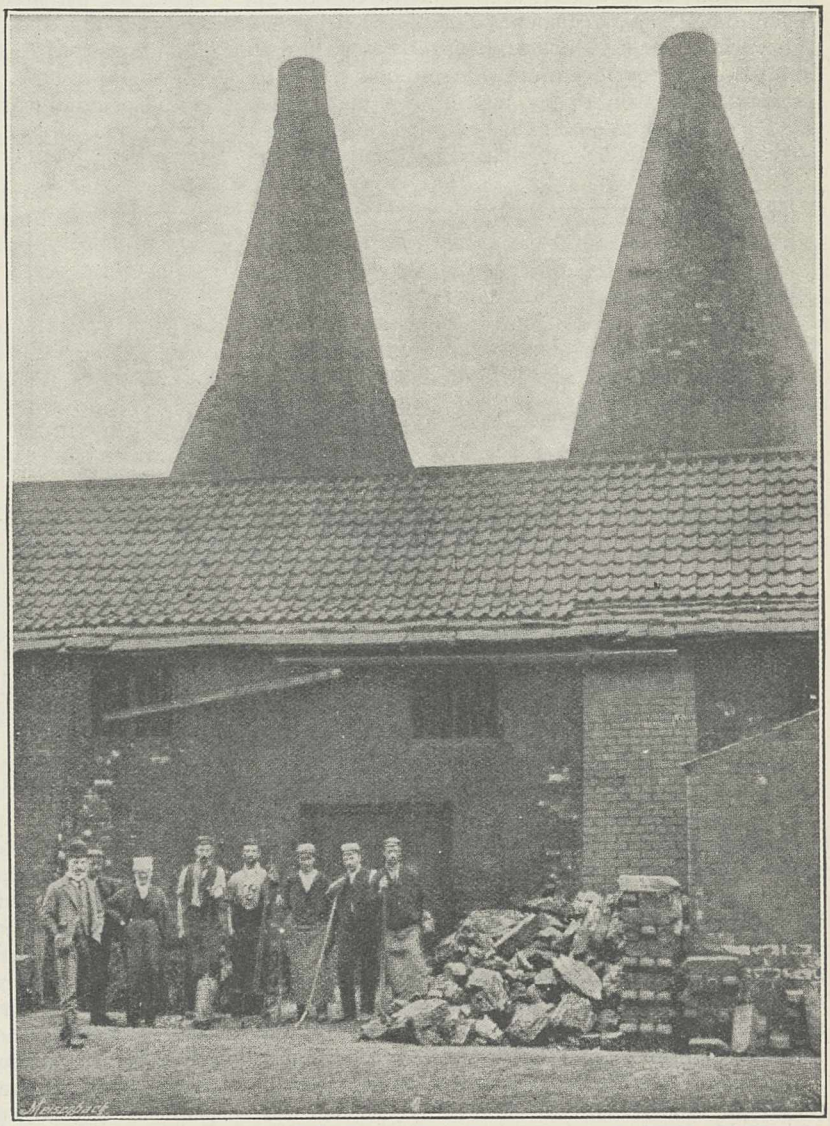

FIG. 1. Huntsman's original works and furnaces. Reproduced by courtesy of Sir Robert Hadfield.

Then followed the Bessemer process for the treatment of molten pig iron by blowing air through it. This process, which was put on a commercial footing in Sheffield, made it possible to produce structural steel cheaply and in reasonable quantity. Later came the development of the open-hearth regenerative furnaces by the brothers Siemens,

working in conjunction with Pierre Martin. The Siemens-Martin method made possible the huge outputs from individual furnaces which have characterised more recent years, and also led the way to the development of the long list of alloy steels now in use for a variety of engineering purposes.

Again, it was a citizen of Sheffield, Henry Clifton Sorby, who devised the microscopic method of examining the structure of metals and laid the foundations of the science of metallography and the technique of heat treatment. Sorby first described the various constituents and structures met with in steel—the pearly laminæ, surrounded either by areas of soft iron or by membranes of a much harder constituent—and thus enabled rational and coherent ideas to be substituted gradually for the atmosphere of mystery and secrecy which had surrounded the operations of steel-making.

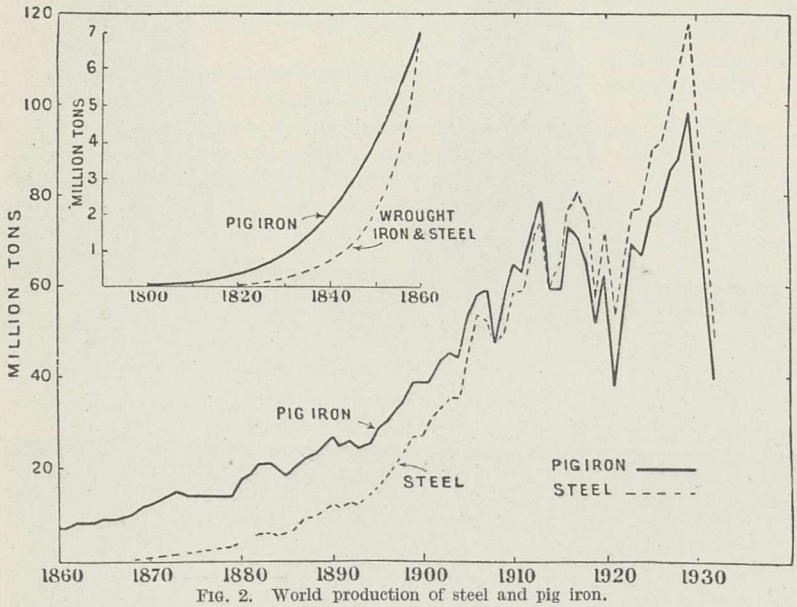

FIG. 2. World production of steel and pig iron.

Two books recently published* place on record much that is of absorbing interest in connexion with the development of the steel industry. Both authors are able to give personal experiences of the steel-making days of more than half a century ago, yet both are still actively interested in modern technique and production methods.

Sir Robert Hadfield's address of welcome to the members of the Iron and Steel Institute who visited Sheffield for the autumn meeting of the Institute is an attractively prepared brochure containing an unique collection of nearly a hundred photographs of past and present metallurgists, and should be of considerable interest and value to those connected with the Sheffield industry or with the University of Sheffield. A vivid sketch is given of the rise of metallurgical industry, with particular reference to the City of Sheffield, together with a miscellany of historical references and personal reminiscences. Throughout the book stress is laid on our great debt of gratitude to the workers of the past, both inventors and craftsmen, upon whose labours the structure of modern steel metallurgy has been erected.

An interesting account is given of the details of Huntsman's method of manufacturing crucible steel, as witnessed by the French metallurgist, Gabriel Jars, and described by him in his "Voyages Metallurgiques", published in 1774. The historic photograph here reproduced (Fig. 1), of Huntsman's original works and furnaces, gains in interest by reason of the fact that it was taken by the late Prof. J. O. Arnold, of the University of Sheffield. The following section surveys the rapid expansion which occurred between 1750 and 1850, owing to the development of the Bessemer process, the Siemens-Martin process, and the basic Bessemer and open-hearth processes. The rise and development of alloy steels are discussed, with particular reference to the Hadfield inventions of manganese and silicon steels. Mention is also made of the newer types of heat and corrosion resisting steels, but surprisingly little is said on the subject of the high duty structural steels for automobile and aircraft purposes, which to-day constitute a considerable proportion of the total output of alloy steels. An interesting diagram, here reproduced (Fig. 2), shows the total world's output of steel and pig iron from 1800 down to 1932.

Succeeding chapters deal with the growth of metallography and heat treatment, the associations of Sheffield with national defence and the manufacture of armaments, and the importance of industrial research. Probably the most interesting section of Sir Robert Hadfield's address is that surveying the development of metallurgical education in Sheffield, and the work of the Faculty of Metallurgy in the University under the successive professors, Greenwood, Arnold, Desch and Andrew. Reference is made to the research department for the cold working of steel, and to the recent project for the establishment of a degree course in foundry work.

Some interesting details are given of the formation of the Iron and Steel Institute in 1869, and of the important part played by the Institute in encouraging research and disseminating knowledge in ferrous metallurgy, and we can heartily commend Sir Robert's advice to all interested in the iron and steel industry to become associated

* "Address of Welcome to the Iron and Steel Institute visiting the East Hecla Works of Messrs. Hadfields, Ltd., on September 14, 1933." Pp. viii+112. (London: Chapman and Hall, Ltd.) 5s.
"Steel-Makers." By Harry Brearley. Pp. xiii+156. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 5s. net.

with this body. The address closes on a note of encouragement to the younger generation of metallurgists, for whom the future holds in store a wealth of opportunity.

Mr. Harry Brearley's book makes exhilarating reading. His main thesis concerns the value of the judgment and vision of the workman—of the art as opposed to the science of steel-making. This idea is developed with the aid of some pertinent thrusts at the too highly scientific metallographer or chemist, who is apt to use a language which only the initiated can understand and to become unintelligible to those who dutifully read his reports. "There are complaints that what should be, or might be, a clearing house for difficulties is apt to degenerate into a priestcraft able to obscure a difficulty if not explain it."

Mr. Brearley has some hard things to say on the subject of the teaching of metallurgy and the comparative neglect of the process side of steel metallurgy. "And as what the schools call metallurgy turns out to be almost exclusively metallography, there is little wonder that the graduate student comes into the works with notions about the importance of this or that which are sadly out of balance. . . . As a supplement metallography is excellent: as a superseder of the older forms of observation and deduction it may not be so excellent—it may be misleading. What a man sees through a microscope is more of less, and his vision has been known to be thereby so limited that he misses what he is looking for, which has been apparent at the first glance to the man whose eye is informed by experience." This leads to views on technical education which are definitely constructive, and a very interesting and attractive suggestion is put forward for the teaching of steel metallurgy under industrial conditions.

Mr. Brearley's book is in part autobiographical, dealing with the author's early days as a cellar-lad in a tool-steel furnace—an occupation he entered at the age of eleven or twelve—with the intimate details of the crucible process as practised in Sheffield in the 'eighties, and with his admiration for the skilled steel-melters with whom he came in contact. "The goodness of the craftsman is in his bones and beats with his blood. The same unruffled confidence, and modesty too, which unfolds itself in men like Faraday unfolds also in humbler workmen; and whilst in them uncouth expression might be mistaken and misunderstood, there are such men whose opinion, muttered in their sleep, is valuable beyond the calculated views of others. Amongst even steel-melters there are 'mute, inglorious Miltons'." L. B. H.

The Asiatic Society of Bengal

By DR. L. L. FERMOR, O.B.E.

AS the Asiatic Society of Bengal is arranging to celebrate on January 15 the one hundred and fiftieth anniversary of its foundation, a short account of its activities will be of interest.

The founder of the Society, Sir William Jones, a Puisne Judge of the Supreme Court at Fort William in Bengal, arrived in Calcutta in 1783. Sir William Jones, who was a distinguished scholar and linguist, soon noticed the want of an organised association as a drawback to progress, and with the co-operation of his friends held a meeting on January 15, 1784, at which thirty gentlemen representing the *élite* of the European community in Calcutta were present. Sir William Jones delivered a "Discourse on the Institution of a Society for enquiring into the History, civil and natural, the Antiquities, Arts, Sciences, and Literature of Asia"; and as a result of this address it was resolved to establish a society under the name of the "Asiatick Society". The name adopted for the Society at the inaugural meeting was borne on the records until the close of the fourth decade of the nineteenth century.

In 1829, soon after the foundation—by Henry Thomas Colebrook, a former president of the Asiatic Society—of the Royal Asiatic Society of Great Britain and Ireland in London, and the affiliation of the Literary Society of Bombay with that institution, a letter was received from the Royal Asiatic Society offering to the Asiatic Society in Calcutta the privilege of affiliation, and in this letter the Asiatic Society was for the first time designated as the "Asiatic Society of Bengal". The Society did not accept the affiliation or the change of title, but as the parent of all the Asiatic Societies extant it fitly retained its original name of *The* Asiatic Society. In 1832, also, when Mr. James Prinsep sought the sanction of the Society to use its name for the journal he was then about to start, the resolution used the words "Asiatic Society" only; but the editor found it convenient to add a local designation and, in 1843, when the journal became the property of the Society, the new name of Asiatic Society of Bengal had already become familiar and it was formally introduced into the code of by-laws published in 1851. This title has been used continuously since.

This detail concerning title has been deemed necessary because of the confusion that sometimes arises between the titles Asiatic Society of Bengal and Royal Asiatic Society of Great Britain and Ireland, and because it is not always realised that the Asiatic Society of Bengal is the parent and older body.

In his inaugural dissertation, Sir William Jones expounded the definition of the aims of the Society contained in the title of his address and his words have been paraphrased into: "The bounds of its investigations will be the geographical limits of Asia, and within these limits its enquiries

will be extended to whatever is performed by Man or produced by Nature" ; and this sentence now serves as the motto of the Society.

At the second meeting of the Society it was decided to invite Warren Hastings, then Governor-General of India, to accept the office of president of the Society. Hastings declined the honour on the grounds of his inability to devote sufficient attention to the work of the Society and for other reasons, and requested the permission of the Society to yield his pretensions to the gentleman whose genius planned the institution. Following this suggestion, Sir William Jones was elected the first president and held office until his demise in 1794.

The institution thus planned and founded has had a continuous existence down to the present and is still in active being. In 1884 the Society celebrated the centenary of its foundation and published a centenary review volume, in which is a full account of the past century's work of the Society. This volume contains first (Part I) a history of the Society, from which the foregoing details have been taken. Then comes in Part II a review of the literary activities of the Society, classified under archæology, history, literature, etc. From this section the reader will learn the outstanding part played by the Asiatic Society in the deciphering of inscriptions on stone and metal, (coins and pillars), and in texts on palm leaf and paper ; and in the discovery of the clues to ancient scripts, with resultant contributions to the history of ancient India. In this section outstanding names are Sir William Jones himself, Henry Thomas Colebrook (the founder of the Royal Asiatic Society), Horace Hayman Wilson (of the Medical Service of the East India Company, Assay Master of the Calcutta Mint and finally Boden professor of Sanskrit at Oxford), and James Prinsep (who succeeded Wilson as Assay Master).

Part III of the centenary volume summarises the researches in science published by the Society, classified under mathematical and physical sciences, including meteorology, geology, zoology, botany, geography, ethnology and chemistry. Amongst researches to which reference may be made are the Venerable Archdeacon Pratt's views on the importance of allowing for Himalayan attraction in determining the curvature of the arc of the meridian in Hindustan, Capt. J. T. Newbold's researches on the geology of Southern India, work on the correlation and classification of the Peninsular formations of India, particularly the researches of Thomas Oldham and W. T. Blanford, the work of Hugh Falconer and Proby Cautley and others upon the rich vertebrate fossil fauna of the Siwalik Hills, Brian Hodgson's studies of the bird and mammalian fauna of Nepal, Sikhim and Tibet, and the work of the "Indian Linnaeus", William Roxburgh, on the plants of the East. A rich field was tilled by a number of workers on the ethnology of the numerous tribes of India.

In the early days of the Society, the East India Company, the predecessor of the Crown in India, had no organised scientific services, and the scope for such a society as the Asiatic Society in collecting, describing and classifying the natural history objects of India, particularly in the fields of geology, zoology, botany and ethnology was enormous ; and the *Asiatic Researches*, the first publication of the Society, and the volumes of the *Journal of the Asiatic Society of Bengal*, contain a great number of papers on aspects of the natural history of India. These activities led to the accumulation of a large quantity of specimens, in consequence of which the Asiatic Society was compelled to found its own museum. Ultimately, the increasing volume of material proved too great a tax on the resources of the Society, and negotiations were opened with the Government of India, which terminated in the establishment of the present Indian Museum, in accordance with Article XVII of 1866. The collections of the Asiatic Society of Bengal were then entrusted to the Indian Museum, which is administered by a board of trustees on which the Asiatic Society of Bengal was, and still is, represented. These collections were incorporated with the collections belonging to Government or made by Government departments, such as the Geological Survey of India, founded in 1851.

The formation of several Government scientific services, such as the Geological Survey of India, the Indian Meteorological Department, and the Botanical Survey of India, the Zoological Survey of India, and the Agricultural Research Institute at Poona, each department with its own journal or journals, now diverts to the respective publications a large number of papers that would formerly have been presented to the Asiatic Society of Bengal. In addition, the formation of specialist scientific societies, such as the Indian Chemical Society, the Indian Physical Society and the Mining and Geological Institute of India, affords an outlet for the papers of non-official workers in science, many of which in the past would have been offered to the Asiatic Society of Bengal. The consequence is that the number of papers in science offered to the Asiatic Society of Bengal has fallen during the fifty years now ending much below the figures of the past.

The Society has not, however, lost its importance to science. Apart from its historical rôle of parent and sponsor directly or indirectly of many of the scientific societies and Government scientific departments in India, the Society now undertakes the important duty of organising the Indian Science Congress Association, a body that plays in India a part analogous to that of the British Association in England, meeting annually in January at different centres in India. The Society not only acts as organiser and office to the Indian Science Congress Association but also publishes the annual volume of *Proceedings* of the Congress meetings.

In respect of science, therefore, the Asiatic Society of Bengal now plays the rôle of an 'elder

body'. There is a general feeling that with the formation in India of an increasing number of specialist and local societies, and the resultant increasing tendency of sciences to work in isolation from one another, that a greater measure of co-ordination is required than is afforded by the annual meetings of the Indian Science Congress; the question of forming an Indian Academy of Sciences is consequently under discussion. One possible solution would be that the Asiatic Society of Bengal should occupy a position analogous to that of the Institute of France and become the parent body for not only an Indian Academy of Sciences, but also for an Indian Academy of Letters to represent the other side of the present activities of the Asiatic Society of Bengal and other groups of men of letters in India. Such a development, with perhaps a reversion of the title of the Society to "Asiatic Society" without the words "of Bengal", so as to remove the provincial sound, would seem to be the simplest solution to the problem and one that would well celebrate the hundred and fiftieth anniversary of the Asiatic Society, should this seem appropriate to the scientific workers of India as a whole. Such a development would also have the great advantage of preserving the liaison that still exists between science and letters in India.

Economics of Nutrition

THE Council of the British Medical Association, having realised that the adequate nutrition of the population is a matter of national importance, appointed a committee in April 1933 "to determine the minimum weekly expenditure on foodstuffs which must be incurred by families of varying size, if health and working capacity are to be maintained, and to construct specimen diets". The report of the committee was printed as a supplement to the *British Medical Journal* of November 25, 1933, which has now been reprinted.

The feature of the pamphlet is a series of sixteen carefully compiled diets suitable in quantity and variety for a single adult man, for children of various ages and families of different sizes. The quantities of the foodstuffs are calculated in accordance with the physiological standards and 'man value' of the families from Cathcart and Murray's figures. A family consisting of a man, a woman, and four children of the ages thirteen, ten, seven and four years, according to this standard has a man value of 4·63.

Stress is laid upon the kind of protein, whether it is of animal origin (first class), or of vegetable origin (second class). The infant's diet of milk consists of animal protein only, and it is advised that the change from the infant's to the adult diet be gradual, with the maintenance of a high proportion of animal protein, and be not completed until the child is three to five years of age. The amount of animal protein is maintained at a high level (60–75 per cent of the total protein) at any rate until school age is past, as shown in the specimen diets, and may be continued at this level so long as the child is growing. Unfortunately, the introduction of animal protein adds to the cost of the diet and is not always practicable. It is recommended that the supply of protein for the child be from cheese, fish and minced meat. We may refer to diet No. 4 proposed for a child of one to two years. It is based upon a minimum of 1 pint of milk daily, which is looked upon as the maximum expenditure which is likely to be possible on this article of food. The weekly quantities are: milk 7 pints; meat ¼ lb.; fish ¼ lb.; butter ⅛ lb.; flour 1 lb.; oatmeal ¼ lb.; sugar ⅛ lb.; potatoes 1 lb.; ½ lb. each of cabbage, turnips, carrots and tinned tomatoes. In this diet the proportion of animal protein is 71 per cent of the total protein and the calorie value is 1006; the child of this age corresponding to a man value of 0·3.

Similar diets with proper first-class protein for older children of three to six years are given in Nos. 5 and 6. In diets Nos. 7 and 8, for children of six to ten years, the milk is reduced to ½ pint daily.

Diet No. 1 is an example of the bare ration without variety for an adult man and costs 58·25 pence weekly. With variety the cost is increased to 70·5 pence weekly. Diets 9–16 are family diets with one or more children of different ages, and the man cost of these diets is 76·1–66·5 pence weekly. The costs have been calculated from a special scale of prices ascertained by the British Medical Association. Another scale of lower prices gives those prevailing in Stockton.

So far as the diets are concerned, the variety and quantities are extraordinarily well chosen and could be universally adopted. We would earnestly recommend all schools and institutions to use these standards of quantities and regard them as the *minimum*, increasing the quantities of milk, meat, fish and egg if funds permit. Children would thus be given a fair start in life. There is at present a tendency in school diets to restrict the supply of first class protein to a level inconsistent with the demands of growth between the ages of fourteen and eighteen years.

A considerable proportion of the specimen diets consists of dairy produce, vegetables and fruits. The minerals of the diet are thus amply provided. The supply of vitamins, especially of A and D, and C is regarded as sufficient from the quantities of milk, butter, eggs, cheese, liver, fish and vegetables. It is pointed out that whole cereals, beans, peas and lentils are the source of vitamin B, but some of the diets do not contain any of these articles of food, and if included the weekly total of such foods is very small. No stress is laid upon the advantage of wholemeal bread in preference to white bread or flour, for the supply of

the vitamin B group, and in respect of this vitamin the diets cannot be regarded as satisfactory.

A main criticism will always be the costs of the diets, which naturally vary greatly according to season and locality. It is not often that a palatable egg can be purchased for a penny. Cheese at 6d. per lb. is not everywhere procurable, and minced meat at 6d. per lb. is not likely to be of good quality, but consist mostly of gristle and fat. Still, the diets show that for a weekly expenditure of 5*s*.–6*s*. 6*d*., a man can procure a well-balanced diet.

The caloric value of these diets is based upon the daily consumption of an adult man, which has been assessed at 3000. Diet as consumed is not the same as diet as purchased since allowance has to be made for waste, such as bone in meat and fish, outer leaves of vegetables, etc. This waste is commonly reckoned at 10 per cent. The caloric values of the diets is given as 3400 as purchased. This gives a figure of 3060 as consumed. This does not thus vary appreciably from that adopted by the Ministry of Health following a report on dietary investigations of which an account was given in NATURE of June 13, 1931 (vol. 127, page 897). There is no doubt, however, that many families can exist upon a smaller calorie intake, down to 2500 calories, depending upon their manual work.

The allowance of first-class protein of 50 gm. a day appears to be a higher allowance than that of the Ministry of Health. The minimum quantity has been assessed at 37 gm. a day. The Army ration in peace time contains 62·7 gm. of first class protein. There can be no serious objection to taking the mean figure of 50 gm. a day, especially when a family including children is taken into consideration.

August Weismann, 1834-1914

THE name of August Weismann, the famous professor of zoology in the University of Freiburg-im-Breisgau, the centenary of whose birth falls on January 17, will always be remembered as that of one who exercised a profound influence on the progress of biological doctrine and speculation. As a teacher of zoology Weismann achieved a far-reaching reputation ; and by the students who worked under his direction, among whom, it may be remembered, was the late Prof. Gilbert Bourne of Oxford, his instruction was estimated at the highest value. But it was as an investigator and explorer of the methods of evolution that his influence was most widely felt, especially perhaps in Great Britain.

It was Weismann who first detected the true significance in the development of the insect wing of the rudimentary larval structures noticed by previous observers. His work on the embryology of the Diptera, and especially of *Corethra*, led him to the recognition of the origin of the appendages of the adult insect in hypodermic downgrowths to which he gave the name of *Imaginalscheiben* (imaginal discs or folds). Linked with this came his discovery of the remarkable phenomenon of histolysis, which he supposed to be of more general occurrence than later observations have shown to be the case. The importance of Weismann's work in this department was early recognised by Darwin, who contributed a prefatory notice to the "Studies in the Theory of Descent". This was the book through which, owing to the good offices of Prof. Meldola, Weismann's biological theories were chiefly brought to the notice of men of science in Great Britain. To the "Studies" may be attributed the impulse which started Prof. E. B. Poulton on many of those lines of investigation which have led in his hands to such fruitful results.

The outstanding claim of Weismann to the attention of biologists, however, was his bold challenging of the supposed effect of Lamarckian factors in heredity. This view, at the time of its publication, was no less than revolutionary. The opposition that it aroused, at first strong and sustained, has never completely died down ; at the present day, however, the votaries of Lamarckism are comparatively few in number. To this result the developments of Mendelism have contributed in no small degree, but the first effective attack on the transmission of somatic modifications was delivered by Weismann. His elaborate scheme of 'biophors', 'determinants' and 'ids' has not stood the test of later investigation ; there is no doubt, however, that his postulate of 'determinants' foreshadows in many respects the present-day conception of 'genes'. Moreover, in his theory of intra-germinal selection, by which he sought to reconcile the old antagonism of preformation and epigenesis, he may be said to have anticipated in some measure the modern doctrine of the interaction of genetic factors in ontogeny.

Weismann was led in course of time to modify to some extent the somewhat exaggerated view that he took of the inaccessibility of the germplasm ; but the distinction now generally drawn between the genotype and the phenotype is evidence of the virtual stability of the position first definitely established by him. It would be interesting to know, were it possible, what his attitude would be in face of the developments that have followed on Mendel's discovery of the segregation of the gametes.

Weismann, with his tall figure and pleasant demeanour, was a striking and attractive personality. He was not averse from discussing the relations between science and philosophy, though he was fully aware of the limitations that exist on both sides. His general position may be briefly summarised in his own words, translated by Meldola as follows : "The mechanical conception of Nature very well admits of being united with a teleological conception of the Universe." F. A. D.

Obituary

SIR FREDERIC NATHAN, K.B.E.

COLONEL SIR FREDERIC LEWIS NATHAN died on December 10 at the age of seventy-two years. As a young artillery officer who had passed through the advanced class of the Ordnance College, Capt. F. L. Nathan, as he was then, was detailed to take part in the experimental work of Abel, Dewar and Kellner, who were bringing out at Woolwich the smokeless propellant cordite. He was thus at the birth of that explosive, to the improvement and manufacture of which he was to devote his energies between 1892 and 1909 at the Royal Gunpowder Factory, Waltham Abbey, as Assistant- and then as Superintendent. During these years it can fairly be said that a new technique was introduced into the manufacture of explosives. The methods of Waltham Abbey were adopted by the then numerous private firms making explosives, while later the propellant factories erected during the War embodied the features of Waltham Abbey practice.

The improvements made during this time included a reorganisation of the work of the factory, to which Sir Frederic devoted the energy of a logical and business mind, the invention and introduction of new processes of manufacture of cordite and its ingredients, the study of danger precautions in manufacture on which he became an authority, and the recognition of the importance of investigative work.

Having raised the Royal Gunpowder Factory to the highest pitch of efficiency, Sir Frederic retired from the Army to apply his methods to the Nobel factory at Ardeer, of which he was works manager from 1909 until 1914, and in March 1915 he was appointed adviser to the Admiralty on cordite supply when he was given the task of designing and laying out the Royal Naval Cordite Factory at Holton Heath. Here, on an open area, unencumbered by ancient water-ways and existing buildings as at Waltham Abbey, he had free scope to erect a magnificent propellant factory such as would embody his experience of process and study of precautions for safety, and in which there was orderly progress from raw to finished material. This having been completed and put into operation, Sir Frederic became Director of Propellant Supplies under Lord Moulton.

After the War Sir Frederic concerned himself for a time with the safety of explosives in coal-mines, and as a member of the Department of Scientific and Industrial Research he gave his attention to the possibilities of home-produced alcohol as a motor fuel, and later to fuel research, for which he was the Department's Intelligence Officer up to the date of his death. In this capacity he applied himself to the extraction of what was relevant in the literature and to the best methods of indexing it. He was also chairman of the Association of Special Libraries and Information Bureaux (A.S.L.I.B.), editor of a *British Power and Fuel Bulletin* issued by the World Power Conference, and projected at the time of his death the publication of an *International Power and Fuel Bulletin* in three languages, indexed according to the decimal classification of the Institut International de Bibliographie.

Among other activities should be mentioned Sir Frederic's interest in the training of the chemical engineer, this being the title of his presidential address to the Institution of Chemical Engineers, of which he was one of the founders and twice president. He was also Commandant of the Jewish Lads' Brigade for twenty-one years. He was knighted in 1906 and became K.B.E. in 1918. Lady Nathan and three sons survive him. His third son was killed in action on June 14, 1917.

Those who came into contact with Sir Frederic Nathan could not fail to recognise his high ideals, his great industry and his methodical mind; those who had the good fortune to work with him found in him an inspiration and constant support in the appreciation and furtherance of their scientific work. ROBERT ROBERTSON.

MR. A. E. P. WEIGALL

WE regret to record the death on January 2 at the age of fifty-three years of Mr. Arthur Edward Pearse Weigall. Mr. Weigall was the son of Major A. A. D. Weigall. He matriculated as a member of the University of Oxford from New College in 1900; but after a brief residence joined Sir Flinders Petrie's staff for archæological exploration at Abydos in Egypt. In 1905 he was appointed Inspector-General of Antiquities under the Egyptian Government, a post which he held until 1914. His archæological work was recognised by his appointment as officer of the orders of the Red Eagle (Germany), Franz Josef (Austria), and the Medjidieh (Egypt).

Weigall was a prolific and versatile writer, his work ranging from the record of archæological investigation to the purely imaginative effort of novel writing. His gifts were perhaps most happily displayed in the imaginative interpretation of archæological and historical data as in his "Life of Akhnaton, Pharaoh of Egypt" (1910) and "Life of Cleopatra, Queen of Egypt" (1914). Among his numerous archæological and historical works may be mentioned :—"Abydos" (sections of) Parts 1 and 2 (1902 and 1904), "Report on the Antiquities of Lower Nubia" (1907); "Catalogue of Weights and Balances in the Cairo Museum" (1908); "A Guide to the Antiquities of Upper Egypt" (1910); "The Treasury of Ancient Egypt" (1911); "Tutankhamen and other Essays" (1923); "A History of the Pharaohs" (1925–26) and with A. H. Gardiner "Topographical Catalogue of the Private Tombs of Thebes" (1913). He was also the author of a book of travel, "Travels in the Upper Egyptian Deserts" (1909).

News and Views

The Loch Ness "Mystery"

SINCE a note appeared in NATURE regarding the alleged "monster" of Loch Ness (Dec. 16, 1933, p. 921) evidence has accumulated, on one hand, to warn the credulous against the suppositions of unskilled observers, and on the other to point to the identity of the creature which has caused so much commotion in the daily newspapers. In the first place, the writer of these notes has examined, through the kindness of the Associated Press, the original negative, said to be a direct photograph of the Loch Ness "monster", from which prints appeared in various newspapers about December 6 and 7. Regarding this photograph, it is not necessary to say more than that the object appears not to have been photographed at the distance stated, 200 yards, and that in the writer's opinion the object represents no animal known to science. In the second place, the "spoor" of the animal, about which fantastic tales were spread, has, according to the *Morning Post*, led the authorities in the British Museum (Natural History) to conclusions decidedly unfavourable to some of the expectations previously aroused. No support was found in this evidence of the 'monstrousness' of the monster.

As to the other side of the story ; in the *Scotsman* of January 1, appeared a sketch made by an observer, and on January 6, the *Aberdeen Press and Journal* published a sketch made by a final year veterinary student who saw the creature on land by the Loch side, by the light of the moon and of his motor-cycle lamp, who, somewhat boldly it would seem, upon his knowledge of natural history and prehistoric animals, stated his opinion that it was "a cross between a seal and a plesiosaurus". But the sketch and the description of the beast and its movements are more reliable than the identification. Without analysing these in detail, for they are wonderfully accurate considering the physical light and the mental atmosphere which surrounded the creature, one can have little doubt that the object figured in the *Scotsman* and seen and sketched by Mr. A. Grant in the early morning of January 5, was a large grey seal. The species occurs not infrequently in the Moray Firth, whence it probably comes from its nearest breeding grounds in the Orkney Islands ; it is the common species of the western isles of Scotland.

Exhibition of British Art

THE winter exhibition at the Royal Academy is devoted this year to British art and it was opened to the public on January 6. The first president of the Academy, Sir Joshua Reynolds, whose dignified statue by Mr. Alfred Drury, R.A., stands in the courtyard before the entrance to the Royal Academy at Burlington House, once said : "Variety reanimates the attention, which is apt to languish under continual sameness". There is certainly no lack of variety in this exhibition. Sir Joshua was one of the earliest to make scientific experiments as to the effect of light and atmosphere upon the permanence of pigments. Since his day the chemist and physicist have given much attention to this subject, with the result that modern paintings, as well as showing great brilliance, undoubtedly possess that lasting quality which is so desirable. No. 568 in Gallery IX is a striking example, and if the rainbow is a little too solid-looking, it at least has the merit of having the colours in the right order. The greater permanence under suitable conditions of water colours, which of course do not suffer from the darkening of varnishes or media used in oil paintings, is a feature of the exhibition, and attention may be directed in this respect to No. 801, by Rowlandson, and especially to the beautiful work of Cotman, Turner and others. In the Architectural Room may be seen a case containing thirty-five watches all made in England between the years 1583 and 1751.

Symbolism in Art

AT the Friday evening discourse delivered at the Royal Institution on November 17, the audience had the unusual, but instructive, experience of hearing, in Sir Herbert Baker's account of "Symbolism in Art", a distinguished practitioner of this form of expression in architecture on his principles, not from the æsthetic, but from the historico-scientific point of view. The discourse is now available in printed form. The interpretation of symbols, which is an element of no little importance in the study of art and the history of religions, suffers in a large number of instances from the drawback that it must be a matter of inference, and sometimes merely guesswork. Sir Herbert, in demonstrating to his audience the ideas which inspired, for example, the choice of motifs and subjects in the design of arms for the provinces of India used in the decoration of the new Delhi, showed the methods of the symbolising mind, first seeking the characteristic quality or incident pertinent to its subject, then giving it concrete form—thus, for example, selecting for the arms of the United Provinces the meeting of the sacred rivers at Allahabad, the bow of Rama, whose capital was at Oudh, and the fishes, the emblem of world power of the old Nawabs of Lucknow. Should events confirm Sir Herbert's diagnosis of the present trend of development in art towards symbolism, as the place of representational art is taken by mechanical means of reproduction, clearly the historical study of these principles and methods of symbolic art, of which he deplored the lack in the early part of his discourse, will demand increasing attention.

SIR HERBERT BAKER treated his subject-matter under two heads, touching first on early historical phases of symbolism and then describing attempts which he and collaborating artists have made to embody in the medium of art some facts of human experience. As already indicated, it is the personal experience upon which the latter part of the discourse was based, which gave weight to the view of sym-

bolism taken in the introductory historical sketch. Here Sir Herbert took the lightning flash and the thunderbolt as the first expression by early man in his 'rude art' of the symbolism of divine power. The gods depicted by man held the symbol of the thunderbolt first as a weapon, later as a baton or sceptre of authority. In that form, Sir Herbert pointed out, it is a widespread symbol in all primitive art. It occurs among Minoans, Greeks, Romans, the Hittites, in Mesopotamia, Central Asia, India and Mexico. The bolt was traced, with the addition of the wings of Jove, as it developed into the trident of Poseidon and Britannia and the lily of France. Two interesting examples of misinterpretation were quoted, which are not without a moral for those who practise interpretation of symbols: first, Napoleon mistook the *fleur-de-lys* of Clovis for bees and changed the *fleur-de-lys* in his own arms and those of Paris to representations of that insect; secondly, the Belgians took the flower on the French soldiers' uniform for representations of the frog and christened the French *crapauds* accordingly.

Sounding the Ionosphere

PROF. E. V. APPLETON showed in our columns in 1931 the importance of determining the variation, with frequency, of the equivalent path traversed by wireless signals returned from the ionosphere, since such determinations measure the maximum density of ionisation in the regions sounded. The letter from Mr. R. Naismith which we publish in our correspondence columns this week describes work which he carried out in May 1933. We understand that publication was deferred in accordance with an agreement between British and German workers that none of the results of radio work within the programme of the Second International Polar Year should be published until after the end of that year. The letter directs attention to the need for a rapid and more or less completely automatic method for recording the relation between the radio frequency of the pulse signals used and the equivalent path traversed by them in their double journey to and from the ionosphere, at nearly vertical incidence. At the time when the work described was carried out, there were available several methods for the continuous automatic recording of equivalent path against time of day, for a single frequency, but not for the more difficult problem of recording path against frequency.

THE radio staff at the U.S. Bureau of Standards has been working on the same problem, and at the annual convention of the Institute of Radio Engineers at Chicago on June 27, 1933, Mr. T. R. Gilliland (*Bur. Stds. Jour. Research*, Oct. 1933) described an automatic recording system giving records of the required type over the frequency range of 2500–4400 kc./s., the frequency being varied at the uniform rate of 200 kc./s. per minute so that the full range was covered in about ten minutes. The closeness of dates between the American and British work is illustrated by the fact that Mr. Gilliland showed a record for April 22, 1933, while Mr. Naismith shows one for June 6 and informs us that his first record was taken on May 20. The means of investigation thus made available is clearly a very powerful one, and geophysicists will look forward to the results of the further developments promised from the Bureau of Standards and the National Physical Laboratory.

Yorkshire Scientific Magazines

THE publication of the December issue of the *Naturalist*, the monthly journal of the Yorkshire Naturalists' Union, completes a hundred years of the regular publication of this scientific magazine. The *Naturalist* originally appeared under the title of the *Field Naturalist* as an octavo monthly of 48 pages in January 1833, under the editorship of Mr. James Rennie. It ran for fourteen issues and then appeared under the title of the *Naturalist*, edited by Mr. Neville Wood, of Doncaster. In 1851 the second series of the *Naturalist* commenced under the editorship of Beverley R. Morris, and later the Rev. F. C. Morris, author of the well-known "History of British Birds"; the third series, edited by C. P. Hobkirk, appeared from Huddersfield in 1864. The fourth series of this magazine were edited by Joseph Wainwright and appeared from Huddersfield under the changed title of the *Yorkshire Naturalists' Recorder*, but the fifth series, in August 1865, reverted to the present title, the *Naturalist* (Sheppard, "Yorkshire's Contribution to Scientific Literature", *Naturalist*, 1915). The fifth series, edited by Messrs. C. P. Hobkirk and G. T. Pomitt, was issued at Pontefract, but later transferred to Leeds under the editorship of W. D. Roebuck and W. Eagle Clark, in 1884. In 1889, W. Eagle Clark, leaving for Edinburgh Museum, vacated his editorial post and Roebuck continued to be editor until 1912, assisted by E. R. Wade in 1892. In 1902 the *Naturalist* was issued from Hull under the editorship of T. Sheppard, assisted by Dr. T. W. Woodward. Mr. Sheppard relinquished the editorship in 1932. He was succeeded in 1933 by Dr. W. E. Pearsall and W. R. Grist as editors, when the *Naturalist* once more was issued from Leeds.

FEW counties have such an interesting record of scientific journalism as Yorkshire, and the *Naturalist* has watched many contemporary magazines rise and fall in its century. The *Bradford Scientific Journal* and the *Halifax Naturalist* were contemporary magazines. The *Circular* appeared as a scientific monthly in Halifax, 1866, while the *Practical Naturalist* commenced in Bradford in 1883 and was continued at Ilkely. The *Naturalists' World* was another of Ilkely's scientific monthlies and in 1879 the *Young Naturalist* appeared from Hartlepool and Huddersfield, becoming the *British Naturalist* in 1891, but ceasing issue in 1894. From 1882 until 1883, the *Naturalists' Monthly* was issued from Bradford and in 1892, the *Naturalists' Journal* commenced, later becoming *Nature Study* and being issued from Huddersfield, where it ceased publication in 1905. The *New Nature Study* commenced at Huddersfield in 1912 but was short lived. The Malton Field Naturalists' Society issued a monthly journal,

Naturalists' Notes, at the end of last century, while the *Natural History Journal* was published at York from 1877 until 1898. A contemporary, the *Naturalist*, but with no connexion with the present journal of that name, appeared monthly in York in 1834, mainly for school nature students.

Conference of Educational Associations

THE twenty-second annual Conference of Educational Associations was held at University College, London, on January 1–8. Dr. George Dyson, of Winchester College, in his presidential address on "Education for Life", said that though there is a great and growing interest in music and the arts, it is still true that the writing of poems, the making of pictures, the modelling of statues, the playing of sonatas, the composition of songs, are regarded as frills. Our education is a system of mental education, training only a fraction of human faculty and character. He recommended a system of differentiated secondary schools, one type being frankly a workshop.

THE Great Hall was crowded on January 4 for a discussion on "The Failure of Modern Science to develop an Adequate Cultural Background to Life". Dr. W. W. Vaughan presided and the discussion was opened by Prof. Julian Huxley, who said that the defects of scientific education are over-specialisation, the failure to link science to other studies and over-emphasis on physics and chemistry, as against biology and related subjects. There is a tendency to devote too much time to practical work. He considers that science should be studied as an integral part of history and that more attention should be given to applied science, the aims of science teaching being a coherent general outlook in which scientific ideas are integrated, and the inculcation of the scientific method in human affairs. Sir Arnold Wilson's contribution to the discussion showed that he favours the teaching of science in elementary schools, in which he thinks there should be great development, and he stressed the ethical aspect of science teaching and its hope of bringing inspiration, strength and inward peace to mankind and stability to civilisation. The subsequent discussion elicited several useful suggestions, one being that young and rapidly developing branches of science might be considered from the viewpoint of their educational value. Several speakers referred to the importance of personal influences, the use of leisure, and emotional life and experience as contributing to 'cultural background'.

Association of British Zoologists

THE annual meeting of the Association of British Zoologists was held in the rooms of the Zoological Society in Regent's Park on January 6. On previous occasions the Association has been interested in the provision of revision classes in biology at the universities for school teachers. Dr. F. A. Dixey reported the work which the Council of the Association has done in the past year on this subject. Classes are now provided at several universities and have been well attended. In view of the expansion in the teaching of biology in schools which is now taking place, the subject is recognised as important, and the Council was asked to continue its activities. Mrs. M. D. Brindley, opened a discussion on the possibility of providing some means by which information concerning the British fauna could be made more easily and rapidly accessible. The preservation of the fauna among the rapid and widespread changes which are bound to occur in a thickly populated country is difficult, but it is a task in which zoologists must always be interested. Changes in the fauna are often of importance to the community. At present a very large amount of information on the natural history of the fauna has been collected but much of it is scattered through many, often obscure, journals.

PROF. D. M. S. WATSON gave his views of the scope of the teaching which should be carried on in a university department of zoology. In order that the student may be able to deal later with the biological problems which will be the subject of his investigations, his teaching should be broad and should be concerned as much with the natural history and physiology of animals as with their structure. Prof. Watson gave an account of the way in which these views have been expressed in the design of the buildings which have recently been built for his department at University College. Some problems of zoological technique were also discussed. Prof. H. G. Cannon gave a lecture on the technique of making drawings for the illustration of zoological papers. It is hoped that the Council will be able to publish his lecture.

Ninth International Congress of Pure and Applied Chemistry

SPAIN will act as host for the ninth International Congress of Pure and Applied Chemistry, which will be held in Madrid on April 5–11, 1934, under the patronage of H.E. the President of the Spanish Republic and of the Spanish Government. The object of the Congress, which was to have been held in 1932, is to promote the progress of pure and applied chemistry, and to strengthen relations between chemists throughout the world. The president of the bureau of the Congress is Prof. Obdulio Fernández, and the general secretary is Prof. Enrique Moles ; the address of the organising committee's office is San Bernardo 49 (P.O. Box 8043), Madrid (8). Membership is of three categories : honorary members, comprising the committees of honour and of patronage, and the official delegates of the Spanish Government and of the governments of other countries ; supporting members, who pay the minimum amount of 300 pesetas ; and active members, who pay a fee of 75 pesetas (about £1 17*s.* 6*d.*). Members' ladies pay 25 pesetas only, but they will not be entitled, as members are, to receive publications *in extenso*, the daily bulletin, summaries of communications, or the report of proceedings. Membership is open to societies, institutions, etc., connected with any branch of pure or applied chemistry, and to individuals interested therein. Applications for membership should be made to the general secretary before February 15, 1934, and should be accompanied by a remittance

made payable to the treasurer. Pamphlets containing the rules of the Congress and other information can be obtained in England from Mr. S. E. Carr, The Chemical Society, Burlington House, Piccadilly, London, W.1.

GROUPS and sections of the ninth International Congress of Pure and Applied Chemistry have been organised as follows: (1) Physical and Theoretical Chemistry, pure (electrochemistry, photochemistry), applied (colloid chemistry, rubber, tanning and leather materials, electrometallurgy); (2) Inorganic Chemistry, pure, applied (glass, ceramics, cement, mineralogy, metallurgy); (3) Organic Chemistry, pure, applied (colouring materials, explosives, sugars, starches, cellulose, paper, fats, oils, soaps, colours, paints, varnishes); (4) Biological Chemistry, pure, applied (medical and pharmaceutical chemistry, fermentation industries); (5) Analytical Chemistry, pure, applied; (6) Agricultural Chemistry; (7) History and Teaching of Chemistry, Economics and Chemical Legislation. Papers may be in the language with which the author is familiar, but the organising committee suggests the use of such languages as will avoid typographical difficulties when rendered into Latin type. Summaries must be given in English, French, German, Italian or Spanish. Scientific communications intended for the Congress should be forwarded by February 5, 1934. The Congress will comprise general lectures; lectures, followed by discussions, in the various groups; and original communications. The general lectures will deal with mineral chemistry, organic chemistry and biochemistry.

Metric System in China and Turkey

ON December 1 of last year, the Chinese Government issued a notice to the effect that the metric system of weights and measures would be introduced into the Customs service on February 1. According to the Shanghai correspondent of the *Times*, the metric system has been applied in the collection of the salt tax since January 1. On the same date, Turkey adopted metric weights and measures, and that system is now obligatory throughout Turkish dominions in Europe and Asia. Thus Turkey, until recently one of the most backward of the European powers, has come into line with the majority of modern States, and no doubt her commerce and industry will benefit from the consequent simplification. Several attempts have, of course, been made to introduce decimal weights, measures and coinage into Great Britain, but the most that has been achieved is the legalisation of the use of metric weights and measures, and the adoption of such terms as 'metric ton'. It would seem that the fuller use of the metric system in Great Britain, like the introduction of the 24-hour clock, is unduly delayed by the prevalent inertia of unscientific public opinion.

Non-Reflecting Windows

NON-REFLECTING windows are beginning to be used for shops. The reflectionless window is a British invention. It is made of a concave sheet of glass so constructed that the light from all sources incident on it is reflected to two black boards arranged one at the top and one at the bottom of the glass. The eye of the observer looking at the glass from in front is completely unaffected by any of the reflected light, the result being that it is very difficult to believe that there is any glass between the objects displayed and the observer. The prospective buyer therefore views the goods more clearly and is not distracted by images. It is also claimed that the reflectionless window effects an appreciable saving in the cost of artificiable lighting, since every lamp in use is able to give its full illuminating value and has not to compete with the disturbing effects of outside rays reflected by the window. The new window is applicable to all shops whether new or old, and for maintenance it costs no more than an ordinary plate-glass window. An illustrated description of the reflectionless window is given in the *Illuminating Engineer* of January, 1934.

Expedition to East Africa

AN important expedition for archæological and geological exploration of the Northern Frontier Province of Kenya Colony left England on January 4. Its purpose is to carry out a topographical and geological survey in the neighbourhood of Lake Rudolph in the great Rift Valley of East Africa. Particular attention will be given to the search for evidence of an archæological or palæontological nature bearing upon the problem of the antiquity of man in the area, in the hope of extending further northward knowledge supplementing the discoveries made by Dr. L. S. B. Leakey in Kenya and Tanganyika. The personnel of the expedition will include two surveyors, Mr. R. C. Wakefield of the Sudan Survey and Mr. W. H. R. Martin of the University of Oxford. Mr. D. G. MacInnes will be responsible for mammalian palæontology, and Mr. J. F. Millard will act as archæologist. Dr. W. Dyson, medical officer of the expedition, will collect zoological specimens and Mr. V. E. Fuchs, who is the leader, is in charge of geology. The work of the expedition, which is supported by a number of learned societies, including the Royal Society, the Royal Geographical Society and the British Association, is planned to occupy about a year.

Overhead Line Distribution Outside Great Britain

AT the meeting of the Overhead-Lines Association in London on September 20, the methods used in North America and Scandinavia for distributing overhead lines were discussed. Mr. A. L. Stanton, president of the Association, said that it is difficult to make comparisons between the methods used in different countries, as the everyday conditions vary widely. In the United States, not more than five per cent of the street lighting is done by gas and not more than 25 per cent of the factory supplies comes from independent stations. The early development of many American supply systems was governed mainly by utilitarian considerations, not much attention being paid to securing continuous service, voltage regulation and avoidance of danger risks.

Mr. T. Stevens described the development of electricity supply in the rural districts of Sweden, Denmark and Norway. Sweden is divided into fifteen areas for the supply of electricity and in most of these the State gives the supply, the remainder being in general owned by a municipality. In the co-operative distribution associations in Sweden, consumers have to hold shares proportional to the acreage of their farms or the number of rooms in their dwelling houses. A certain length of cable is allowed free of charge. When only small supplies are taken, the tariff is greater. Denmark exports to southern Sweden steam-electric power at the times when the water supply is insufficient, and Sweden reciprocates when necessary. In recent years the supply from Sweden has increased from 20 to 90 million kilowatt hours a year. Sweden has 2,387 hydro-electric plants. There are three submarine power lines connecting the two countries.

Phosphates in Sugar Fermentation

In his second Liversidge Research Lecture before the Royal Society of New South Wales, Prof. W. J. Young discussed the "Functions of Phosphates in Fermentations of Sugar". Although the production of alcoholic liquors by the fermentation of sugar is older than recorded history, it was only in 1837 that the suggestion was made that the change is due to the living organism yeast. The final proof of this was the work of Pasteur, who showed that the conversion of sugar into alcohol and carbonic acid is a physiological action of the yeast cell. Later on, Buchner discovered that the active principle, or enzyme as it is now called, can be separated from the living cell and will still carry on the action after such separation. Further work has shown that fermentation is a series of chemical reactions in which phosphoric acid plays a part, and during the process compounds between the sugar and phosphoric acid, termed hexosephosphates, are formed. Phosphates play a similar rôle in other biological processes in which sugars are decomposed to simpler compounds, as, for example, in the animal during muscular activity. During muscular work the animal uses up carbohydrate as a source of energy and this is changed to lactic acid, a process which requires no oxygen. Thus an animal can do a certain amount of work without requiring oxygen, as, for example, in a short sprint race. Oxygen is required later on to remove the lactic acid, hence one goes on panting after the effort is over. Fermentation in yeast and lactic acid production in the animal are thus similar changes, the sugar being decomposed through the same intermediate compounds to alcohol and carbonic acid in the former, and to lactic acid in the latter, and for both phosphates are necessary, and the same sugar phosphates are produced.

Work of the National Institute of Industrial Psychology

The *Human Factor*, 7, No. 12, presents the thirteenth annual report on the work of the National Institute of Industrial Psychology. The wide range of subjects dealt with by the Institute is very striking. The report gives brief indications of the work that has been done in factories, school buildings, retail stores, offices and even gold mines and tea and rubber plantations. The underlying problems of lay-out, 'processing' and personnel, etc., appear to have a certain similarity despite the diverse environments in which they are found. In the Research Section of the report, several interesting investigations are worthy of note. Mr. Harding's work on rhythm in occupational movements has thrown open new possibilities in relation to training schemes and the elimination of fluctuations in the speed of work in various occupations : its application to industry in general may be expected to produce far-reaching results. The nature and measurement of the mental abilities involved in factory assembly operations has been studied, and a colour-discrimination test is now ready for use. In addition, various occupational analyses have been undertaken, and the work on vocational and educational guidance has been maintained and extended.

Uses of Rubber in the Home

We have received an interesting and well-illustrated reprint from the *Furnishing Trades Organiser* on "Rubber Flooring and Furnishings". Rubber flooring has been improved both as regards quality and design and the price has come down substantially. The latest type of sponge upholstery is made direct from rubber latex. It is moulded in one piece and obviates the necessity for built-up construction. Sofas, chairs, mattresses and loose cushions are now made of rubber and are stated to be practically everlasting. Lists of companies manufacturing these products are given in the reprint, which is issued by the Rubber Growers' Association (Inc.), 2, 3 and 4 Idol Lane, Eastcheap, London, E.C.3.

Coloration of Fossil Bones

In the September number of *Revue Scientifique* occurs the last of a series of articles upon the coloration of bones which have been for longer or shorter periods buried in the ground. In the present article, L. Franchet deals with the effects upon bones of the boiling of a corpse, and the various colour changes due to incineration. The articles, in which the author discusses experiments he has made to check the effects which occur naturally, should be of value especially to archæologists and prehistorians, particularly in warning against rash deductions regarding the age of buried bones, derived solely from the condition of the bones.

Crystal Structure Models

In the October issue of the *Review of Scientific Instruments*, Mr. G. Glockler, of the University of Minnesota, describes a convenient form of model of crystal structure. The atoms are represented by black, white or coloured dots on vertical sheets of 'Cellophane', which are hinged along their bottom edges to a thin sheet of wood or cardboard and can be folded down for packing. When so folded, each model is about the size of a volume of Nature.

Standards for Surgical Dressings

THE Pharmaceutical Society of Great Britain has issued a report on "Dressings" by a sub-committee of the Codex Revision Committee (Pharmaceutical Press, 23 Bloomsbury Square, London, W.C.1. 1*s.* 6*d.*). It contains a summary of standards for surgical dressings, provisionally accepted for inclusion in the British Pharmaceutical Codex, 1934, which should provide information useful for manufacturers and others. The standards suggested include those for the basic materials, such as jute, silk and wool, and for dressings such as phenol and mercuric chloride gauzes, and others, as well as methods for the determination of moisture, water extract, foreign matter, cotton and wool in the dressings.

Benefits to Animals from Animal Experiments

THE autumn issue of the *Fight Against Disease*, the quarterly journal of the Research Defence Society, contains the concluding portion of Sir Leonard Rogers' Stephen Paget Memorial Lecture. After a survey of some of the principal animal and virus diseases, Sir Leonard concludes that "the examples given from the limited field of tropical medical and veterinary science alone, suffice to prove that the reduction in the suffering that results year by year to animals, as well as to man, from the discoveries made in about three decades through a limited number of animal experiments, is incalculably greater than the pain inflicted on the animals under our humane laws".

Leverhulme Research Fellowships

APPLICATIONS are now invited for Leverhulme research fellowships for 1934. These fellowships are intended in the first instance for the assistance of experienced workers rather than to add to the provision already existing for workers in the early stages of their careers. It has been decided that no definite limit shall be placed to the amount of individual grants, but that they will be adjusted according to the circumstances of each particular case. Fellows will usually be required to work at, or in connexion with, a recognised centre of research, either at home or abroad. No subject of inquiry is excluded from the scope of the scheme. Awards will not be made, as a rule, for a shorter period than three months or for a longer period than two years. The closing date for receipt of applications is March 1. The awards will be announced in July and will date from September 1. All applicants must be British-born and they must also be normally resident in the United Kingdom. Further information can be obtained from Dr. L. Haden Guest, Secretary, Leverhulme Research Fellowships, Union House, St. Martins-le-Grand, London, E.C.1.

Announcements

DR. L. W. G. MALCOLM, conservator of the Wellcome Historical Medical Museum, has been appointed an officer of the Venerable Order of the Hospital of St. John of Jerusalem.

THE following appointments in the Colonial Agricultural Service have recently been made: Dr. F. J. Martin, assistant director of agriculture, Sierra Leone, to be director of agriculture, Sierra Leone; R. S. Ball and J. T. Moon to be agricultural officers, Kenya.

AT the ordinary meeting of the Institution of Electrical Engineers to be held on January 18, at 6 p.m., Viscount Falmouth will present to the Institution a copy of Sir William Orpen's painting of Sir Charles Parsons.

A JOINT meeting of the Royal Astronomical Society and the Geological Society will be held in the rooms of the Royal Astronomical Society, Burlington House, W.1, on January 26, at 4.30 p.m., when a discussion will be held on the "Origin of the Earth's Major Surface Features". The meeting will be presided over by Sir Frank Dyson.

THE annual meeting of the International Society of Medical Hydrology is to be held on January 28–February 2 at Zurich, Davos and St. Moritz. The president elect is Prof. O. Veraguth, professor of physical therapy in the University of Zurich. The principal subjects for discussion are the thermal bath reaction and the physiological and therapeutic effects of high mountain climates. Decisions will be taken concerning the nomenclature and classification of muds, peats, etc., used in physical medicine. The meeting is open to scientific workers generally as well as medical men. Further information can be obtained from the General Secretary, I.S.M.H., 109 Kingsway, W.C.2.

WE have received the 1934 pocket diary of Messrs. John G. Stein and Co., Ltd., silica and firebrick manufacturers, of Bonnybridge, Scotland. The diary contains many features of interest, for example, chemical analysis of various types of firebrick; special refractories, their analyses, expansion curves, thermal properties, etc.; equilibrium diagram of the system $Al_2O_3 - SiO_3$ (Bowen and Greig); first aid treatment; standards of measurement, and their equivalents; sectional road maps of Great Britain; and much other useful standard information.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An examiner in the aeronautical Inspection Department of the Air Ministry—The Secretary (S.2), Air Ministry (Jan. 15). A maintenance and test engineer in the Public Works Department, Electricity Branch, Government of the Punjab—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Feb. 1). A demonstrator in dairy husbandry and an advisory entomologist in the Department of Agriculture, University of Leeds—The Registrar (Feb. 2). A head of the Departments of Municipal Engineering in the Manchester Municipal College of Technology—The Registrar (Feb. 5). An agricultural chemist and an entomologist at the Imperial Institute of Agricultural Research, Pusa—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Feb. 12).

Letters to the Editor

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

Refraction of Ionised Media

IN a recent letter Prof. Hartree[1] has directed attention to certain difficulties in the theory of refraction as applied to ionised media, and has criticised previous letters by Tonks[2] on the subject. I have myself been occupied for some time in trying to clear up this matter, and can confirm Hartree's opinion of the subtlety of the subject, but at the same time it should be said that, in spite of the defective proof, Tonks's result is certainly right. The problem is whether the formula of Sellmeier or that of Lorentz should be applied for a gas composed of free electrons moving among ionised atoms, which may be taken as fixed protons without losing the point of the question. The refractive index n is to be derived from atomic characters, and the problem is whether it is

$$S = n^2 - 1, \qquad (1)$$

or

$$L = 3(n^2-1)/(n^2+2) \qquad (2)$$

which is directly related to these. The alternatives for the ionosphere are whether it is S or L that is equated to

$$-Ne^2/\pi m\nu^2 \qquad (3)$$

where N is the number of electrons per c.c., ν the frequency of incident waves, and e and m, the charge and mass of the electron respectively. If the formulæ are used to estimate the actual electron density of the ionosphere, there is a discrepancy of 50 per cent according to which of them is adopted; so that the question is by no means trivial. The same problem arises with even greater force in connexion with the optics of metals. It has been discussed by Kronig and Groenewold[3]; their defence of the use of S is open to exactly the same criticism as that of Tonks, but from the known values of the optical constants of metals it is here even more certain that S is the correct form.

The essential point of the question consists in making the correct allowance for the mutual forces between the various particles concerned in scattering the light. The question is one in which we do not anticipate any great difference between classical and quantum theory, and it is easier to work with the classical; in the quantum theory of metals it has been usual to consider what is in effect only a single electron, and this cannot possibly throw any light on the present question. The main difficulty lies in estimating the large influence on each electron of its close neighbours, both protons and electrons. Tonks tries to overcome this difficulty by replacing the protons by a uniform distribution of positive charge-density, but this replacement is the crucial point of the problem; it is only done by an illegitimate inversion of the order of integrations, and this inversion leads to a large change in the resulting value. Unrigorous processes, like the inversion of integrations, are so habitually done in physics with impunity, that one is apt to trust them completely; with an unrigorous formulation of the present problem it is easy to find entirely plausible arguments leading either towards L or S. It is quite easy to show that a set of electrons moving in a uniform positive medium will obey a formula in S, and everyone agrees on this; the whole difficulty is to justify the replacement of the protons by the continuum, for there is little resemblance between the smooth motion of an electron in the continuum, and the zigzag path among the protons.

The technical problem of discussing with rigour the optics of a finite volume of any material is formidable, for it demands retarded potentials for the mutual forces of each pair of electrons, and so the system cannot be taken as a self-contained dynamical system, but must be treated with the help of Lorentz's device of making a fictitious spherical cavity round each electron. Most of the difficulty can, however, be avoided by the device of taking a small isolated sphere of the material and calculating the light it will scatter to a distance. If the radius a is much smaller than the wave-length of the incident light, there is no need to allow for retardation and the whole sphere can be regarded as a single dynamical system. A simple optical calculation shows that under incident light of amplitude A, it scatters light as though having electric moment

$$A\,a^3(n^2-1)/(n^2+2),$$

and therefore n is found if we can calculate the moment directly. For a set of separate elastically bound electrons, as in neutral atoms, there results at once a formula in L; at the opposite extreme, with a continuum of positive electricity, an equation is easily formed for the electric moment which leads to a formula in S. The important question is how the moment behaves for a set of discrete protons lying arbitrarily throughout the sphere. This is not the place to discuss details, but it can be seen that the average motion will satisfy the same equation as in the case of a continuum, provided that each electron undergoes many collisions during the period of the light. This condition is satisfied in the ionosphere for the long waves used, and in metals for ordinary light, so that S is the right expression in these cases.

As a general comment, it seems natural that S rather than L should be the more fundamental formula. Lorentz derived L by introducing a spherical cavity that was quite fictitious, and yet the algebraic form of (2) shows clear evidence of a real sphere. The reason is that there is a genuine sphere (or perhaps some other shape arbitrarily orientated) round each molecule; this is its own surface which prevents the entry of other molecules, and it is the existence of this small real sphere, and not the comparatively large fictitious sphere of Lorentz, that is responsible for (2). S is the natural formula for pure electromagnetic systems, and L is an expression of the fact that the systems to which it applies are governed by a law that is not electromagnetic—the exclusion principle which prevents one atom from penetrating another.

C. G. DARWIN.

The University,
Edinburgh.
Dec. 28.

[1] NATURE, **132**, 929, Dec. 16, 1933.

[2] NATURE, **132**, 101, July 15, and 710, Nov. 4. See also a letter by Norton, *ibid.*, p. 676, which seems open to the same criticisms, though his method is not very fully described.

[3] *Proc. Amst. Akad.*, **30**, 974; 1932.

A New Hard Component of the Cosmic Ultra-Radiation

THE Steinke apparatus, which recorded the ionisation caused by the cosmic ultra-radiation at Abisko in northern Sweden during the polar year 1932–33[1], was moved in the middle of July to the iron ore mine Kiirunavaara, near Kiruna, in order to record the absorption curve of the cosmic ultra-radiation below various thicknesses of iron ore. The Kiirunavaara mountain is pierced at different levels by numerous galleries with rail tracks, some of which follow the ore body through its whole length (4 km.). It was therefore possible to move the apparatus, placed on a wagon or trolley, below layers of pure iron ore of different thickness from 160 to 10 metres, corresponding to water equivalents of 800–50 metres (the specific gravity of the ore being 5). Above the ore is only the atmosphere.

During three weeks in July there were holidays in the mines, and the management kindly lent me an electric train for the investigation of the cosmic ultra-radiation in the main galleries of the Kiirunavaara mountain. The apparatus and a lead shield of 10 cm. thickness were assembled in a wagon and kept at constant temperature, and the wagon was moved below thicknesses of 107–60 metres of ore. It immediately appeared, however, that the ore sends out an unexpected and rather strong penetrating radiation; later investigation showed that the ore in this gallery had a radium content up to 0·05 mgm. per ton. (So far as I have been able to find from the literature accessible to me, this is the first time that radium has been found in iron ore.) Also the air in the gallery was highly radioactive and increased the ionisation within a 10 cm. lead shield to values which were impossibly high for the cosmic ultra-radiation. Nevertheless, if these values were reduced to their equivalent in radium radiation (which was taken up without shield), they showed an increase with decreasing thickness of the ore, and this increase indicated an absorption coefficient of the cosmic ultra-radiation about ten times less than that of the hardest component found by E. Regener[2]. At the beginning of August, V. F. Hess, W. Kolhörster, E. Regener and E. Steinke were privately informed about this result.

In order to eliminate the radium radiation, especially that from the air, special precautions and arrangements were necessary for the following measurements. A large airtight iron box of the dimensions 120 cm. × 80 cm. × 85 cm. was constructed containing two chambers, one above the other. This box was placed upon a trolley and in the lower chamber the ionisation cylinder of the Steinke apparatus was placed within a lead shield of 20 cm. thickness open upwards. Before the microscope was a window, and the photographic recorder was placed outside the box before this window. The airtight floor of the upper chamber was laid directly upon the lead shield, and upon this floor the upper lead shield of 10 or 20 cm. thickness was placed. Also the upper chamber could be made airtight. At the request of the management of the mines, measurements of the radium radiation were also carried out, and therefore the ionisation was recorded both with the shield open above (that is, with no shield in the upper chamber) and with shields of 10 cm. and 20 cm. above. During a month and a half, seven series of measurements were taken below 13–104 metres of ore; one series was taken without a shield in the upper chamber in order to get the radium radiation. The apparatus stood generally twenty-two hours at every place in every series and recorded the ionisation during every hour.

As might have been expected with respect to the radioactive air enclosed in the box, the values decreased steadily until the last two series, but the differences between daily values and the corresponding values of the last series were found to fit closely to the curve of decreasing radium emanation as given by Meyer and Schweidler[3], so that daily values could be accurately reduced for this air radiation. The values were further reduced for some radium radiation, which entered around the microscope, where it is impossible to make the shield as thick as elsewhere. The resulting mean values of the cosmic ultra-radiation plus the zero ionisation of the apparatus are: below 13 m. ore, 0·1346 J.; below 28 m., 0·0615 J.; below 53 m., 0·0402 J.; below 75 m., 0·0374 J.; below 86 m., 0·0366 J.; and below 104 m., 0·0366 J.

Irrespective of the value of the zero ionisation (*Restgang*), these numbers indicate three components of the cosmic ultra-radiation penetrating 13–86 metres of ore, and the softest component has an 'apparent' mass absorption coefficient of $(\mu/\rho)_{H_2O}$ 0·00020 cm.^{2} gm.$^{-1}$; that is, is identical with the hardest component of E. Regener[2] ($\rho = 5$; $(\mu/\rho)_{H_2O} = 1{\cdot}19\ (\mu/\rho)_{Fe}$). The coefficients of the two harder components are rather sensitive to the magnitude of the zero ionisation, the exact value of which is not yet known but will be observed by the forthcoming measurements below 160 metres of ore at a deeper level of Kiirunavaara. The zero ionisation cannot, however, be much less than the value now observed, namely, 0·0322 J., and, taking 0·0300 J. as preliminary value, we obtain as apparent mass absorption coefficients of the two still harder components: $(\mu/\rho)_{H_2O} = 0{\cdot}00011$ and 0·00003 cm.^{2} gm.$^{-1}$ respectively. The first coefficient agrees rather well with that recently found by W. Kolhörster[4] $(\mu/\rho)_{H_2O} = 0{\cdot}00013$ cm.^{2} gm.$^{-1}$, but the second coefficient indicates a hitherto unknown component, much more penetrating than the others, and the existence of this hardest component seems well established by the present measurements. The exact mass absorption coefficients will be calculated, when the zero ionisation has been determined below 160 metres of iron ore.

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Observatory,
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Nov. 22.

[1] *Lund Obs. Circ.*, 6, 1931.
[2] *Phys. Z.*, **34**, 306; 1933.
[3] "Radioaktivität", p. 419; 1927.
[4] *Berlin Ber.*, **23**; 1933.

Cosmic Rays and the New Field Theory

REGENER[1] has found that cosmic rays can be observed at 230 m. below the level of Lake Constance. If these rays, as is generally assumed, consist of electrons (not of protons) the great penetrating power raises a serious difficulty in the adopted theory of electronic motion, that is, Dirac's equation. Using this equation, Heitler and Sauter[2] have shown that a beam of very fast electrons (with an energy $E > 200\ mc^2$) should penetrate not more than 1 m. of water when all kinds of absorption processes are taken into account.

The new field theory proposed recently[3] seems to be able to give the explanation of the high penetrating power of very fast particles, either photons or electrons. In this theory there are two types of field vectors, B, E, and H, D, which are identical for very weak fields only. They are different for strong fields, especially in the 'interior' of the electron. The true charge is always concentrated in points, that is, div $D = 0$, $\int D_r d\sigma = 4\pi e$. But, as has been shown by my colleague, Dr. L. Infeld, a 'free' charge can be introduced with a finite space density, given by div $E = 4\pi\rho$. This can be considered as the source of the electronic field and as the charge upon which the external field acts, as in Maxwell's theory. For an electron ρ is given by

$$\rho = \frac{e}{2\pi r_0^3} \cdot \frac{1}{\frac{r}{r_0}\left(1+\frac{r^4}{r_0^4}\right)^{3/2}}$$

and the space integral of ρ is equal to e.

Under the action of an electromagnetic wave with an amplitude proportional to $e^{2\pi iz/\lambda}$, the behaviour of the electron will be expressed approximately by Dirac's equation provided we replace the charge e by an 'effective' charge $\bar{e}$, given by

$$\bar{e} = \int \rho e^{2\pi iz/\lambda} dV = ef\left(\frac{2\pi r_0}{\lambda}\right), \quad f(x) = \frac{2}{x}\int_0^\infty \frac{\sin xy}{(1+y^4)^{3/2}}\, dy.$$

It is immaterial whether the field be due to a light wave or to the passage of fast electrons; for if $E \gg mc^2$, one has in both cases, with a very good approximation, $\lambda = hc/E$ and

$$x = \frac{2\pi r_0}{\lambda} = 1{\cdot}236 \cdot \frac{2\pi e^2}{hc} \cdot \frac{E}{mc^2} = \frac{1{\cdot}236}{137{\cdot}1} \cdot \frac{E}{mc^2} = \frac{1}{111} \cdot \frac{E}{mc^2}$$

Now the function $f(x)$ is equal to 1, for $x = 0$ (long waves, small energies), but decreases with increasing x. For $x = 2{\cdot}4$, or $E = 266mc^2$, it is $\frac{1}{2}$; and for $x = 5$ or $E = 555mc^2$, only $\frac{1}{10}$. The cross-section of action, which is proportional to $(\bar{e}/e)^2$, will therefore diminish rapidly with increasing energy of the rays.

Provided the assumption of protons could be excluded, the high penetrating power observed for the cosmic rays may be considered as a confirmation of the new field theory.

MAX BORN.

246, Hills Road,
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[1] E. Regener, *Phys. Z.*, **34**, 306; 1933.
[2] W. Heitler and F. Sauter, NATURE, **132**, 892, Dec. 9, 1933.
[3] NATURE, **132**, 282, Aug. 19, 1933.

The Pre-Crag Men of East Anglia

IT is common knowledge that the Suffolk Bone Bed beneath the Red Crag is made up largely of the remains of a land surface which existed, for a prolonged period, prior to the submergence of East Anglia beneath the sea of Crag times. Sir Ray Lankester pointed out many years ago[1] that the bones and teeth of land mammals found in the Suffolk Bone Bed are of different ages—some being of a Miocene antiquity, while others are to be referred to certain phases of the Pliocene epoch. He was able also to show that the tooth of a mastodon, by reason of its being partly embedded in a deposit of Diestian sandstone, must be older than this Lower Pliocene accumulation, which is represented in the Suffolk Bone Bed by the well-known fossiliferous box-stones. Thus, by these investigations, it was made clear that, so far as the remains of terrestrial mammals are concerned, the contents of the Suffolk Bone Bed are markedly derivative and referable to widely separated periods anterior to the deposition of the Red Crag.

When, some twenty-five years ago, the announcement was made[2] that flint implements had been found in the Suffolk Bone Bed, a considerable body of opposition to this claim was encountered, and, for a long time, it was needful to concentrate upon the primary task of establishing the fact that the pre-Crag flints had been humanly flaked. But it has now become advisable to proceed to the next stage, and to classify these very ancient relics of man with the view of attempting to ascertain their probable geological antiquity. This process of classification has been made possible by the large number of pre-Crag implements now available for study, and, especially, by the excellent specimens recovered recently during excavations carried out on behalf of the Royal Society, the Wellcome Historical Medical Museum and the Trustees of the Percy Sladen Memorial Fund. The critical examination which has been undertaken of the pre-Crag flints is leading to certain unexpected and far-reaching conclusions, which I propose to set forth briefly here.

It can now be claimed without fear of serious contradiction that, at least, four distinct and different groups of flint implements are contained in the Suffolk Bone Bed. This is established by the fact of the discovery of numerous examples of flints exhibiting flaking of more than one period and in which the newer flake-scars definitely cut into and are patinated a markedly different colour from the older. Moreover, it is apparent that the four types of patination represented can be precisely matched by that to be observed upon a series of implements which are each different in their forms and condition. Thus, for example, the oldest artefacts are thick and coarsely flaked, exhibit a peculiarly archaic, washed-out yellow colour and have evidently been subjected to very considerable striation and abrasion. The latest implements, on the other hand, are usually white or light blue in colour, are little if at all abraded, and are not thick and coarsely flaked. Between these groups are two others which in patination, condition and general appearance are equally distinct from each other.

There is, in fact, as much divergence in these matters, between Group 1 and Group 4 of the pre-Crag implements, as there is, for example, between the Early Chellean and Late Acheulean hand-axes. It is possible also that the gap in time between Group 1 and Group 4 of the pre-Crag industries is greater than that separating the palæolithic implements mentioned. This supposition is based upon the 'morphology' of the former specimens, the thickness and consequent antiquity of the various patinated surfaces, and the fact that there has now been found beneath the Red Crag a well-made rostro-carinate implement which has attached to various parts of its surface areas of material which, so far as a very careful visual examination goes, is indistinguishable from Diestian sandstone.

The manner of distribution of this deposit upon the implement makes it highly probable that the specimen was at one time embedded, like the mastodon tooth described by Lankester, in a Diestian

nodule, and must therefore have been made at some period prior to the laying down of this Lower Pliocene stratum. Moreover, the patination of the flake-scars of the rostro-carinate in question is precisely similar to that to be observed upon others which are clearly later in date than the flaking of Group 1 of the pre-Crag implements. It would seem to be necessary therefore to relegate the latter to an epoch still further anterior to the Diestian period than is the rostro-carinate to which reference is made.

If these conclusions are sound, they give us much additional information upon the question of the antiquity of man. The earliest flint implements in this bed, which comprise primitive though well-made specimens, including rostro-carinates, referable apparently to some at present unspecified period preceding the Diestian, seem definitely to surpass, in their forms and flaking, the type of artefact which, it may be supposed, would have been produced by the most lowly representatives of the human race. The implements of Harrisonian eolithic form associated with Group 1 of the Suffolk Bone Bed specimens were at one time thought to be actually comparable with the well-known Kentian eoliths. But it now appears that the pre-Crag examples are mostly made from intentionally struck flakes and thus represent a more advanced stage of human achievement than do the true Harrisonian implements.

Thus it seems reasonable to conclude that prior to the laying down of the Suffolk Bone Bed, which must pre-date by a considerable period the earliest palæolithic civilisations, various races of flint flaking people inhabited the ancient East Anglian land surface. It is clear, from an examination of the pre-Crag implements, that they must be much older than the marine sands under which they now lie, and it is possible that the most ancient groups of artefacts date back to epochs earlier than that known as Diestian. After a very careful consideration of the whole matter, I believe that this is indeed the case, but in order to give all those interested an opportunity for coming to their own conclusions, the large collections of pre-Crag implements in the Ipswich Museum have now been re-arranged upon the lines indicated in this note and can be freely examined by responsible visitors. A representative selection from the four groups of specimens has been arranged as a loan exhibition in the British Museum, and I hope to publish a fully illustrated paper dealing with these implements.

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[1] *Phil. Trans.*, B, 1912.
[2] *Proc. Prehist. Soc. East Anglia*, vol. 1, pt. 1, pp. 17–43.

Science and Politics

ALL scientific workers will thank Prof. A. V. Hill for raising the problem of their status in a world in acute political tension (NATURE, Dec. 23). Most will agree with his main thesis, and few, if any, will hold it to be the duty of scientific societies, such as the Royal Society, to meddle with divinity, metaphysics, morals or politics. But this rule applies to the society as a corporate body, and not to its individual members. Those men of science who interest themselves in politics will be unable to agree with Prof. Hill's contention: "If scientific people are to be accorded the privileges of immunity and tolerance by civilised societies, however, they must observe the rules". I am glad to think that individual fellows of the Royal Society, at any rate, have consistently disregarded these rules. Among its earliest fellows, Pepys and Brouncker, to mention no others, meddled in politics; in the eighteenth century, Franklin and Priestley meddled even more conspicuously.

Everyone recognises the difficulty of keeping emotion out of one's scientific decisions when they have a political bearing. But does Prof. Hill condemn scientific men who investigate human heredity because their results discredit the theory of the equality of man, or those who investigate human diet because they demonstrate that a considerable section of the British working classes is underfed? Science could "remain aloof and detached", to use his words, so long as it only concerned itself with man as something to dissect. That day is past.

Prof. Hill condemns the irrational character of certain modern political movements. May it not be that the remedy for this lies simply in the application of scientific thought to political and moral problems? It is obvious that such an attempt will endanger the immunity which scientific workers enjoy so long as their opinions are regarded as politically unimportant. But science is in any case in danger of perishing during a general collapse of our political and economic system. If we refuse to apply scientific method to human affairs because they are inevitably tinged with emotion, we may help to precipitate this collapse. Such application will be very largely critical, in so far as many political doctrines are based on hypotheses which cannot stand scientific criticism, but it must be to some extent constructive, as when it is pointed out that, owing to defects of Nature and nurture, some men and women cannot play an adequate part in society, and remedies for this state of affairs are suggested.

I do not see why a man of science who "meddles" with such matters should thereby forfeit a right to tolerance, and question whether Prof. Hill has done a service to science by penning a sentence which might be interpreted as meaning that his profession should only be tolerated in so far as it is muzzled. His subsequent eulogy of independence of thought and speech make it clear that his meaning was quite otherwise. But many of his colleagues will continue to feel that, while scientific societies should restrict their activities to the purest science, their members have not merely the right, but even sometimes the duty, to interest themselves in more controversial matters.

J. B. S. HALDANE.

John Innes Horticultural Institution,
London, S.W.19.

OF course I would not condemn scientific men who investigate human heredity, whatever their results may discredit, but I should advise them to avoid an emotional bias towards any particular political or social theory which may be affected by their investigations: otherwise experience teaches that their results are suspect. Of course I should not condemn scientific men for studying human diet, but the motive should be the discovery of scientific fact, not the demonstration that the British working class is underfed.

Prof. Haldane fails to distinguish between "people scientifically trained" who, I urge, "should take some part in affairs" and the scientific investigators themselves. It is perilous, as I said, to disregard the scientific basis of modern civilisation, and all educated

men should have some direct appreciation of the methods and ideas of science. This is exactly what Prof. Haldane himself urges in his third paragraph. It is the application of scientific methods to politics and social affairs, and the increase of scientific education and outlook, not the interference of specialist scientific investigators with matters outside their own special competence, which may avert the dangers of which both Prof. Haldane and I are aware. A reputation gained by scientific achievement, and the immunity accorded to scientific pursuits, should not be lightly used to extort consideration in other respects. One may not approve of political intolerance, but one may recognise as a fact that eminent scientific men do well, in the interests of science, to avoid meddling with "morals or politics".

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Methods of Ionospheric Investigation

PROF. E. V. APPLETON[1] has described a method of measuring the maximum ionisation existing in the lower region of the ionosphere. It is clear from recent work[2,3,4] that, in order to investigate ionospheric fine-structure in sufficient detail, our technique must be improved along at least two lines :—

(1) The time taken in making a measurement of ionisation density should be as short as possible.

(2) Measurement of the equivalent path of the atmospheric rays should be made over a frequency range which is continuous.

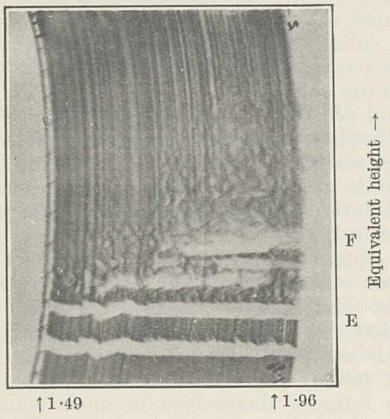

FIG. 1. Frequency in megacycles/sec.

The complexity and sudden changes in ionospheric conditions observed in the polar regions would have made an apparatus embodying such improved technique a powerful instrument in our investigations. The transmitter and receiver were about ten miles apart, so that any form of mechanical linkage or remote control was not practicable. As a result of attempts to meet the requirements, the method finally adopted consisted in increasing continuously the frequency to which the transmitter was tuned and causing the tuning of the receiver to vary in synchronism. The scheme, although not ideal, enabled (2) to be satisfied over a limited frequency range and an approach towards (1) above. The time taken to make one picture (such as that reproduced as Fig. 1) involving a determination of the ionic density was two minutes. The calibration frequency marks which appear on the records were made by attaching a contact arm to the condenser spindle of the high-frequency oscillator of the superheterodyne receiver and arranging that each time this condenser dial responded to the particular frequencies marked on the records, the incoming signals were cut off and a local calibration from a 2·5 kc./sec. time-base was switched on. This condenser spindle was turned uniformly so that it is possible to interpolate between calibration marks on the record.

Records which will show the importance of this type of observation will be published amongst the results of the British Polar Year Expedition to Tromsø. One specimen is reproduced here to illustrate the importance of (2) above. It is a record taken at midnight during the period of the 'midnight sun'. The calibration marks on the left of the picture are caused by a 2·5 kc./sec. oscillator so that the distance between two successive marks corresponds to 0·4 milliseconds or an effective height of 60 km. The picture shows the ground ray and echoes from the *E* region, intermediate region and *F* regions of the ionosphere. There is also a considerable amount of scattering visible. The frequency range shown is only 0·5 mc./sec., but it will be seen that the echo pattern changes greatly over this comparatively small amount. At 1·49 mc./sec. the *E* echo is prominent with a small amount of reflection from the intermediate region. This latter increases with frequency up to 1·93 mc./sec. At 1·7 mc./sec., marked reflection begins from the *F* region and continues to the highest frequency shown. The picture gives some idea of the complexity of the ionosphere in the polar regions.

This work was carried out in May 1933 at Nordlysobservatoriet, Tromsø, as part of the Polar Year programme of the Radio Research Board, and I am indebted to Hr. Harang, director of the Observatory, for the loan of apparatus and for experimental facilities which made these results possible.

R. NAISMITH.

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[1] Appleton, NATURE, **127**, 197, Feb. 7, 1931.
[2] Appleton, *Proc. Phys. Soc.*, **45**, 673; 1933.
[3] Appleton and Naismith, *Proc. Phys. Soc.*, **45**, 389; 1933.
[4] Schafer and Goodall, NATURE, **131**, 804, June 3, 1933.

Liquids of High Refractive Index

IN measuring the refractive index of precious stones, we have succeeded in extending the range of the total reflectometer type of instrument by the preparation and use of liquids of higher refractivity than the sulphur in methylene iodide solution ($n_D < 1{\cdot}79$) which is usually employed to make optical contact between the stone and the glass hemisphere of the instrument. The various immersion media of high refractive index proposed by Merwin[1] and Wright[2] were found to be unsuitable. Of a number of compounds prepared the following are worthy of note.

1. Tetra-iodo-ethylene, C_2I_4. This compound dissolves readily in methylene iodide (22 per cent at 15° C.) and with sulphur in this liquid forms a stable clear solution, n_D 1·81, well adapted for routine use with the refractometer[3].

2. Phenyldi-iodoarsine, $C_6H_5.As.I_2$. Prepared by the method of Steinkopf and Smie[4] it is a clear orange liquid, $d^{15°}$ 2·56, with a high refractive index and dispersion, as shown by the following mean values :

$\lambda(A)$	6708	6438	6141	5893	5535	5350	5106
$n^{15°}$	1·822	1·828	1·835	1·843	1·856	1·865	1·879

Phenyldi-iodoarsine has a blistering action when in contact with the skin, but, handled carefully, provides an excellent liquid for use with the refractometer, and should prove valuable as an immersion medium.

3. Selenium monobromide, Se_2Br_2, has a higher refractive index than that of any pure liquid hitherto recorded. Prepared by direct combination, the value for n_{Li} is $1{\cdot}96 \pm 0{\cdot}01$ rising to 2·02 on exposure to the atmosphere, owing to decomposition of the bromide, with separation and reabsorption of selenium. It is opaque, except in thin films, to all but deep red light, but when mixed with methylene iodide can be used with the refractometer. To obtain a high reading we find it convenient to mix the selenium-saturated bromide with the special methylene iodide solution mentioned above, in small quantities as required. Such mixtures have $n_D > 1{\cdot}90$ and thus enable readings to be made up to the limit imposed by the refractive index of the glass hemisphere of the instrument (no instrument reading above 1·90).

To make still higher readings possible we hope that fine quality transparent zinc blende (n_D 2·37) may be worked and used in place of the glass, the instrument being suitably modified. Further work on this subject is in progress.

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[1] Merwin, J., *Washington Acad. Sci.*, **3**, 35; 1913.
[2] Wright, Carnegie Publication No. 158, Washington, 1911.
[3] *Gemmologist*, **2**, 201; 1933.
[4] Steinkopf and Smie, *Ber.*, **59** (B), 1461; 1926.

Crystal Structure of 1–3–5 Triphenylbenzene

A PAPER has recently appeared[1] in which a structure is proposed for 1–3–5 triphenylbenzene, based on X-ray measurements. The unit cell has dimensions $a = 11{\cdot}2$, $b = 19{\cdot}8$, $c = 7{\cdot}6$ A., and contains 4 molecules. No reflections were observed from planes $(h0l)$ where l is odd, and $(hk0)$ where $h + k$ is odd. On the assumption that the crystals are orthorhombic bipyramidal, this would mean that the space-group is Q_h^{16} (Pmcn) and that the molecule has a plane of symmetry. The authors place this plane of symmetry parallel to (010), but it is clear from the 'absent reflections' that (010) and (001) are both glide-planes of symmetry and that the molecular plane of symmetry, if it exists, must be parallel to (100). This result is incompatible with the authors' structure and also, as it happens, with the most probable dimensions of the molecule and the actual intensity data.

The explanation of this apparent anomaly is that the crystal class is not orthorhombic bipyramidal, but orthorhombic pyramidal. The crystals show a small, but quite definite, piezo-electric effect, indicating that the crystallographic 'a' axis is, in reality, a polar axis. The molecules are *asymmetric*, though pseudo-trigonal, and the plane of the benzene rings is not coincident with the crystallographic (001) plane, as in the proposed structure, but makes a small angle with that plane. A complete account of the correct structure, based on accurate X-ray intensity measurements, together with optical and magnetic data, will be published shortly.

Meanwhile the importance of making piezo-electric measurements whenever possible cannot be too strongly emphasised, as lack of knowledge may otherwise lead not only to the assumption of too much molecular symmetry, but also to a completely incorrect structure. It is, I think, a fact that in every case for which a plane of symmetry in the benzene ring has been reported, the presence of a piezo-electric effect (not tested for) would eliminate that plane.

KATHLEEN LONSDALE.

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[1] E. Hertel and G. H. Römer, *Z. phys. Chem.*, B, **23**, 226; 1933.

A New Wound Parasite of Potato Tubers

IN a recent communication, Mr. S. F. Ashby of the Imperial Bureau of Mycology, Kew, informs me that he has not been able to find a record of *Fusarium viride* (Lechm.), Wr. on potato or of any tests of its parasitism on that host. Recently Wollenweber[1] has renamed it *F. solani* var. *medium*, Wr., but its pathogenicity does not appear to have been tested.

Single spore cultures of *F. viride*, kindly identified by Dr. Wollenweber, were inoculated into potato tubers by a slightly modified method of Granger and Horne[2]. After 24 days at room temperature (20°–25° C.) all the inoculated potatoes showed a well-advanced dry rot with a wrinkled sunken patch and whitish pustules on the surface near the plug. The fungus was re-isolated in a pure form both from the diseased parts as well as from the pustules. Its saltant was as virulent as the parent. *F. moniliforme*, *F. camptoceras*, *F. diversisporum*, *F. semitectum* and *F. semitectum* var. *majus* failed to infect the tubers. The controls all remained healthy.

ANIL MITRA.

Department of Botany, University of Allahabad. Nov. 30.

[1] "Fusarium Monographie", 1931.
[2] *Ann. Bot.*, **38**, 212; 1924.

Scurvy in the 17th and 18th Centuries

THERE is an English seventeenth century reference to the treatment of scurvy, which, perhaps, is not so well known as it might be. John Woodall, author of "The Surgeon's Mate, or Military and Domestique Surgery", 1639, wrote on p. 171, "juyce of lemmons was ever reputed a cold medicine, prescribed and given daily by physicians in burning and pestilentiall fevers, and that with good reason and good successe even to this day, and yet to that notable and cold and terrible disease of the Scurvy, how excellent hath it been approved. . . ."

In the next century, Capt. Cook did not find citrous fruits to be of striking value, for a very good reason arising from the nature of his supplies. There is appended to his paper in *Phil. Trans.*, vol. 66, 1776, a letter in which he writes: "I have no great opinion of them alone", 'them' being oranges and lemons, preserved as a 'rob' or syrup of *boiled* juice.

E. G. T. LIDDELL.

University Laboratory of Physiology, Oxford. Dec. 21.

Research Items

China and the Maya. A communication from Dr. Kiang Kang-Hu on the resemblances between the Maya civilisation of Central America and that of the Chinese, accompanied by an introductory note, dealing broadly with the question of cultural diffusion across the Pacific, by Dr. W. D. Lighthall, has appeared (*Trans. Roy. Soc. Canada*, Ser. 3, 27, Section 2). Dr. Kiang from his familiarity with the cultures of his own and kindred peoples is able to bring forward a number of instances, in which he sees resemblances between the two civilisations, for the further scrutiny of specialists. Among these are the physical characters and the mental outlook of the two peoples, the Maya more nearly resembling the Chinese physically than any other of the aboriginal tribes of Central and North America. He also points to similarities in language, in the complicated and elaborate calendrical system, both peoples using the 'large' and 'small' month count. Their religion and deities, sacrifice and worship are also alike, especially in regard to the use of idols of wood and clay to which human blood was applied. China, however, does not appear to have practised human sacrifice, although there are traditions of it in ancient days and remote parts. The astronomical and astrological systems are strikingly similar; and the creation legends of the two peoples have many common features, as also have the story of the deluge and of the creation of the first men out of mud. Art, dress and ornament are reviewed with the same result. Setting aside the elements which are common to many primitive peoples, many resemblances remain which cannot be dismissed lightly. If the Mayas were of Chinese origin, they must have crossed to America more than six thousand years ago, otherwise their culture would be more specifically Chinese. Alternatively, they may have been derived from other adjacent races, different from, but culturally related to, the Chinese.

Phylogeny of Hemiptera–Heteroptera. In describing a new family, Leotichidæ (*Ann. and Mag. Nat. Hist.*, Ser. 10, 12), W. E. China discusses the general classification of Hemiptera–Heteroptera and proposes a hypothetical phylogenetic arrangement of the 51 families at present recognised within this suborder. This arrangement is compared with the latest attempt by Pruthi (*Trans. Entom. Soc., London*, 1925) to revise the family classification solely on the basis of the morphology of male genitalia. It is stressed that there are no grounds for assuming that genitalia are less affected by environment and habits than are other characters. Indeed, the fact that whole groups of species exist which differ only in genital structures would seem to indicate that often these structures are the first to be affected. It is only the general plan of genital structures which is of value in supplying important clues to the phylogeny of the group. The two main types of genitalia, those of the pentatomoid and reduvioid groups of families respectively, follow the biological difference in feeding habits, members of the first group being mainly phytophagous, and those of the second mainly predaceous. Nevertheless, the primitive Heteroptera were undoubtedly phytophagous, not predaceous, and were homopteroid in character. The family Corixidæ contains the only aquatic phytophagous Heteroptera, and it is considered to represent the aquatic form derived from those ancestors, whereas the true aquatic bugs (as opposed to the littoral and surface forms) arose from predaceous terrestrial forms of the littoral type, at a much later date. A biological sequence showing a gradual change from littoral life to a truly aquatic existence is traced from family to family, and a 'family tree' including all known families serves to illustrate the interesting discussion.

South American Lizards. A preliminary check list of the lizards of South America has been compiled by Charles E. and May Danheim Burt (*Trans. Acad. Sci. St. Louis*, 28, Nos. 1 and 2; 1933). The authors consider that probably, in their catalogue of 86 pages, they have listed too many rather than too few species, and that great systematic modifications of the present groupings must ultimately be made. But the list should stimulate field work and research on South American lizards, the more so since the distribution of even common species is not precisely known, and since little has been published concerning the habits and habitats of any.

Reproductive Apparatus of *Thalassema*. P. R. Awati and D. S. Deshpande (*J. Univ. Bombay*, 1, Pt. 5, 1933) describe the reproductive apparatus of *Thalassema bombayensis*. The single gonad is around the posterior part of the ventral vessel, and from it fall into the cœlom clusters of cells which in males develop into sperm morulæ while in females one cell in the centre of each mass enlarges and becomes an ovum growing at the expense of the sister ova. There are usually four pairs, occasionally five pairs, of gonoducts in the anterior region of the body. Each organ consists of a vesicle into which opens the common duct of two spiral 'flagella'; from the vesicle issues a short duct which opens to the exterior. The vesicle is small in immature examples but in mature specimens is distended with the sexual cells. Each 'flagellum' is ciliated along its margins and along its length has a ciliated groove. The two 'flagella' meet and fuse, the two grooves forming a common duct which opens into the vesicle; near this the short duct leads from the vesicle to the exterior. The sexual cells are brought from the cœlom into the vesicle by the ciliated grooves of the 'flagella', accumulate therein and finally pass to the exterior by the short efferent duct. The authors regard these 'segmental organs' as cœlomoducts.

Fungi of Butter. Many of the taints and faults of butter are due to the activities of fungi. This fact has led workers in several countries to study the fungi which occur naturally or appear during the manufacture of this product. A very complete list is published in vol. 9 of the *Canadian Journal of Research* ("The Fungi found in Butter", by G. R. Bisby, M. C. Jamieson and M. Timonin, pp. 97–107, Aug. 1933). Samples of butter from all the creameries in Manitoba were tested for the presence of fungi. One creamery produced butter with no moulds, and the product was of excellent flavour. A long list is given of all the fungi isolated from other samples, not only by the authors, but also by other workers on the same subject, and should prove valuable to dairy workers for reference.

Mesozoic Pteridosperms from South Africa. In a recent publication (*Phil. Trans. Roy. Soc. London*, B, 222) Dr. Hamshaw Thomas gives an account of some remarkable fossil plants from rocks of Triassic Age in Natal which notably extends our knowledge of Pteridosperms as constituents of post-Palæozoic floras. He describes an interesting set of seed-bearing and pollen-bearing fructifications which, by evidence of cuticular structure, other morphological considerations, and close association, he is able to relate to one another and to such well-known form-genera of fronds as *Thinnfeldia*, *Dicroidium*, *Pachypteris*, etc., fronds which have for some time been suspected, without adequate evidence, of being pteridospermous. These he groups into two families: (1) the Corystospermaceæ, characterised by having seed-bearing branches with terminal recurved cupules each of which bears a seed with a curved bifid micropyle. The pollen-bearing branches bear their microsporangia in groups on small laminæ, and the microspores, which have also been found adhering to the nucellus in the seeds, have two lateral, symmetrical wings and closely resemble those of *Antholithus* in the Caytoniales. The foliage probably was of the types known as *Dicroidium* and *Pachypteris*. (2) The Peltaspermaceæ, a closely allied family, have seed-bearing branches with the seeds attached to small peltate terminal expansions of the axis. The foliage was of the *Lepidopteris* type but the pollen-bearing structures have not as yet been identified. These discoveries have an important bearing on the question of the possible origin of the Angiosperms from a Pteridosperm stock and on the morphological nature of seed-bearing structures in general.

Artificial Vibrations of the Ground. Some interesting experiments on this subject, made by S. K. Banerji and M. D. Manohar, are recounted in the *Indian Journal of Physics*, 8, 95, Sept. 1933. An iron ball of about 28 lb. weight was dropped on to the ground from a height of about one yard, and the resulting ground vibrations were measured by two horizontal component (north-south and east-west) Milne-Shaw type seismographs (period 12 sec., damping ratio 20 : 1) and a vertical component seismograph (period 3 sec.). Records were taken when the point of impact was in different directions from the small seismograph house, and at numerous distances up to about 50 yards. The records show a sudden impulse followed by oscillations compounded of forced vibrations of the ground (period 0·05 sec.) and the free period of the seismograph house (0·015 sec.). Using a theory given by Lamb, the ground vibrations, and their law of variation of amplitude with distance (proportional to $1/\sqrt{\text{distance}}$) can be reasonably well accounted for. The free period for the building also agrees with a theoretical estimate.

Landing of Aircraft by Radio. The October *Bulletin of the Bureau of Standards* contains a description of the complete form of the equipment for enabling aircraft to land in fog or other conditions of low visibility. The methods have been developed since 1928, and have now been incorporated into a practical form and tested by repeated use in actual fog and in an aeroplane with hooded pilot's cockpit. The course of the aircraft is directed to the airport by a beacon station using a 200–400 kc. frequency and a visual indicator on the machine. The intensity of the beacon signals provides an approximate indication of the distance from the airport on a milliammeter graduated in miles. When several miles from the airport, the machine picks up a landing beam from a special short-wave transmitter (10,000 kc. frequency) which is arranged so that a surface of constant signal intensity is a sloping path down which the aeroplane may glide. The signal intensity meter on the aeroplane is combined with the beacon indicator, so that the pilot needs only to keep the two pointers intersecting over the centre of the dial by movements which easily become intuitive. As the machine approaches the airport it picks up a marker signal beam modulated with a distinctive tone and directed vertically at a position a few thousand feet from the landing field. At the edge of the field itself a second distinctive marker tone is heard. The aeroplane is then only a few feet from the ground and a landing may be effected without difficulty (see also NATURE, 132, 925, Dec. 16, 1933).

Helium in Beryl. Lord Rayleigh (*Proc. Roy. Soc.*, Nov.) has made determinations of the helium content of a number of specimens of beryl of varying geological age. The beryls were finely powdered and decomposed with molten caustic potash at about 300°; the gas was purified and measured over mercury in a McLeod gauge. The beryls obtainable were predominantly from Archæan formations, but a number of specimens were classified as Palæozoic, Mesozoic or Tertiary. Within each group the helium content was very variable, but the helium content showed a definite tendency to increase in going from younger to older specimens. The largest helium contents were limited to specimens of great geological age. The conclusion appears to be that the helium has accumulated in beryl during geological time, and that it was not trapped when the mineral was formed or produced by the disintegration of short-lived radio elements during the early life of the beryl.

Holley-Mott Continuous Counter-Current Washery and Petroleum Products. In a paper read on November 14 before the Institution of Petroleum Technologists, Mr. E. Thornton maintained that sponsors of the Holley-Mott continuous counter-current washery for the treatment of cracked spirit were justifiably proud of the good results achieved with this plant, the usefulness of which is determined solely by the application of generally accepted principles in the most straightforward manner. All good treating plants must be so designed as to be capable of mixing reagent and treated material in suitable proportions, maintaining the admixture for a given length of time and separating reagent and treated material at the expiration of that time. Intimacy of contact between reagent and treated material is achieved in the Holley-Mott process by means of a vessel containing a suspended stirrer revolving at a moderate speed and with no footstep bearings. Not only is this method of mixing simple and efficient, but it is also definitely economical. The time of contact between reagent and treated material is controlled by the size of the vessel in relation to throughput, as is the case with most continuous plants. Since the degree of mixing is kept definitely under control, the problem of separation is not formidable and is solved simply and cheaply by means of gravity-settling in reasonably-sized vessels. In addition to fulfilling the above main requirements, the Holley-Mott plant satisfies a number of other conditions essential to the effective treatment of spirit.

Annual Meeting of the Science Masters' Association

THE thirty-fourth annual meeting of the Science Masters' Association was held at the Imperial College of Science, London, on January 2–5. More than 600 members attended.

This year's president, Mr. H. T. Tizard, Rector of the Imperial College, inaugurated the proceedings, after the annual dinner, with an address on "Science and the Industrial Depression". He referred to the gloomy picture of the immediate future envisaged by Dr. Norwood in his presidential address two years ago, and how it had been justified by succeeding events. There was a widespread belief that science contributed to industrial depression in creating unemployment by substituting the machine for the man, in discouraging skill by replacing skilled work by unskilled work, and in promoting discord by increasing the powers for evil. The last, however, was a moral question, the decision to use the powers of science for good or evil being dependent upon education.

Mr. Tizard denied that it was true that the progress of science tended to discourage skill; what it had really done was to replace one skill by others. In the matter of increase of unemployment, figures were given for both England and the United States to show that mechanisation actually increased the number of wage earners between 1914 and 1927. The responsibility for industrial depression lay with the economist and politician rather than with scientific workers.

It was possible, however, that because of the inertia of industry in times of prosperity, continuous advantage was not taken of new inventions and discoveries of science. Consequently, a set-back, due to whatever slight cause, would put into operation widespread economies, and sudden application of scientific labour-saving devices that would give rise to the unemployment of many workers who, however, were really superfluous to industry, even in times of prosperity. The coal industry was given as an example.

To overcome this industrial apathy towards the application of science, it was necessary for science to be added to the mental equipment of administrators, possibly by a combination of science and economics at the universities. Moreover, it was the duty of all science masters not only to imbue the gifted few of their pupils with the spirit of intellectual adventure, but also to impart to many the power of observation and the skill of hand that bring interest and happiness to life, and to send all out into the world with a sense of fact and a sense of law.

Prof. E. N. da C. Andrade in his lecture on new experimental work in sound, dealt with the phenomena associated with Chladni's plate, Kundt's tube and the sensitive flame, and showed by ingeniously simple experiments new facts that could only be explained by new theories. In particular, the vortex theory, which explained the phenomena of Kundt's tube, made possible very accurate measurement of the velocity of sound. It was found that the velocity of sound did in some measure depend upon the frequency and that previously noticed but ignored irregularities in the velocity of sound in the work of other investigators were of significance.

The nature of heavy hydrogen and heavy water was the main feature of interest in Prof. H. V. A. Briscoe's lecture on recent advances in chemistry. The nomenclature of the new hydrogen, and its isolation by electrolysis, fractional distillation, or fractional diffusion through palladium were described. The properties of heavy water, f.p. 3·8° C., b.p. 101·4° C., density 1·1056, temperature of maximum density 11·6°, its 50 per cent greater viscosity and its biological effects excited great interest, as did the discussion of the theoretical implications in the matter of atomic structure.

Dr. Allan Ferguson provided a most interesting lecture on London's contributions to science, ranging backwards from Lord Rayleigh, Clerk Maxwell, Faraday, Wollaston, Young, Cavendish and Halley, to Wren and even Chaucer. The biographical details of these celebrities were supplemented by interesting historical exhibits.

The evening lecture on January 3 was devoted to fungi, by Mr. J. Ramsbottom, who, starting from yeast and its influence on life's necessities, beer, bread and cheese, proceeded, with the aid of beautifully coloured slides, to demonstrate the difference between edible and poisonous fungi.

Very interesting experiments capable of school demonstration, and therefore doubly valuable to the science masters, were shown on January 4 by Mr. H. Haile, in his lecture on the polarisation of light and its application to applied science. This was followed by a lecture by Prof. A. Brammall on geochemistry applied to the genetic study of 'hybrid' rock types—a compact summary of useful information. In the evening, the Astronomer Royal, Dr. H. Spencer Jones, summarised the modern views on the structure of the universe, illustrating his discourse by striking astronomical photographs, particularly of the Milky Way. There was a further lecture on January 5 by Prof. R. A. Fisher on adaptation and mutations.

It has always been a feature of the annual meeting of the Science Masters' Association for members to exhibit and demonstrate with home-made apparatus new technique, methods and notions developed in the school laboratories. Many of these are now found in the "Science Masters' Book", published by the Association. This year, the members' exhibition was larger than ever, and full of stimulating ideas. A gramophone record used to reflect light, giving rise to interference fringes, 'Cellophane' as a semi-permeable membrane, milk bottles as gas jars, soap bubbles blown in an enclosed space so that they may drain undisturbed in order to demonstrate colours of thin films, were among the striking features.

There was a much appreciated innovation this year in that Mr. F. A. Meier was invited to give a lecture demonstration on some of his ingeniously simple experiments, which obviously delighted the lecturer as well as the audience. With the aid of toy trucks, thermos flasks, home-made springs, football bladders, balloons, bicycle wheels, pickaxes, flour bins, he demonstrated principles of mechanics, hydrostatics, properties of matter, light, heat, electricity and magnetism. Moreover, these experiments were quantitative, and Mr. Meier was able to show that it was usually possible to obtain at least a one per cent accuracy.

In addition to these lectures, there were two important discussions, one on the School Certificate

biology syllabus, and the other on the elementary science suggested by the School Certificate Investigators' Report as a compulsory subject at the School Certificate stage. This latter discussion will form the subject of a further report.

Visits were paid by various members to seventeen factories and Government scientific institutions in and around London. These included, among others, the Courtauld Institute of Biochemistry, the Paint Research Station, Government Laboratories, the Royal Observatory, the Royal Aircraft Establishment, and the Royal College of Surgeons. These, together with the exhibition of scientific textbooks and apparatus, made a very full programme. Twenty-three publishers and thirty-nine manufacturers and thirty-five members exhibited.

The next annual meeting will be at Oxford under the presidency of Dr. N. V. Sidgwick. F. W. T.

Annual Meeting of the Mathematical Association

THE annual meeting of the Mathematical Association was held at the Institute of Education, London, W.C.1, on January 4–5, under the presidency of Prof. G. N. Watson. Discussions on the place of mathematics in the new central schools, on the interesting and novel suggestion that in the teaching of elementary geometry, solid geometry should precede plane geometry, and on the place of differentials in the teaching of the calculus, showed that the Association has not forgotten its primary purpose, the improvement—if necessary, the reform—of the teaching of elementary mathematics.

Under the title "Scraps from some Mathematical Note-Books", Prof. Watson delivered a lucid and stimulating presidential address. It was based on the diary in which C. F. Gauss (1777–1855), one of the greatest mathematicians of all time, recorded many of his discoveries; Gauss started keeping this diary at the age of nineteen, and it is remarkable that the majority of the hundred and fifty entries were made before 1801.

The first entry is the discovery of the possibility of a ruler and compass construction of the regular polygon of seventeen sides, a particular case of a more general problem to which Gauss himself gave a complete answer at a slightly later date. There are several entries referring to the quadratic reciprocity theorem; another, prefaced by a triumphant "Eureka", is equivalent to the result that every integer of the form $8m + 3$ is expressible as the sum of three odd squares. Other entries mentioned by Prof. Watson deal with continued fractions, the zeros of a Bessel function, and a function which is connected with the famous zeta function of Riemann. In connexion with this last entry, Prof. Watson pointed out that in a copy of Schulze's logarithm tables inscribed "Gauss, 1791", Gauss has made a note which can readily be interpreted as a statement that the number of primes less than a large number x is approximately equal to $x/\log_e x$; this is the "prime number theorem", of which the first proofs were given by Hadamard and de la Vallée Poussin in 1896.

In addition to describing these striking results, Prof. Watson gave a brief account of the developments to which these results have led, concluding with a description of some remarkable numerical work connected with the prime number theorem which was carried out in 1933. His general aim was not only to honour Gauss but also to stress the importance to mathematicians of the dictum of N. H. Abel (1802–29) who, when asked how he had been able to accomplish so much in so short a time, replied: "By studying the masters, not the pupils".

Prof. E. H. Neville, professor of mathematics in the University of Reading, has been elected president of the Association for the forthcoming year.

Research at the Cawthron Institute

THE Cawthron Institute at Nelson, New Zealand, was founded and endowed through the munificence of Mr. Thomas Cawthron, who was born in 1833, and after his death his trustees decided that a research institute for the investigation of agricultural problems should be established as the best means of carrying out his expressed desire. The Cawthron centenary lecture, "The Achievements of the Cawthron Institute", delivered on October 9 by Prof. T. H. Easterfield on his retirement from the directorship of the Institute, formed a fitting epilogue to the first Cawthron lecture, "The Aims and Ideals of the Cawthron Institute", given by him in 1917.

Beginning with the early work of the Institute, Prof. Easterfield said that one of the first problems to be attacked was the improvement of the fruit industry. A soil survey of the Nelson province was initiated, and the distribution and special characteristics of the soils studied with particular reference to fruit growing. The information thus gained led to recommendations with regard to soil treatment and cover cropping without which many orchardists would have been obliged to abandon their crops. Biological problems such as bitter-pit, black spot, woolly aphis and codlin moth were investigated concurrently. An insect, *Aphelinus mali*, was imported in 1920 for the control of woolly aphis and induced to breed in New Zealand. Its remarkable success is evidenced by the fact that it is no longer necessary to spray trees which formerly had suffered heavily. Such parasitic control is being extended with promising results to other insect and plant pests including the blowfly, which attacks lambs, and the piri-piri, a burr-producing plant which seriously reduces the commercial value of wool fleece. Much useful work has been done in controlling fungus diseases of fruit and flowers. In the work on black-spot, the main fungal disease of pip fruit, it has been found that infection can be controlled by spraying at a period, varying with the season, when ascospores are just about to be ejected by the fallen leaves of the previous year.

Prof. Easterfield gave further instances of researches which have resulted in outstanding increases in the production of fruit and other important crops, notably the control of brown rot in peaches, the improved fertilising of raspberries, the selection of soils for tobacco and lucerne, the steam sterilisation

of tomato soils, and the cultivation treatment of barley. Discussing the extensive work on the mineral content of pastures, he said that the data so far recorded promise to have a very marked effect on the agricultural practice of the future, and emphasised the importance of supplementary fodder production for stock. Studies of stock ailments such as bush-sickness and xanthin (urinary) calculi of sheep have also yielded conclusive evidence indicating the means of controlling them. The first, due to nutritional deficiency of iron, has been shown to be due to lack of soluble forms of iron in the soil rather than in the pasture; stock appear to derive much of the iron they need by ingestion of the soil itself. It has also been shown that xanthin calculi can be avoided by the encouragement of English grasses and clovers, by suitable top-dressing, and by the supply of supplementary feeds.

Among other examples of the practical value of the work of the Institute, Prof. Easterfield referred to the economic importance of the investigations carried out on the reclamation of the extensive pakihi lands occurring chiefly in the more populated mining districts. Field plot studies have shown that it is possible to bring the land, supporting only fern and rush in its natural state, into a condition suitable for dairy farming at a cost as low as £6 per acre.

The Japanese Seismic Sea-waves of March 3, 1933

THOUGH we may have to wait some time for the complete reports on the great Japanese earthquake of March 3, 1933, some valuable papers have recently been published*, of which an abstract is here given. The earthquake occurred at about 2.32 a.m., Jap. Stand. Time, on March 3 (5.32 p.m. on March 2, G.M.T.). From the records at stations connected with the Earthquake Research Institute, Prof. Ishimoto finds the epicentre to be in lat. 38·2° N., long. 144·0° E.; while the observations at Tokyo, according to Prof. Imamura, place it in lat. 38·5° N., long. 143·3° E. The latter point is represented by the more southerly of the two crosses in the accompanying map (Fig. 1), the other being the epicentre of the great earthquake of June 15, 1896. The dotted lines on the map are isobaths in thousands of metres, and the two points, which are about fifty miles apart, both lie near the isobath of 4000 metres or about 2½ miles, on the northern slope of the Tuscaroora Deep, the depth of which exceeds five miles.

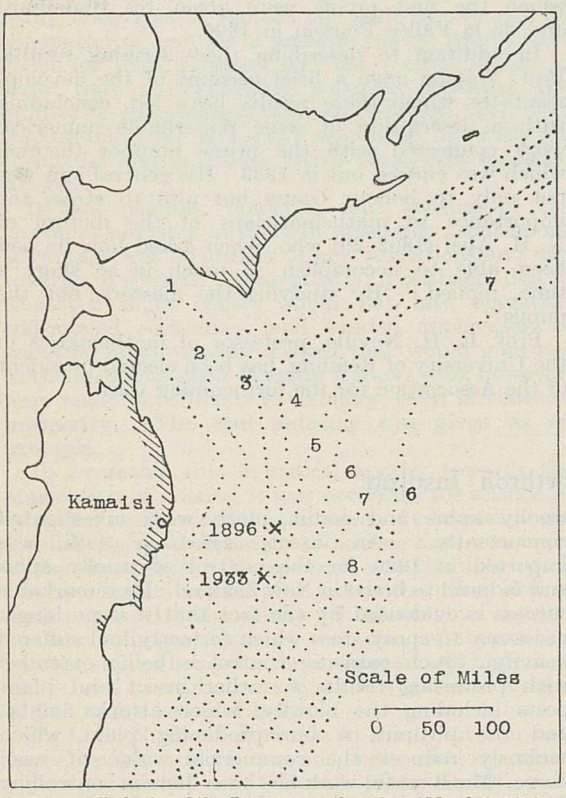

FIG. 1. Isobaths of the Japanese earthquake of March 3, 1933.

The point given above is that below which the movement of the crust-block began. It differs slightly, however, from the origin of the great sea-waves. Assuming the velocity of the waves to be $\sqrt{(gh)}$ ft. per sec., where h is the depth in feet, Mr. R. Takahasi has determined the position of the wave-centre from the times of arrival of the sea-waves at Miyako, Tyôsi and Tukihama, namely, lat. 38·3° N., long. 143·6° E.

Both points, however, being about a hundred miles from the coast, the shock, though widely felt on land, caused only slight damage along and near the coast. After an interval, ranging from 25 to 40 minutes, the great sea-waves swept over the shores shaded on the map, and drowned 3,022 persons, washed away 6,889 houses, besides destroying more than 8,000 boats and other vessels. In 1896, the earthquake was less severe than in 1933, but the waves were in most parts higher, and the destruction was far greater, 27,122 lives being lost and 10,617 houses washed away. In Hokkaido, the greatest height of the waves as shown by marks left on trees, posts, slopes, etc., was 15 ft. In the Main Island, it was 15 ft. at Kamaisi, the place that suffered most in 1896, but somewhat farther to the south, it rose to 62 ft. along the coast at Ryôri Sirahama (and 93 ft. inland) and 75 ft. at Hirota Atumari. The waves swept in with such velocity that a motor-boat from Kamaisi, with a speed of 12 miles an hour, could make no headway against them. Across the Pacific, they were recorded by mareographs at Honolulu, San Francisco and Santa Monica.

Mr. K. Musya has made an exhaustive study of the luminous phenomena seen as the waves came in. Among them is reported a strong flash of light that seemed to be emitted from the surface of the sea near the mouth of Kamaisi Bay. Prof. Terada shows that the most probable explanation of the flash is that the turbulence of the water in front of the

* M. Ishimoto. Preliminary notes on the *tunami* of March 2, 1933 (G.M.T.), and an outline of the investigations now being made concerning it at the Earthquake Research Institute. *Japan. J. Astron. Geophys.*, **11**, 1–9; 1933.

T. Matuzawa, K. Kanbara and T. Minakami. Horizontal movement of water in the *tunami* of March 3, 1933, *ibid.*, pp. 11–16.

A. Imamura and Z. Kawase. The Sanriku *tunami* of 1933, *ibid.*, pp. 17–35.

T. Terada. Luminous phenomena accompanying destructive sea-waves (*tunami*). *Proc. Imp. Acad., Tokyo*, **9**, 367–369; 1933.

Notes on the prevention of damage from *tunami*. Issued by the Imperial Earthquake Council, 1933.

advancing wave excited simultaneous luminosity in a swarm of, say, *Noctiluca miliaris*.

The coasts of Sanriku contain many V-shaped indentations facing the Tuscaroora Deep, and they have suffered so often from the sea-waves from the northern slope of the Deep, especially in 869, 1611 and 1896, that the Imperial Earthquake Investigation Council has issued a volume of notes on the prevention of damage from *tunami*. The main suggestion is the removal of coast villages to elevated ground, but, if this should be impossible, the construction of defence works, such as sea-walls and breakwaters, or groves of trees, and the provision of avenues of escape and *tunami* warnings. C. D.

University and Educational Intelligence

LONDON.—A special committee has been appointed to report fully as a matter of University policy on the amount and nature of technological study at present carried on in the University, and as to the desirability of instituting a new Faculty of Applied Science or Technology.

IT is announced that Miss Ethel Strudwick has been appointed a trustee of the London Museum. Miss Strudwick is high mistress of St. Paul's Girls' School, and her appointment is intended to associate schools with the museum.

A COURSE of nine lectures on cathode ray oscillographs will be given at East London College, Mile End Road, London, E.1, on Mondays at 5.30, commencing on January 22. The first lecture, entitled "Cathode Rays and their Use in Electrical Engineering", will be delivered by Prof. J. T. MacGregor-Morris; lectures 2–5, entitled "Low Voltage Oscillographs", by Mr. L. H. Bedford; and lectures 6–9, entitled "High Voltage Oscillographs", by Prof. G. I. Finch. Admission will be free, without ticket

ON the place of biology in education hangs the efficiency of efforts to popularise appreciation of the laws of health. In this belief, the British Social Hygiene Council organised a year ago a conference on the subject, and set up in March last, as an outcome of the conference, an Educational Advisory Board. In a leaflet recently issued, the objects of the Board, its composition and committees and the services it offers are set forth in detail. It aims at promoting the teaching of biological sciences in all kinds of educational institutions, at securing adequate recognition for biology as a general and as a specialist subject by examining bodies, and at giving guidance in the production of textbooks and teaching material. Its chairman is Dr. W. W. Vaughan, formerly headmaster of Rugby, and among its members are representatives of the Board of Education and the Scottish Education Department, of most of the universities of Great Britain, of several examination boards, of many associations of members of the teaching profession and of local education authorities. One of the standing committees concerns itself with the teaching of biology in outlying parts of the British Empire, especially colonies and protectorates and mandated territories under British rule. The Board offers a variety of services including recommendation of books, advice regarding syllabuses and information about current research in methods of teaching.

Science News a Century Ago

Death of M. Hachette

On January 16, 1834, the eminent French mathematician and engineer, Jean-Nicolas-Pierre Hachette, died in Paris at the age of sixty-four years. Born in Mézières on May 6, 1769, he was the son of a bookseller and was educated at Charleville and Rheims. At the age of nineteen he became a draughtsman in the military engineering school at Mézières, and four years later was made a professor of hydrography at Collioure. His mathematical writings having brought him to the notice of Monge, who then held the post of Minister of Marine in the Revolutionary Government, Hachette in 1793 was made a deputy-professor at Mézières, and the following year at the battle of Fleurus on June 26, 1794, he assisted Guyton de Morveau in the experiment of using a balloon for military observations. A few months later, after the fall of Robespierre, he assisted Monge and Guyton de Morveau in founding the École des Travaux Publiques, renamed in 1795 the École Polytechnique, and was given the chair of descriptive geometry. In 1798 with Berthollet, Monge, Fourier, Jomard and other savants he accompanied Napoleon to Egypt. Once again in France, he resumed his lectures at the École Polytechnique, having among his students Arago, Poisson and Fresnel. At the restoration in 1816, like Monge he was deprived of his chair and twice the Government refused to allow his election to the Academy of Sciences, which he did not enter until the Revolution of 1830. His writings comprise an admirable series of works on descriptive geometry, many reports on mathematical and physical subjects and memoirs on machines. Though his name is connected with no great discovery, his services were of great importance to constructors of machinery, and as a man he was respected for his amiability and uprightness.

Sir John Herschel at the Cape

After his father's death in 1822, Sir John Herschel lived at Slough with his mother, continuing the survey of the northern heavens with the 20 ft. telescope he had made under his father's directions. His 'sweeps' resulted in a catalogue of 2,307 nebulæ of which 525 were new discoveries, presented to the Royal Society in 1833. "Strongly invited," as he himself said, "by the peculiar interest of the subject, and the wonderful nature of the objects which presented themselves," he resolved to attempt the completion of the survey of the southern hemisphere, and on November 13, 1833, embarked with his wife and family in the *Mount Stewart Elphinstone*, and after a prosperous voyage landed at the Cape on January 16, 1834, about ten days after Maclear, the successor of Henderson as H.M. Astronomer. "Choosing as the scene of his observations a rural spot under the shelter of Table Mountain, he began regular 'sweeping' on the 5th of March. The site of his great reflector is now marked by an obelisk, and the name of Feldhausen has become memorable in the history of science; for the four years' work done there may truly be said to open the chapters of our knowledge as regards the southern skies" (Clerke).

Herschel's work at the Cape led to an extraordinary hoax which had a remarkable sequel. On the staff

of the newly-founded New York *Sun* was the reporter Richard Adams Locke. Locke contributed to the *Sun* a series of articles stated to be based on Herschel's discoveries with a giant telescope which enabled him "to study even the entymology of the moon in case she contained insects upon her surface". The fake, of course, was later on exposed, but was regarded with amusement. It had helped to establish the *Sun*, which achieved the largest circulation of any daily in the world, 19,360 copies as against the 17,000 of the London *Times*, and led to the birth of cheap newspapers. "We are indebted," said Edgar Allen Poe, "to the genius of Mr. Locke for one of the most important steps ever taken in the pathway of human progress" (see *British Weekly*, Jan. 16, 1918).

Examination of Mummies

A mummy was opened at the College of Surgeons on January 16 by T. J. Pettigrew, F.R.S., in the theatre of the College, before a very crowded audience, consisting not only of members of the College, but also scientific men generally who had been invited by advertisements. It was stated that the mummy was the property of the College, and had been in its museum since 1820, brought from Thebes by Henderson. Mr. Pettigrew said that a mummy opened at the Leeds Philosophical Society was covered an inch thick with an aromatic powder. In concluding his discourse, Mr. Pettigrew expressed his pleasure that this antiquity had proved to be a male subject, as he had predicted, and did not therefore bring into question his reading of the inscriptions.

Quantity of Electricity to Decompose a Grain of Water

Faraday's experiments on the decomposition of compound bodies by electrolysis, described in the Seventh Series of the "Experimental Researches in Electricity", led him to speculate as to the "quantity of electricity associated with the particles or atoms of matter", and his wonder was excited by the "enormous electric power of each particle or atom" which his measurements showed. "What an enormous quantity of electricity therefore", he says, "is required for the decomposition of a single grain of water". He compares the quantity of "voltaic" electricity required for the purpose, measured electro-chemically, with that of "common" electricity from the frictional machine, and finds that "the proportion is so high that I am almost afraid to mention it". This experiment was recorded on January 17, 1834, in the Diary ("Faraday's Diary". Vol. 2, p. 214). The "battery" was a little voltaic arrangement of zinc and platinum wires dipping into sulphuric acid :

"Now in this form of battery 1 gr. of water require solution of 3·6 grains of zinc—and as 6·8 gr. dissolved in 7 days, 3·6 would require 3·7 days ; but if a wire 5 inches long required 3·7 days to loose 3·6 grs., one only $\frac{5}{8}$ of an inch in length but of the same diameter would require 29·6 days for solution of same weight, if constant action could be sustained. Now the comparitive battery required 0·0533 of a minute to equal one charge of Leyden battery, but 29·6 days divided by 0·0533 of a minute gives very nearly 800,000. So that from this calculation the electricity required to decompose a single grain of water is about equal to that of 800,000 charges of the Leyden battery, any one of which would kill a cat or dog."

Societies and Academies

LONDON

Physical Society, Dec. 15. G. I. FINCH and A. G. QUARRELL : Crystal-structure and orientation in zinc oxide films. A new type of electron-diffraction camera is described incorporating means for greatly increasing the accuracy hitherto obtainable in electron-diffraction analysis. Partially and completely oxidised zinc films have been examined by transmission. The normal type of zinc oxide is formed by the oxidation of zinc via a zinc oxide which is basally pseudomorphic with the zinc. The corrosion-resisting properties of zinc appear to be due, in the main, to a protective coating of such pseudomorphic zinc oxide. A. O. RANKINE : Note on the behaviour of the Eötvös gravity balance in fluctuating gravitational fields. Attention is directed to the semi-diurnal variation of gravity at a point on the earth's surface, due to lunar attraction and recently measured by Loomis. This temporal variation of g is much larger than the spatial differences measured by the Eötvös gravity balance, but it produces no effect on the balance. This constitutes an experimental proof of the power of the Eötvös instrument to discriminate between space and time changes of terrestrial gravitation. ALLAN FERGUSON and J. T. MILLER : The temperature variation of the orthobaric density of unassociated liquids. A formula connecting the orthobaric density of a liquid and its temperature is developed in the form $\rho = 2\rho_c[A\ (1-m)^{0\cdot3} + (1-\frac{1}{2}m)]$, where m is reduced temperature and A is a constant which varies slightly from liquid to liquid, and may be taken to have a mean value 0·911. The formula is a long-range one, and has been tested for thirty pure organic substances. It has been applied to the evaluation of expansion coefficients and to show the manner in which free and total molecular surface energy vary with temperature. L. C. MARTIN : The theory of the microscope (2). A discussion of the effects in dark-ground illumination when the image of the source of light is projected into the object plane by an illuminator of the symmetrical type. The treatment is two-dimensional. The conditions necessary for the formation of genuine and spurious images are investigated, and it is shown that the Abbe principle is theoretically valid in the cases considered. A short practical investigation with Grayson's rulings supports the theoretical conclusions, but indicates the desirability of closer examination of the causes of misleading interference phenomena. G. GRIME : Measurement of impact stresses in concrete. A quartz piezo-electric gauge, using a cathode-ray oscillograph for recording, has been developed to measure impact stresses in concrete. It is being employed to study the stresses in driven reinforced-concrete piles.

PARIS

Academy of Sciences, November 27 (*C.R.*, 197, 1257–1368). EMILE BOREL : Studies on the probability of series of rainy days or of fine weather. The analysis of 50 years' data, taken at Paris between October 1 and January 31, shows that given a run of either fine or wet days, there is a tendency towards persistence of the run (see also NATURE 132, 864, Dec. 2, 1933.) GEORGES CLAUDE : New progress in lighting by luminescence. The light emitted by neon-mercury lamps is known to be deficient in the

blue region. The use of a coating of zinc sulphide has been suggested and the present communication describes a practical method for forming and fixing this coating. Increased efficiency results, the tubes thus treated requiring 0·3 watts per candle instead of 0·4 in the usual type. FRED. SWARTS : The catalytic hydrogenation of trifluoracetic anhydride : trifluoralcohol. Trifluoracetic anhydride is reduced by hydrogen under pressure (40–50 atmospheres) in the presence of platinum black, the reaction products being trifluorethyl trifluoracetate, trifluorethyl alcohol, trifluoracetic acid and trifluorethane. The methods of separation of these substances, together with their physical and chemical properties, are described. M. GIGNOUX, L. MORET and D. SCHNEEGANS : The geological structure of the gap of L'Argentière to the south of Briançon (Hautes-Alpes). MAURICE FRÉCHET : The coefficient known as the correlation coefficient. I. PÉTROWSKY : The topology of real and algebraic plane curves. GASTON VERGNÈRES : The unicity of the minimum distance from a point to an ensemble. GEORGES BOULIGAND : C.M. parallelism and parallelism in the classical sense. BERTRAND GAMBIER : Lines of connexion of surfaces : geodesic lines, umbilical lines, lines of curvature. GEORGES KUREPA : General separable spaces. ROSENBLATT : The application of Picard's method of approximations to the study of certain partial differential equations with real and multiple characteristics. N. ADAMOFF : Some properties of the integrals of an equation of the second order with periodic coefficients. PAUL FLAMANT : Convergence and compacity in classes of (D) quasi-analytical functions. M. MURSI : The values of the modulus of $\sigma(z)$ at infinity. ALEX. VÉRONNET : The complete evolution of a heterogeneous mass in rotation. The impossibility of a division into two. The figure of a heterogeneous mass in rotation, although not rigorously ellipsoidal, is nearly ellipsoidal. Owing to the perfect continuity of the figures of equilibrium, it is impossible to explain the formation of double stars. JACQUES VAN MIEGHEM : Dirac's system of equations and the equation of Jacobi. ALBERT TOUSSAINT : The corrections to be applied to the aerodynamical characteristics of a supporting wing, under experiment in a wind tunnel with rectangular air stream semi-guided by lateral walls, parallel to the spread of the wing. CH. SADRON : A new optical method of exploring a field of bidimensional velocities. The method is based on the work of Maxwell regarding the double refraction presented by liquids in motion in the regions where the velocity gradient differs from zero. With suitable precautions, the method proposed can be used to measure the velocity gradient up to a distance of the order of 0·1 mm. from the wall. MAX SERRUYS : Recording piezometric effects resulting from knocking in internal combustion motors. Four reproductions of records are given, one in normal working without knocking, three showing various conditions of detonation. They show that detonation is produced at the end of the combustion and corresponds to the combustion of only a small proportion of the mixture. The velocity of propagation of the detonating waves appears to be about 500 metres per second for normal compression (5·5 : 1). CONRAD KILIAN and J. PETIT-LAGRANGE : The probable course of the Tafassasset oued below the wells of In-Afellallah. J. TILHO : Remarks on the preceding communication. FRANCIS PERRIN : The materialisation of electrons during the collision of two electrons. Various processes of annihilation of positive electrons. J. GÉHÉNIAU : The L. de Broglie waves in any gravific and electromagnetic field. A. GUILLET : The stabilisation of the frequency n of the alternating current supplying a system. L. NÉEL : The fluctuations of the molecular field and the magnetic equation of state of nickel. N. THON : Remarks on the theory of supertension of metals. MME. BRANCA EDMÉE MARQUES : The fractional crystallisation of radiferous barium chloride. YEU KI HENG : The influence of neutral salts on the rotatory power of α-phenylethylamine chlorhydrate. MME. A. DOBRY and J. DUCLAUX : The viscosity of cellulose solutions. It was suggested by J. Duclaux and E. Wollman that the value of k in the Arrhenius formula is, as a first approximation, independent of the solvent, but this has been contested by other workers. Calculating the coefficient k of Arrhenius to infinitely small concentration (k_0) it is now shown that the variations are small, the extreme values of k_0 for eleven solvents being 126 and 143. LÉON GUILLET, Jr. : The modulus of elasticity of the α bronzes in the annealed condition. The decrease in Young's modulus with increasing proportions of tin in the alloy follows a linear law to the first approximation. PIERRE JOLIBOIS and GEORGES FOURETIER : The crystalline analysis of unstable precipitates. MLLE. M. L. JOSIEN : Contribution to the study of iodometric determinations. P. CARRÉ and D. LIBERMANN : The alkyl and aryl bromosulphites. By the interaction of thionyl bromide on alkyl or aryl sulphites, bromosulphites can be prepared possessing the general formula RO.SO.Br. MLLE. M. DARMON : The preparation of phenylacetylcarbinol and of some of its ether oxides. HENRI WAHL : The chlorine derivatives of paraxylene. LÉON ENDERLIN : Researches on the chemistry of the rubenes. A colourless hydrocarbon with violet fluorescence derived from diphenylditolylrubene. DUQUÉNOIS : The conditions of fixation of $HSbO_2$ by some aromatic monoacid-monoalcohols. β-Phenyl-α-lactic acid forms the best crystallised emetics and these are also less readily hydrolysed. Their stability is comparable with that of the tartaric emetics. FRÈREJACQUE : The oxidation of uric acid in the presence of glycocoll. By oxidation in a special manner described, salts of isoallantoylaminoacetic acid were obtained. A. DAUVILLIER : The origin of atmospheric ozone. Researches made at Scoresby Sound during the Polar Year. P. IDRAC : The study of the internal movements of cloud masses by accelerated kinematography. L. HERMAN : The absorption of ultra-violet radiations in the lower atmosphere. A. DEMOLON and A. DUNEZ : Bacteriophage and fatigue in soils under lucerne. MLLE. M. L. VERRIER : Researches on the visual field of the vertebrates. Determination of the field of vision of *Scorpœna scrofa*. G. PETIT : Remarks suggested by the discovery of the skull of a cat in the sub-fossil deposits of Madagascar. The presence of this skull is in agreement with the hypothesis of human immigration into Madagascar from Africa at a very remote date. P. LASSABLIÈRE and A. PEYCELON : The comparative action of raw meat and of calves' liver on the general nutrition. Raw meat proved to be superior to calves' liver in the general nutrition of dogs. LOUIS BAUDIN : Diurnal variations of the blood in fishes. RAYMOND-HAMET : Does oxyacanthine, the alkaloid of *Berberis vulgaris*, possess a sympathicolytic action ? J. RISBEC : An enemy of *Brontispa froggatti* at the New Hebrides. E. BRUMPT : Experimental fatal ascending paralysis of the dog

due to the bite of the Australian tic *Ixodes holocyclus*. G. RAMON: Associated vaccinations. C. LEVADITI, MLLES. R. SCHOEN and Y. MANIN, A. VAISMAN: The presence of *Treponema pallidum* in the ovary of mice contaminated with syphilis.

SYDNEY

Linnean Society of New South Wales, Sept. 27. W. W. FROGGATT: The Coccidæ of the casuarinas. Twenty-eight species of the coccid fauna of the casuarinas are described or noted, five of the species being new. The new species belong to the genera *Gymnaspis* (1), *Eriococcus* (3) and *Pseudaripersia* (1). One genus is also described as new. E. C. CHISHOLM: Useful Coccinellidæ found on the Comboyne Plateau. Notes are given on eight species of Coccinellidæ which are of economic importance on the Comboyne Plateau. Seven of these species are insectivorous and the eighth is vegetarian. IDA A. BROWN: The geology of the south coast of New South Wales, with special reference to the origin and relationships of the igneous rocks. The tectonic history from Cambrian (?) to post-Tertiary times, considered in relation to the building of south-eastern Australia, indicates that the south coast district was portion of a mobile borderland-massif until the close of the Middle Devonian, when it finally became a portion of the continental massif of Australia. The history of igneous activity is closely related to the tectonic history, and, viewed broadly, supports Harker's generalisation of the association of sub-alkaline and alkaline intrusions with orogenic and epeirogenic earth movements respectively. An ultimately comagmatic origin for all the igneous rocks is suggested.

Forthcoming Events

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

Monday, January 15

VICTORIA INSTITUTE, at 4.30.—(at the Central Hall, Westminster).—Capt. B. Acworth: "Bird Flight and its Bearing on Evolution."

ROYAL COLLEGE OF SURGEONS, at 5.—Prof. W. E. Le Gros Clarke: "The Evolutionary Origin of Primates" (succeeding lecture on January 17).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Miss Cecilia Goodenough: "Homesteading in North-Western Canada".

Tuesday, January 16

EUGENICS SOCIETY, at 5.15.—(at the Linnean Society, Burlington House, London, W.1).—"Safeguards in Eugenic Sterilisation"; speakers, Drs. R. Langdon-Down, E. Mapother and C. P. Blocker.*

KING'S COLLEGE, LONDON, at 5.30.—Prof. Felix Krueger: "Work, Machines and Man" (succeeding lectures on January 18 and 19).*

Wednesday, January 17

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—(Annual Meeting to be held in the B.M.A. House, Tavistock Square, London, W.C.1).—Conrad Beck: "Some Recent Advances in Microscopy" (Presidential Address).

TELEVISION SOCIETY, at 7—(at University College, London, W.C.1).—G. Parr and T. W. Price: "The Application of the Cathode Ray Tube to Television".

ROYAL METEOROLOGICAL SOCIETY, at 7.40.—(Annual General Meeting). Presentation of Symons medal to Sir Gilbert Walker.

Prof. S. Chapman: "The Gases of the Atmosphere" (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—J. M. Waldram: "Modern Developments in Street Lighting".

Friday, January 19

KING'S COLLEGE, LONDON, at 5.30.—D. B. Hoseason: "Apparatus for Power Factor Correction" (succeeding lectures on January 26 and February 2).*

Official Publications Received

GREAT BRITAIN AND IRELAND

Safeguards in the Laboratory. Compiled by the Science Masters' Association and Association of Women Science Teachers. Pp. 4. (Ely: Canon Kirkland, King's School.) 6*d*.

The British Mycological Society Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 18, Part 3, 13 December. Pp. 189–256+plates 9–18. (London: Cambridge University Press.) 7*s*. 6*d*.

Proceedings of the Royal Society. Series A, Vol. 143, No. A848, December 4. Pp. 241. 12*s*. Series B, Vol. 114, No. B787, December 1. Pp. 103–180. 6*s*. (London: Harrison and Sons, Ltd.)

Geological Literature added to the Geological Society's Library during the Year 1932. Compiled by the Library Staff. Pp. iv+308. (London: Geological Society.) 10*s*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 73, No. 444, December. Pp. 545–616+xii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Philosophical Transactions of the Royal Society of London. Series A, Vol. 232, A715: On the Effect of the Temperature of Liquid Hydrogen (−252·8° C.) on the Tensile Properties of Forty-one Specimens of Metals comprising (a) Pure Iron 99·85 per cent, (b) Four Carbon Steels, (c) Thirty Alloy Steels, (d) Copper and Nickel, (e) Four Non-Ferrous Alloys. By Prof. W. J. de Haas and Sir Robert Hadfield. Pp. 297–332. (London: Harrison and Sons, Ltd.)

OTHER COUNTRIES

Proceedings of the American Academy of Arts and Sciences. Vol. 68, No. 11: The Lower Permian Insects of Kansas. Part 6: Deloperidæ, Protelytroptera, Plectoptera, and a New Collection of Protodonata, Odonata, Megasecoptera, Homoptera and Psocoptera. By Frank M. Carpenter. Pp. 411–503+1 plate. 1.45 dollars. Vol. 68, No. 12: Methods and Procedures used in the Massachusetts Institute of Technology Program of Investigation of the Pressures and Volumes of Water to 460° C., Part 1. By Frederick G. Keyes. Pp. 505–564. 1.20 dollars. (Boston, Mass.)

U.S. Department of the Interior: Geological Survey. Bulletin 849-E: Mineral Deposits near the West Fork of the Chulitna River, Alaska. By Clyde P. Ross. (Investigations in Alaska Railroad Belt, 1931.) Pp. viii+289–333+plates 25–27. 15 cents. Water-Supply Paper 656: Ground-Water Resources of Western Tennessee. By Francis G. Wells. With a Discussion of the Chemical Character of the Water, by Francis G. Wells and Margaret D. Foster. Pp. vii+319+16 plates. 60 cents. Water-Supply Paper 729: Surface Water Supply of the United States, 1932. Part 4: St. Lawrence River Basin. Pp. v+155. 10 cents. (Washington, D.C.: Government Printing Office.)

Memoirs of the Geological Survey of India. Vol. 62, Part 2: Vindhyan Sedimentation in the Son Valley, Mirzapur District. By J. B. Auden. Pp. vii+141–250+x+plates 7–17. (Calcutta: Central Book Depot.) 5.4 rupees; 8*s*. 6*d*.

Records of the Geological Survey of India. Vol. 67, Part 3, 1933. Pp. 249–356+plates 12–16. (Calcutta: Central Book Depot.) 2.12 rupees; 5*s*.

Common Indian Trees and How to Know Them. By R. N. Parker. Pp. iii+46+40 plates. (Delhi: Manager of Publications.) 3.6 rupees; 5*s*. 9*d*.

The South African Journal of Science. Vol. 30: Being the Report of the Thirtyfirst Annual Meeting of the South African Association for the Advancement of Science, Barberton, 1933, 3 July to 8 July. Pp. xl+716. (Johannesburg.) 30*s*. net.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1932. Pp. ii+40. (Jamaica: Government Printing Office.)

Kungl. Sjökarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1930. Pp. xvii+80. (Stockholm.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 18: Sun Spots and Weather. By C. G. Abbot. (Publication 3226.) Pp. 10. Vol. 89, No. 10: Studies of American Species of Foraminifera of the Genus Lepidocyclina. By Thomas Wayland Vaughan. (Publication 3222.) Pp. 53+32 plates. Vol. 89, No. 11: Tertiary Larger Foraminifera of Venezuela. By Donald Winchester Gravell. (Publication 3223.) Pp. 44+6 plates. (Washington, D.C.: Smithsonian Institution.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 134: Water-ways as Vehicles of Infectious Diseases, affecting particularly Cattle in Egypt, and the Relative Sanitary Precautions. By Prof. Dr. M. Carpano. Translated from the Italian by E. Talarewitch. Pp. 8. (Cairo: Government Press.) 2 P.T.

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Année 5, No. 11, Novembre. Pp. 457–502. (Prague: Regia Societas Scientiarum Bohemica.)

Japanese Journal of Mathematics. Translations and Abstracts, Vol. 10, No. 2, November. Pp. 83–132. (Tokyo: National Research Council of Japan.)

Ibero-Americana 6: The Acaxee; a Mountain Tribe of Durango and Sinaloa. By Ralph L. Beals. Pp. iv+36. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 35 cents.