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Research in Central Asia

HOWEVER admirable in theory may be the ideal that science should transcend the limitations of nationality, it has to be recognised that there are fields of scientific research in which, in the circumstances of the present day, this is neither possible nor perhaps in every way desirable. The intensity of national self-consciousness, which has been fostered by various influences during the last fourteen or fifteen years, has invaded the field of science, and restricts the activities of research in those branches of study which depend for their material on the exploration, or as the nationalists would have it, the exploitation, of territory to which everywhere access is limited by national rights. Further, as a logical consequence, each nation claims, not necessarily without some show of justice, to determine the number and character of the specimens collected which shall be allowed to leave the country or shall be retained to enrich the national collections.

This intensification of national feeling is responsible for the increased stringency of regulations which once were at worst irksome, but now, at times, have become definitely obstructive or even prohibitive. The most recent and serious example of a more exigent regulation of scientific exploration—especially serious because of the wide range of scientific activities affected—is afforded by China. The strongly restrictive attitude of the Chinese authorities since 1928 towards scientific expeditions working within the boundaries of the Empire has imposed conditions upon the work of the Central Asiatic expedition of the American Museum of Natural History, which the Museum does not feel able to accept, and has brought to an end ten years of unprecedented contribution to scientific knowledge; and it has caused Sir Aurel Stein to withdraw from Turkistan, where his explorations had brought to light an unexpected wealth of evidence bearing upon the cultural history and geography of Central Asia.

It may be a not unreasonable view that the very success of these expeditions has led to their embarrassment. Dinosaur's eggs, for which collectors, according to the story given a world-wide circulation in the Press, were prepared to pay £100 each, six thousand manuscripts of early Buddhist and other writings, including texts translated by the Chinese Buddhist missionary and traveller of the seventh century, Hsüan-Tsang, and priceless painted silks, the earliest

known, with many other finds of equal scientific, if less widely advertised, value when conveyed to America and England, may well have impressed upon the Chinese the idea that they were being deprived of historic treasures of untold worth. With this point of view, the European peoples, who are making every effort to prevent their own artistic and historic treasures from leaving their respective countries, may well sympathise. From the scientific point of view, it is possible to hold that a specimen, whether appertaining to the natural kingdom or to the culture of man, is best preserved for study within striking distance of its natural environment, provided that it is then reasonably accessible to students and that adequate facilities are afforded for its examination.

While the claims of science and politics are thus seen to coincide in the demands of regional studies and historic association, too great insistence upon them may prove detrimental to the advancement of knowledge. It may check exploration. Expeditions on the scale now considered necessary for regional exploration in an area like Central Asia are expensive undertakings, and can be initiated and carried out only by, or through, a great organisation, such, for example, as one of the more important museums. Apart from finance, only an organisation such as this can hope to bring together and hold the numerous body of experts in the various branches of science—geology, geography, climatology, zoology, botany, palæontology, anthropology and archæology—which is considered essential if full advantage is to be taken of the opportunity afforded by such an expedition for joint study of related problems in the field. It is not unnatural, however, that in the conduct of an expedition on this scale the organising body should expect to be allowed a certain freedom of initiative to enable it to deal with unexpected developments in the course of the investigation, as new vistas are opened up by exploration; and that it should look for a return in the shape of additions to its collections. If in both these directions the regulations laid down by the national authorities are unduly restrictive, exploration presents no adequate inducement and science is deprived of material *ex hypothesi* essential to its advancement.

Much of this may seem obvious. Its recapitulation will serve to recall conditions which have been found obstructive to research in more countries than one. In China they have brought about a deadlock in the two instances mentioned, notwithstanding the expressed desire of the Chinese to co-operate in scientific exploration. In view of the importance of China as a future field of research, it is of the utmost moment that every effort should be made to bring about a more favourable situation in order to enable science to reap the fullest advantage from Chinese readiness to join in promoting the exploration of the vast store of scientific material in that Empire.

China is the gateway of Central Asiatic research. Not only does the vast area of Chinese Turkistan and Inner Mongolia lie under her jurisdiction; but also through China access may be gained to Outer Mongolia, Russian Turkistan, and Tibet along ways which have been trodden by one race after another for thousands of years. The achievement of the American Central Asiatic expedition in Mongolia in geology, in palæontology, in palæobotany and, to a lesser degree, in archæology has demonstrated the importance of that area as a great and almost unexplored source of evidence for the history of the Asiatic continent and as a centre of dispersal of many forms of animal life. The sense of this importance is borne upon us, not so much by the evidence that has been collected during the past ten years, great as this is in the mass, as by the array of further problems in the various sciences which that evidence has suggested, but of which the investigation is now suspended. It may well be, as one of the members of the expedition hopes, that eventually further exploration in this area will bring to light evidence of *Proanthropus*, the precursor of man, for whom research has waited so long. The results of Sven Hedin's expedition in Chinese Turkistan during the last six years, an expedition planned on similarly comprehensive lines to those of the American expedition to Mongolia, also point to the importance for scientific research of this area.

The material which has already been obtained, and which it is hoped to obtain from further exploration, is not merely of interest for its bearing on strictly local problems, or even of problems within the bounds of Asia. In Mongolia, for example, the alternation of desiccation with the growth of vegetation, for which there is geological evidence, and in later ages the variations in the occupation by man of areas now desert, may well help to solve, by the light they throw on climatic oscillation, problems relating to early man in East Africa and the relation of conditions in both Africa and Central Asia to the glaciations and associated cultural material of

Europe. Again, studies in the palæobotany of Mongolia are already throwing light on the distribution of the flora in tertiary times not only of the extreme east of Asia, but also of America.

Such problems as these are of world-wide interest, and should be attacked in no particularist spirit. Central Asia, indeed, has attracted scientific exploration from many sources. Within the present century, Russian, American, German, French, Italian, Swedish and British expeditions have contributed to the study of its problems in geography, geology, palæontology, zoology, archæology and other related sciences. Japan is interested in these researches in view of their bearing on her own problems. Nor must it be forgotten that the palæontological researches of the Geological Survey of China, which led to the first discovery of evidence of Peking man *in situ*, were initiated by Swedish money and with a Swedish personnel. Since 1928, China herself has had a body, now known as the Commission for the Preservation of Ancient Objects, which concerns itself with the scientific exploration of the Empire's natural and cultural history. Although it has not undertaken scientific exploration independently, it has taken steps to ensure that Chinese investigators should be included in the personnel of foreign expeditions which have received the sanction of the Chinese authorities.

In view of the magnitude of the undertaking, the importance to science of the results, and of past history, the exploration of Central Asia—and with this must be included a great part of China proper—seems pre-eminently a matter for international co-operation. On political and other grounds, it is clear that the task is too great for China unaided, at any rate for the moment; while co-operation between China and individual expeditions conducted by foreigners may not, at the best, be entirely satisfactory, failing any international board of arbitration in scientific matters, such as might perhaps have been in other circumstances a function of the International Committee on Intellectual Co-operation.

Of the various possible methods of dealing with the situation, the most practicable is, perhaps, an International Institute for Central Asiatic research. Such a proposal, indeed, has been put forward by Dr. Roy Chapman Andrews, leader of the American expedition to Mongolia, in the recently published first volume of the final reports of the Expedition. Dr. Andrews, however, has now abandoned this proposal in view of the differences which have arisen with the Chinese authorities and have brought his explorations to a close.

There is no reason why this should be final. Whereas, however, Dr. Andrews intended that the headquarters of the institute should be in New York, with field headquarters in Peking, it is probable that, if the full co-operation of the Chinese is to be secured, the Institute should be situated in China. Each of the western nations participating in the work of the Institute should have a resident representative, advised and supported by a committee in his own country, acting as a medium of communication between the general body of scientific workers of that country and the Institute, as well as being responsible for finance. The countries territorially interested, China, Mongolia, the Russian Soviets and Tibet, would also be represented in the Institute, although the extent to which they should participate in its actual work would, perhaps, be difficult to suggest before the proposal begins to take more definite shape. Full co-operation would seem the ideal, but might be difficult of arrangement. Such an Institute should be in a position to formulate and organise schemes of research upon a settled plan, with economy of money and effort and, it is hoped, with an absence of friction, whether relating to the objects and details of exploration, or the disposal of its material results to the best advantage of scientific studies.

Science and Culture

The Anatomy of Modern Science: an Introduction to the Scientific Philosophy of To-day. By Bernhard Bavink. Translated from the fourth German edition, with Additional Notes and Bibliography for English Readers, by H. Stafford Hatfield. Pp. xiii+683. (London: G. Bell and Sons, Ltd., 1932.) 21*s.* net.

THE imperative need of supplementing the specialist's knowledge by a more comprehensive consideration of the problems of science, without which the former is little more than a kind of scientific trade, is increasingly felt and is illustrated by the number of books which in recent years have attempted to interpret to a wide public the results of scientific research, and to correlate from a general and philosophical point of view the significance of these results and of the problems still unsolved. Such an exposition

calls for exceptional gifts, and though the attempt has been freely made in England, there still appears to be an outstanding need for a real synthesis on broad philosophical lines of the inexhaustible material of natural science.

The outstanding success of Bavink's "Anatomy of Modern Science" in Germany may be attributed to his presentation in the first place of the results of science out of which the philosophical questions have been allowed to develop naturally, and few books have raised more fairly the problems of the relations of science and philosophy or given a more sincere, impartial or patient interpretation of human values. If only for its brief remarks on the problems of rationalisation and the mechanisation of life, the book should be welcomed by all who, from the scientific side, are attempting to see life steadily and to see it whole.

A grave danger of the present time is that man's knowledge of physical laws far exceeds his knowledge of the science of man. On this point Bavink cites some impressive evidence. A convinced believer that the biological sciences are capable of yielding genuine knowledge, he emphasises the importance of scientific biological knowledge for the discussion of cultural questions. He regards the neglect of science in the curricula of our higher educational institutions as responsible for the inadequate conceptions of the driving forces of history possessed by large sections of educated people. Those who confuse culture with literature and art cannot understand the biological conditioning of cultural achievement, and accordingly cannot draw the appropriate deductions.

Ignorance of the true causes of such processes results in our failure to perceive that many so-called social reforms are in fact anti-social, and, apart from perpetuating tainted and undesirable elements in our population, lead to opposition to the measures required to preserve racial health. This misdirection of moral and social effort is a serious factor in our present position, above all in the framework of democracy, and the danger of persistent degeneracy is too serious to be ignored. Bavink makes the trenchant comment that no civilisation has ever possessed the knowledge which we possess of the deeper causes of cultural processes and racial decline. The remarkable development of our physical technology gives us some idea of the possibilities in biotechnology when biology represents a science as advanced as physics or chemistry.

Here we touch on the ideal of fitness for a purpose for its own sake, an ideal which is behind the present-day urge for rationalisation and scientific administration, and in one of the most suggestive chapters of his book Bavink discusses the value of technology as a cultural field for itself, standing on an equality with art, science and religious ethics. This discussion is the more timely in view of the tendency to overstress the financial side in referring to the economy of technology.

In his presentation of these issues, Bavink brings us face to face with the problem of values. These concluding chapters are undoubtedly provocative, but they keep clearly in mind the question of preserving the values bequeathed to us by the past without exposing civilisation to unbearable hindrances. There is no hasty dogmatism but the realisation, taught by the historical perspective, that it is fundamentally wrong to believe we hold in our hands the absolute and final truth, the ultimate value in any category. As in the field of scientific knowledge of truth, there must be constant striving for truth, believing that such striving is not in vain, that æsthetic values, like scientific truths, have a significance independent of whether, where, and by whom they are grasped. Scientific workers and artists of the highest rank have often shared the same feeling that what was given to them to achieve was something that they laid hold of, and not really something they themselves produced.

Bavink concludes his exposition of scientific philosophy upon a note which irresistibly recalls General Smuts's presidential address in 1931 to the British Association. "Where the scientist and philosopher have to be silent, the artist, the poet and the prophet may still speak to us, indeed, this is their truest realm. What can no longer be stated in the ingenious phrases of human wisdom may still be brought home to the sensitive spirit by the language of religious inspiration, art, and above all music to such an extent that we may well be in doubt which may bring us nearest to the root of the matter."

It is a worthy close to a valuable work which gives us at once a comprehensive view of man's achievements in the physical world, as welcome for its pragmation and relation to the real problems of our society as for its consciousness of the spiritual and moral values among which science itself is rightly to be ranked.

R. B.

Stands Darwin Where He Did?

The Causes of Evolution. By Prof. J. B. S. Haldane. Pp. vii+235. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 7*s.* 6*d.* net.

ONCE again Prof. J. B. S. Haldane has produced a lively and stimulating book. Dealing with problems of general significance, it contains much to interest both the professional biologist and the layman. It is based on a course of lectures delivered at the Prifysgol Cymru, Aberystwyth, and entitled "A Re-examination of Darwinism". Although, as its new title implies, its scope is now somewhat larger than the original title of the lectures would suggest, yet the main purpose of the book is to examine the Darwinian hypothesis of natural selection as a cause of evolution in the light of modern experimental and theoretical work.

As we should expect, Prof. Haldane's discussion combines vigour with authority, and his text is full of new and illuminating material. His first chapter states the problem. He shows how, when the doctrine of evolution first gained general acceptance, it was combined, as Darwinism, with the explanatory idea of natural selection. Later the two became dissociated. Positive evidence for evolution accumulated and became more and more convincing. But at the same time the belief in natural selection, which was originally almost inseparable from the belief in evolution, has weakened—or at least, it has not gained support at anything like the same rate, so that, as Prof. Haldane writes, "a few biologists and many laymen regard it as more or less exploded". The reasons for this reaction are described.

The next two chapters, perhaps the most valuable in the book, deal with variation within a species, and with interspecific differences, in the light of recent genetical and cytological investigations. It is shown that

"Interspecific differences are of the same nature as intervarietal. But the latter are generally due to a few genes with relatively large effects, and rarely to differences involving whole chromosomes or large parts of them. The reverse is true of differences between species. The number of genes involved is often great, and cytologically observable differences common. It is largely these latter which are the causes of interspecific sterility."

After this comes a discussion, occupying two chapters, of the effects of selection. The first part describes cases of stable populations, which have maintained the same numerical proportion between individuals of different types for long periods of time, and changing populations in which one type, owing apparently to environmental change and consequent selection, has increased rapidly at the expense of another. Then, natural selection having been shown to be an observable reality, and the different kinds of inheritable variations having been defined, there follows an inquiry into the extent to which the observable facts of evolution can be accounted for by supposing the one to be acting on the other.

Much of this discussion is based upon the recently developed mathematical theory of natural selection, a theory to which Prof. Haldane has made important contributions, and which he outlines in an appendix of forty-five closely printed pages. This is a most useful addition to the book, for many of the original papers are rather inaccessibly published.

Although Prof. Haldane inquires chiefly into the effectiveness or otherwise of natural selection as a cause of evolution, he comments briefly on other suggested causes, and makes damaging attacks from time to time against the Lamarckian position. The conclusion is that

"it would seem that natural selection is the main cause of evolutionary change in species as a whole. . . . Although we have found reason to differ from Darwin on many points, it appears that he was commonly right when he thought for himself, but often wrong when he took the prevailing views of his time—on heredity, for example—for granted."

Finally, less scientific perhaps than the rest but excellent reading, there comes a chapter on the æsthetic aspects of evolution, in which the author, who has already told us why he believes in evolution, goes on to confess why he is glad that he believes as he does.

When Prof. Haldane concerns himself with present-day phenomena he is vividly interesting, but the reviewer was aware of a faint feeling of dissatisfaction when he came to the passages which extrapolate from present-day experience into the past. The trouble—which is due to a fault, not of the author but of the material at his disposal—arises from the following considerations.

Prof. Haldane deals of course in his discussion with the objection, which has so often been raised against Darwinism, that although natural selection accounts for the acquisition by an evolving race

of advantageous characters, it cannot account for characters which are damaging, or which are simply indifferent. Palæontology gives examples of the evolution of characters which appear to be a hindrance rather than an advantage to their possessors, and systematists distinguish many species by differences of colour and shape which have no discernible survival value. To meet this criticism, Prof. Haldane points out, as Darwin did, but with a wealth of new examples, that characters which seem different are often linked together in inheritance and transmitted as a single unit. Thus various anatomically distinct strains of wheat differ also in their susceptibility to rust; the white and coloured populations of America die from different diseases; and there is evidence that immunity to measles is correlated with hair and eye colour. One can therefore account for the evolution of useless characters by supposing them to be accompanied by unknown advantages. Even a disadvantageous character might prevail if it was linked to a sufficiently profitable adaptation.

It will at once be seen that natural selection is a very formidable explainer of data. Indeed, short of abrupt discontinuity in the fossil record, it is difficult to imagine any facts that, properly manipulated, it would fail to explain. Imagine a fossil population consisting of individuals of two types—one, so far as we can judge from its structure, better adapted to the conditions than the other. If the well-adapted one is seen in the rocks to triumph and replace the other, well and good; if not, then one has only to postulate unknown characters linked to the visible ones to explain the issue. If *Eohippus*, instead of begetting and being replaced by the mechanically more efficient modern horse, had evolved out of it, the selectionist would only have to assume that the more toes a horse had the more immune it was against diseases.

The reviewer (who confesses that for the moment he has stopped reviewing) does not wish to suggest that the argument of linked characters is false. But it seems to him that by its aid the hypothesis that evolution occurred by natural selection acquires a facility that is almost indecent. Just as coffee can be too sweet, so a theory can explain too much—the first is undrinkable, the second is useless for scientific prediction. To be satisfyingly true, a theory should from time to time run the risk of disproof.

If we had a fossil record of Utopian completeness, how very different the state of affairs would be! Given a large collection of specimens of an evolving species all from the same level, one might perhaps determine from their sizes which individuals lived longest, and which died young. That would afford a basis from which the subsequent evolutionary history of the race could be predicted. But until that kind of check can be applied to it, the hypothesis that natural selection has been the main cause of evolution in the past is of a rather low order of truth. When it is applied to the horns of titanotheres or to the coilings and uncoilings of ammonites it is little more than specious. Our chief excuse for adopting it is that nobody can think of a better hypothesis—and that, after all, is a pretty poor one. Reinforced by the argument of linked characters, it can explain all the facts of evolution, but, skilfully handled, it could probably explain their converse equally well; and for that very reason it cannot at present be confirmed.

On the other hand, there is plenty of evidence in Prof. Haldane's pages that at least we are approaching a critical estimate of the importance of selection in such evolutions as occur to-day. There are the rapid advances in genetics and cytology and in the mathematical theory of selection; and there are the fascinating cases—all too few at the moment—in which a change in the composition of a population has been watched, one variety supplanting another. Here are opportunities for experiment and critical analysis, and promises of truths solid enough to satisfy even the most carping. The chapters in which the author gives an account of the present condition of this rapidly progressing branch of knowledge constitute by far the most exciting and valuable part of his book. G. P. W.

Universities Yearbook

The Yearbook of the Universities of the Empire, 1933. Edited by Sir H. Frank Heath. Published for the Universities Bureau of the British Empire. Pp. xxxi+975. (London: G. Bell and Sons, Ltd., 1933.) 15*s*. net.

IN issuing this admirable conspectus of British universities, the Universities Bureau, now in its twenty-first year, renders an important public service. The yearbook displays in convenient form authentic information regarding the personnel, organisation, regulations and recent activities of universities and thus obviates much laborious search among official calendars, many

of which are to be found in but few public libraries. Facilitating, as it does, intercourse between seats of learning in all parts of the Empire, the yearbook becomes, as this intercourse develops, ever more indispensable. In addition to particulars given separately for each university there are generalised accounts of the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, and these are from time to time rewritten: in the present issue the South Africa and India chapters have been revised and brought up to date, as those of Canada and Australia were in the two preceding issues.

In appendices covering two hundred pages are summaries of the conditions governing admission to various professions and careers for which university studies are a fitting preparation, the qualifications for admission to a first degree in the universities of Great Britain and Ireland, lists of open post-graduate scholarships, fellowships and grants for research available (whether within or without the Empire) to British nationals and lists of centres of scientific research and of scientific information (whether connected with the universities or not) with particulars of the conditions of admission of independent research workers.

In the present issue the presentation of the conditions of admission to the universities of Great Britain and Ireland and qualification for their first degrees has been further clarified—an improvement which will substantially enhance the value of the book in the estimation of the general public, as will also the further improvements that have been made in the general index. The memorandum and new articles of association of the Universities Bureau are published for the first time in the present issue together with the names of the representatives of the member universities. All the universities of Great Britain and Ireland are members, but of the remaining fifty-one universities in other parts of the Empire twenty are, it appears, not at present members of the Bureau.

Short Reviews

The Subject Index to Periodicals, 1931. Issued by the Library Association. Pp. x+267. (London: The Library Association, 1932.) 70*s*.

THE Library Association is to be congratulated on having accelerated the rate of publication of the annual volume of its "Index to Periodicals", so that the volume for 1931 appears only eight months after that for 1930. For this promptitude we have to thank the editor, Mr. T. Rowland Powel, and the increasing number of voluntary contributors who help him in the work.

The present volume contains the titles of 25,650 articles selected from 582 periodicals. The periodicals examined are chiefly English and American. No less than 540 of these have been indexed. In addition, 23 French, Belgian and Swiss, 17 German and Dutch and two Italian periodicals have been examined.

It should be noted that, with few exceptions, no attempt has been made to index periodicals covered by the following publications: *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colourists*, *Photographic Abstracts*, *Revue de Geologie*, Royal Meteorological Society's *Bibliography*, *Science Abstracts* and the Textile Institute's *Journal*. The subjects indexed are not confined to pure and applied science, for while poetry and fiction are excluded, the range of subjects dealt with is very wide. It includes, among other topics, art, architecture, music, language, literature, biography, education, law, medicine, labour questions, philosophy, peace and war.

The Changing Culture of an Indian Tribe. By Margaret Mead. (Columbia University Contributions to Anthropology, 15.) Pp. xiv+313. (New York: Columbia University Press; London: Oxford University Press, 1932.) 28*s*. net.

DR. MARGARET MEAD'S study of present conditions in an Indian tribe living on a reservation, of which the anonymity is preserved under the title of "Antler", deals more particularly with the position of the women. It is, in a sense, an experimental study in that it has been undertaken with a view of elaborating and testing methods of observation which, it is pointed out, will in the near future have to be employed in an increasing degree in ethnographical observation, owing to the rapid changes which are taking place all over the world among backward peoples, as they come more and more closely into contact with civilisation, and their customs and native economy are modified thereby. In a preface, Dr. Clark Wissler points out, for example, that the Indians whom Dr. Mead has had under observation, are living under two incompatible ideals. On one hand they are trying to preserve their old tribal ideals of community, and on the other hand they are forced to conduct their life in accordance with the white concept of competition. Dr. Mead's book, which has some valuable detail bearing on moral conditions among a partially detribalised people and on the modification of conditions in marriage, is thus of both special and general interest to the student of ethnology.

Pedigree Schedules: the Study and Preparation of Family Records. 11 pp. of Explanatory Notes, +30 Case Sheets and specimen Charts. (London: The Eugenics Society, 1932.) 10*s.*

THIS publication consists of a stout adjustable cover to which is attached a pamphlet of 11 pages of explanatory notes, a folded sheet of strong graph paper, destined to receive the pedigree chart, six blank leaves for comments on the pedigree, and thirty individual case sheets.

The explanatory notes are, up to p. 10, devoted to instructions for filling up the pedigree in standardised symbols and arrangements of generations. The greater difficulties of the individual case sheets are more lightly touched. Indeed the information asked for on these sheets is so slight as to be of little interest to the hypothetical descendants. Nationality and race are asked for, and the explanatory notes show that the latter question may be answered in such terms as ½ Slav, ½ Chinese. Spaces are left for the dates of birth and death, but marriage, perhaps on a modernist assumption that such a state is transient, fruitless, and of no interest to posterity, is not mentioned.

To be widely useful far more space should have been given to the occupational record and personal history of the subject, and space should not have been given for inquiries so vague as 'physical type'.

Land and Labour in China. By R. H. Tawney. Pp. 207. (London: George Allen and Unwin, Ltd., 1932.) 7*s.* 6*d.* net.

PROF. TAWNEY has written an excellent review of social, economic and educational conditions in modern China, taking the land and labour on the land as his starting point and the central core of the problem of future development. His book in part is based on his own observation and in part is an analysis of recent literature, of which a considerable proportion is by Chinese authorities. The special feature and chief source of interest in Prof. Tawney's work is its grasp of the Chinese attitude of mind towards Western civilisation and the recognition that in the final solution of the conflict of West and East now proceeding, in all probability it will be anything but a mechanical adoption of the machinery of progress, which in the long run will satisfy the Chinese temperament. As Prof. Tawney indicates, where we think in years or generations, the Chinese think in hundreds and thousands of years. Hence their tolerance of conditions which another people would feel to be unendurable, but also their faith in an ultimate solution.

The Frazer Lectures, 1922–1932. By divers Hands. Edited by Warren R. Dawson. Pp. xv+304. (London: Macmillan and Co., Ltd., 1932.) 15*s.* net.

THE Frazer Lectures, founded in honour of Sir James Frazer and to commemorate the completion of the third edition of "The Golden Bough", have now been delivered for ten years in succession in the Universities of Oxford, Cambridge, Glasgow and Liverpool in rotation. Among the lecturers have been the late Sidney Hartland, the late Canon J. Roscoe, Dr. A. Moret, Dr. A. C. Haddon, Dr. Marett, Prof. Westermarck, Prof. Malinowski, Sir Arthur Evans and Sir Arthur Keith. Although some of the lectures have already appeared in print, the convenience of having them together within the covers of this handsome and well-printed volume will appeal to all classes of reader, while marking the manner in which those representing different schools of thought have united to do Sir James Frazer honour.

The Races of Man: Differentiation and Dispersal of Man. By Prof. Robert Bennett Bean. (Highlights of Modern Knowledge.) Pp. vi+134. (New York: The University Society, Inc., 1932.) n.p.

DR. BEAN'S "The Races of Man" is a volume in a series published by an organisation in New York which exists for the popularisation of knowledge in science and art and now has offices in most of the more important countries of Spanish America. Dr. Bean's book is well produced and well and fully illustrated; but its text shows signs of over hasty preparation leading at times to statements perilously near misstatements. On such matters as racial differentiation and racial dispersal it is good and attacks its problems on broad lines; but in dealing with the origin and descent of man, the author does not appear to be abreast of either recent discovery or theory. Misprints are frequent.

Be your own Weather Prophet: a Book for the Holidays and After. By E. S. Player. Pp. vii+128. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1932.) 3*s.* 6*d.* net.

EVEN in these days of broadcasts, weather information is still profitable to the holiday maker, and this brightly written little book is full of weather wisdom. It sets out simply the relations of wind and weather to moving systems of isobars, and tells the reader how to diagnose the weather situation from his own observations, his only instruments being an aneroid barometer and a thermometer. The account of cloud prognostics is good, and the local peculiarities of weather are adequately discussed.

Climate and Acclimatization: some Notes and Observations. By Sir Aldo Castellani. Pp. viii+152. (London: John Bale, Sons and Danielsson, Ltd., 1931.) 7*s.* 6*d.* net.

SIR ALDO CASTELLANI describes with a wealth of technical detail the medical effects of tropical climates, especially of great heat and moisture and strong insolation. On the latter subject there is much to interest meteorologists, but in matters of meteorological theory the book is less satisfactory. There is an excellent bibliography.

Nature of Cosmic Rays*

By Prof. ARTHUR H. COMPTON, Ryerson Physical Laboratory, University of Chicago.

THERE are three kinds of experiments which seem to afford direct evidence regarding the nature of cosmic rays. These are: (1) the Bothe-Kolhörster double counter experiment, which compares the absorption of the particles traversing the counters with the absorption of cosmic rays; (2) measurements of the relative intensity of cosmic rays over different parts of the earth, designed to show any effect due to the earth's magnetic field; and (3) studies of the variation of cosmic ray intensity with altitude, which should follow different laws according as the rays are electrons or photons.

(1) The Bothe-Kolhörster experiment serves to measure the absorption in a block of gold or lead of the high-speed electrified particles that produce coincident impulses in two neighbouring counting chambers. It is found that this absorption is surprisingly small, about the same, in fact, as that of the cosmic rays themselves.

The simplest interpretation of this similarity in absorption is to suppose that the high-speed particles in question are the cosmic rays. There is, however, the alternative possibility that the primary cosmic rays are photons which eject high-speed electrons as recoil electrons when the photons are stopped, and that these recoil electrons are absorbed at about the same rate as the primary rays themselves. Theoretical calculations indicate that the recoil electrons should be absorbed five or ten times as rapidly as the photons which give rise to them. These calculations are somewhat uncertain because of extrapolation far beyond the wave-length region where the existing formulæ have been tested. For this reason, the equal absorption coefficients of the cosmic rays and the high-speed particles does not necessarily rule out the possibility that the particles in question may be recoil electrons excited by the cosmic rays. It would, nevertheless, be surprising if the formulæ were in error by so large a factor as five or ten, as would be implied if the coincidences are due to secondary electrons.

(2) If the cosmic rays consist of electrified particles coming into the earth's atmosphere from remote space, the earth's magnetic field should affect their geographical distribution. This effect has been investigated theoretically by Størmer, Epstein, and recently much more completely by Lemaître and Vallarta. It appears that for energies less than 10^9 electron volts, electrons approaching the earth can reach it only at latitudes north of about 60°. For energies greater than about 5×10^{10} volts the geographical distribution is not affected by the earth's magnetic field. For intermediate energies, there will be a difference in intensity with latitude according to the distribution of energy of the incoming electrons.

Experimental studies of the relative intensity of cosmic rays in different parts of the world have been made by J. Clay, who made several trips between Java and Holland, and found consistently a lower intensity near the equator; Millikan and Cameron, who found but slightly lower intensity in the lakes of Bolivia than in the mountain lakes of California, and no difference between Pasadena and Churchill close to the north magnetic pole; Bothe and Kolhörster, who carried a counting tube from Hamburg (53° N.) to Spitsbergen (81° N.) and back, and detected no variations in the cosmic rays larger than their rather large experimental error; Kennedy, who, under Grant's direction, carried similar apparatus from Adelaide, Australia, to Antarctica, and likewise found no measurable change; and Corlin, who on going from 50° N. to 70° N. in Scandinavia found some evidence of a maximum at about 55° N. The prevailing opinion regarding the significance of these measurements has thus been expressed by Hoffman in a recent summary: "The results so far have on the whole been negative. Most of the observers conclude

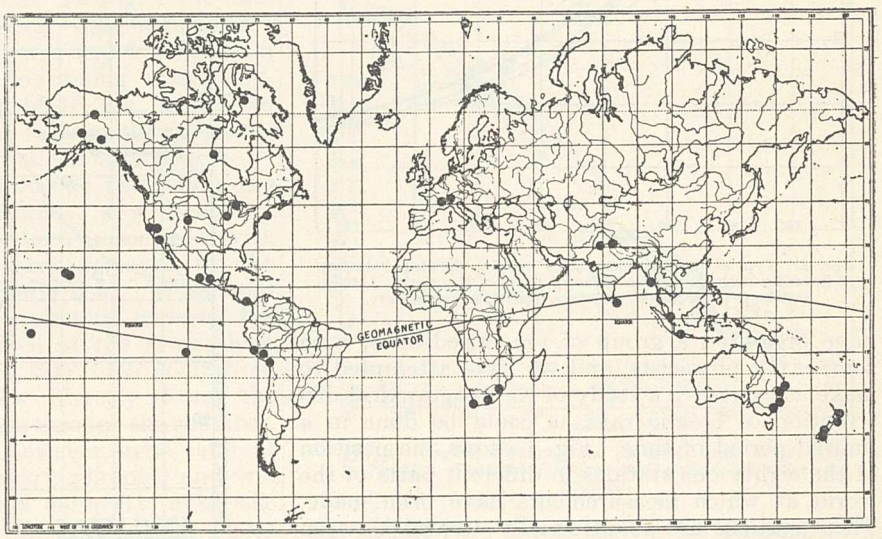

FIG. 1. Map showing major stations at which associated expeditions have made cosmic ray measurements during 1932.

* Substance of an address presented at a symposium on cosmic rays, held by the American Physical Society at Atlantic City on December 30, 1932.

that within the errors of experiment the intensity is constant and equal, and those authors who do find differences give their results with certain reservations."

During the past eighteen months, Prof. Bennett of the Massachusetts Institute of Technology, Prof. Stearns of the University of Denver, and I

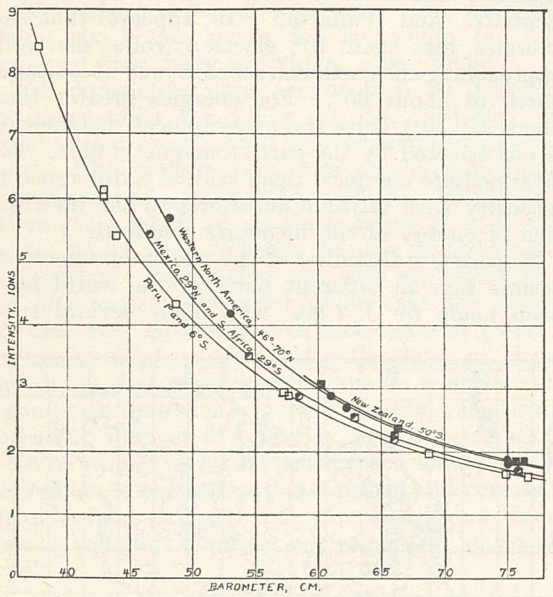

FIG. 2. Typical intensity-barometer curves, showing variation of intensity with altitude in different parts of the world. Circles, northern hemisphere; squares, southern hemisphere.

have organised a group of ten expeditions, with some sixty physicists, and we have attempted to make as extensive a study of the geographical distribution of cosmic rays as could be done in a limited period of time. Fig. 1 shows the position of the eighty-one stations in different parts of the world at which measurements have been made. These stations are about equally divided between the northern and southern hemispheres. They have extended from latitude 46° S. to latitude 78° N., and from sea level to about 20,000 ft. (Figs. 2 and 3). When these data are brought together, they show a marked difference in intensity between the cosmic rays at temperate and polar latitudes, as compared with the tropical latitudes. At sea level the difference in intensity is about 14 per cent, at 2,000 metres about 22 per cent, and at 4,400 metres about 33 per cent. The change between the intensity for tropical as compared with that for temperate latitudes occurs rather sharply between geomagnetic latitudes 25° and 40°.

Comparison of the experimental data with the theory of Lemaître and Vallarta shows that the distribution of cosmic rays is about that to be expected if the rays consist of electrons entering the earth's atmosphere in two energy groups. One of these is of such great energy that it is not appreciably affected by the action of the earth's field. This group comprises in the temperate zone 88 per cent of the total radiation at sea level, and might, so far as these experiments are concerned, be classified as photons. At 4,400 metres this component constitutes 75 per cent of the total radiation. The second component is less penetrating and represents particles with an energy, if they are electrons, of about 7×10^9 electron volts. It is these particles which reach the earth at temperate latitudes but fail to reach it near the equator.

It may be remarked that even these less-penetrating cosmic rays have energies which are much larger than those that could be accounted for as recoil electrons resulting from photons, if these photons were to constitute the main body of the cosmic rays. According to Millikan, measurements of the absorption of the cosmic rays at sea level indicate that their energy, if they are photons, is of the order of 2×10^8 electron volts. This is so much less (a factor of 35) than that of the electrons responsible for the difference in intensity

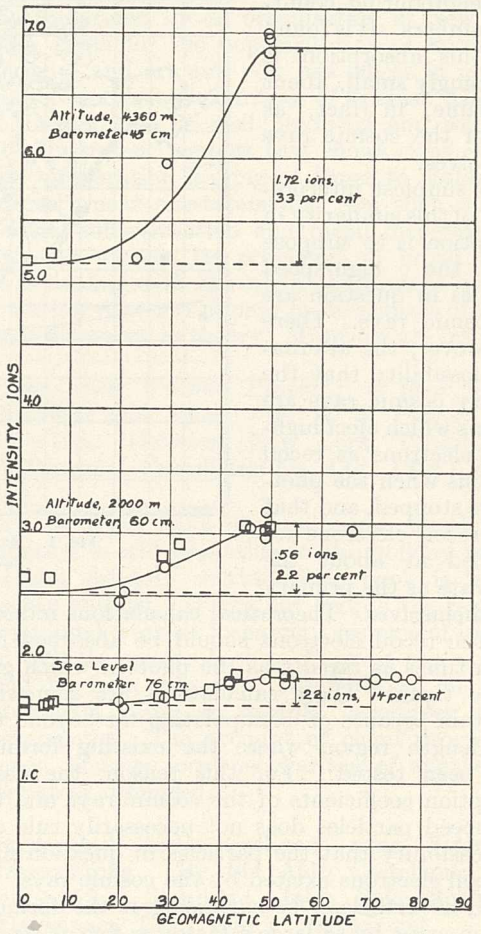

FIG. 3. Variation of cosmic ray intensity with geomagnetic latitude, as found for three different altitudes. The variation is more prominent at high altitudes. Curves calculated from Lemaître-Vallarta theory.

between temperate and tropical zones, that we would seem to be safe in concluding that the particles reaching the earth are not of the recoil type. On the other hand, the energy of 7×10^9

electron volts demanded by the Lemaître-Vallarta theory for these particles would mean a range taken along the particle's trajectory of about three times the thickness of the earth's atmosphere. This is in accord with the fact that these rays penetrate the earth's atmosphere, but with difficulty.

This geographical study of the cosmic rays thus indicates that the less penetrating part of the cosmic rays, at least, consists of high-speed electrified particles. Regarding the more penetrating component, we conclude that if they are electrified particles, they must have an energy of 3×10^{10} electron volts or more.

(3) During the past two years, extensive experiments have been carried out studying the variation in the intensity of cosmic rays with altitude. The highest altitudes have been those reached by Regener with his sounding balloon and Piccard with his famous stratosphere balloon. We have also paid especial attention to this problem in our mountain experiments. In Fig. 4 the data from mountain and balloon observations are compared. These data show a rapid increase in intensity with altitude, continuing nearly exponentially to an altitude of 15 km., and from there approaching a limiting value as the apparatus is carried close to the top of the atmosphere.

If we suppose that the cosmic rays enter the earth's atmosphere as photons, any secondary electrons that may have been associated with them in space will have been removed by the action of the earth's magnetic field. We should thus have a beam of pure photons entering the atmosphere. At the surface of the atmosphere these photons will produce very little ionisation, for the ionisation results directly from the secondary electrons that pass through the chamber. The secondary electrons, however, arise only at the absorption of the primary photons, and will not approach their normal intensity until the photons have traversed a thickness of air about equal to the range of the electrons. This means that at very high altitudes the ionisation due to a beam of photons entering the earth must be almost zero. The ionisation current should rather approach a maximum at a depth in the atmosphere at which the cosmic rays are somewhat less than half absorbed, and should then gradually diminish in intensity as sea level is approached. Our high mountain experiments confirm the recent balloon experiments as indicating that no such high altitude maximum exists. This would seem to rule out the possibility that the cosmic rays can be photons entering the earth's atmosphere from remote distances.

If we suppose, on the other hand, that the cosmic rays are electrons entering the atmosphere from above, we should expect very much the kind of intensity-altitude curve that the present experiments show. It is well known that the ionisation per unit path by high speed electrons remains almost constant over a wide range of energies. Thus, if a beam of such electrons enters the atmosphere, it will produce nearly uniform ionisation down to such depths that an appreciable number of the electrons are stopped by the air. If the initial electrons were all travelling downward, there would be a rather definite limit or range where there would be a rapid reduction in the ionisation by the cosmic rays. If, however, the initial electrons entered in all directions, some of them would be stopped even in the upper layers of the atmosphere. Thus, supposing that the cosmic rays consist of electrons entering the earth's atmosphere from outer space, the general characteristics of the intensity-altitude curve can be readily accounted for.

If Regener's measurements from his balloon flights during the past summer are reliable, it appears that there is no detectable decrease in ionisation as the top of the atmosphere is approached. This would mean, in accord with the above reasoning, that no appreciable portion of

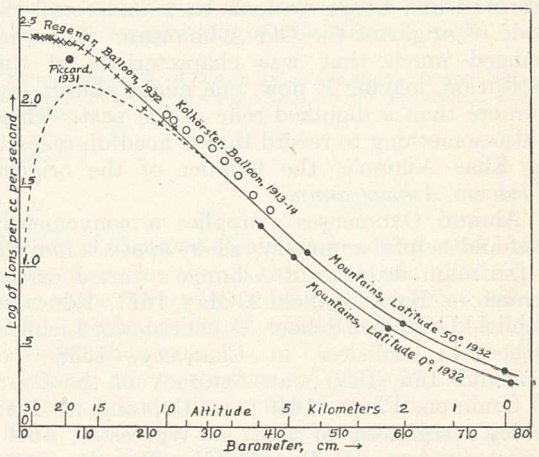

FIG. 4. Combined balloon and mountain data on intensity as function of altitude. Broken line, anticipated values for photons.

the cosmic rays enters the earth's atmosphere in the form of photons.

On the other hand, if the cosmic rays enter the atmosphere as electrons, they will produce photons just as cathode rays striking a target produce X-rays. Accordingly, at lower altitudes a mixture of electrons and photons will be present, and it may be expected that the photons will have the greater penetrating power. It is thus not impossible that the very penetrating cosmic rays observed by Millikan, Regener, and others at great depths under water may be such photons excited by the incoming electrons.

Although we have discussed the problem as if the electrified particles which seem to constitute the cosmic rays are electrons, it will be understood that the experiments that have been cited do not serve to distinguish between negatively and positively charged particles. The experiments are equally consistent with the view that the rays consist of protons or high speed α-particles. I find no way of reconciling the data, however, with the hypothesis that any considerable portion of the primary cosmic rays consist of photons.

The Old Ashmolean, Oxford

By T. E. JAMES

IN celebration of the occasion of the two hundred and fiftieth anniversary of the opening of the Old Ashmolean, Oxford, which falls on May 21, a series of events has been arranged. Addresses will be presented on May 22, by delegates of scientific and literary institutions, whilst a lecture is announced for the same day by Sir Arthur Smith Woodward on "Plot and Lhwyd and the Dawn of Geology". This will be delivered in the University Museum. Various exhibitions which are of cognate interest in connexion with the anniversary will be available to the public.

As an event of importance in the history of early science in Great Britain, but more particularly, perhaps, in relation to natural history, it is well and fitting to look back and recall the mode of origin of the Old Ashmolean. Time has changed much that was characteristic of this institution, leaving it now, one might almost say, no more than a dignified relic of the past. There is also something to record that is needful, respecting Elias Ashmole, the founder of the original *Musaeum Ashmoleanum*.

"Alumni Oxonienses" supplies a conveniently brief and helpful summary, where space is limited, of the main features of Ashmole's varied career. It runs :—"Born Lichfield 23 May, 1617. Educated Lichfield Grammar School. A chorister of Lichfield Cathedral ; solicitor in Chancery, 1638 ; of Clement's Inn, 1640 ; an Attorney of the Court of Common Pleas, 1640 ; a Captain in Lord Ashley's regiment of foot at Worcester, 1646 ; barrister-at-law of the Middle Temple, 1660. Windsor Herald, 1660. Chief Controller of H.M. Excise in England and Wales, 1668. D.Med., by diploma (Oxon), 1669—." The anniversary of Ashmole's date of birth thus falls on the day after Sir A. Smith Woodward's promised lecture. Ashmole died on May 18, 1692, and he was interred in South Lambeth Church, where a black marble slab commemorates him in eulogistic terms. He had married three times, his third wife (1668) being the daughter of Sir William Dugdale.

Elias Ashmole, "skilled in chemistry, antiquities, heraldry, mathematics", and other abstruse studies, including alchemy and astrology, was among those persons, who, on May 20, 1663, were registered, and declared to be original fellows of the Royal Society, following upon the incorporating Charter of July 15, 1662. Ashmole's name, however, was included in that earlier and historic list of supporters of a proposed new society, whose declaration ran—"Wee whose names are underwritten doe consent and agree that wee will meete together weekely . . . to consult and debate, concerning the promoting of Experimentall Learning". This was dated, in the first instance, December 5, 1660, but names were appended after that particular date. On December 26, 1660, there is a minute that "Mr. Boyle, Mr. Henry Oldenburg, Mr. John Denham, Mr. Rawlins, Mr. Elias Ashmole, Mr. John Evelyn, and Nathaniel Henshaw, M.D., were proposed candidates for election". The association of Ashmole with these pioneer promoters of the new philosophy is of special though incidental interest. Ashmole not only signed the document quoted above, but also the Charter Book, when that fellowship roll was received and inscribed by original fellows as for 1663.

Hence, the Royal Society has two testifying signatures of Elias Ashmole. In election he preceded Edmund Waller and Abraham Cowley. On the other hand, Ashmole never served on the Council ; nor did he appear to advance any schemes at hand. But he had divers interests and occupations as just excuse. Still, as regards activities in early science at Gresham College, or at Arundel House, Ashmole is a disappointing study.

In other directions, however, Ashmole's personal equipoise was assured. On June 18, 1660, he was introduced to the presence of King Charles II by no less a functionary than Thomas Chaffinch ; and on the next day he was constituted Windsor Herald. When that folio on the History of the Most Noble Order of the Garter was published (1672), it was brought to the King by Ashmole.

We may now briefly consider Ashmole's connexion with the Old Ashmolean, and how it came to be established at Oxford, where scientific studies had already begun. On one of the rural sides of London, at South Lambeth, there had been established, by 1629, an extensive botanic garden, an adjunct to a residence, the latter a repository for 'rarities' in natural history. It was the home of John Tradescant, whom we hear of as married in 1607 at Meopham, in Kent. First as a gardener helping to stock the Hatfield demesne, next, he is travelling abroad and collecting assiduously, encouraged and stimulated by the Duke of Buckingham. It was the Duke's wish (so wrote Tradescant in 1625), that "I should deal with all merchants from all places". The South Lambeth house came, in time, to be known by the suggestive title of 'Tradescant's Ark' ; its collections were noteworthy in the infancy of the study of natural history in England.

John Tradescant, son and heir, was imbued with his father's tastes and likings, and he carried on the collecting work at Lambeth when his father died in 1637. A decade or so later, we find that Ashmole was a frequent visitor across the Thames, and became very friendly with John Tradescant. In 1659 a diary entry by Ashmole records, "Mr. Tradescant and his wife told me they had been long considering upon whom to bestow their

Closet of Curiosities when they died, and at last had resolved to give it unto me".

After the death of John, the husband (1662), acute trouble arose in regard to the collections, settled, however, by Lord Chancellor Clarendon, in 1664, in favour of Ashmole, who was to "have and enjoy" the collection of rarities. Ashmole was then living in a house next to the Tradescants.

After Ashmole had obtained possession of the repository there came a period (about 1677), when it was urgently necessary to assign its contents. There were also certain manuscripts and books thought worthy. It was no use to cast eyes towards Gresham College. It was therefore not unreasonable, he thought, to offer his possessions to Oxford, his *alma mater*, but *conditionally* on the erection of a building to house them. He had been much honoured there in 1669 as a "curioso and virtuoso". Certainly a bold proposition, all things considered; nevertheless, it was gratefully accepted. Thereafter, the Ashmolean building took shape and became the designated habitation, erected at the charge of the University, fulfilling, at least in some measure, Ashmole's original hopes.* The foundation stone was laid on Thursday, May 15, 1679, and the Museum was opened on May 21, 1683. The Duke and Duchess of York, and their retinue, attended. There was feasting and jollity, and Ashmole (with whom was Mrs. Ashmole) was applauded and favoured to the top of his bent. Dr. Plot, the first custodian, gave a "sette speech". After the chief ceremony, the company went down to a newly fitted chemical "elaboratorie", where they witnessed some experiments, which are recorded as having given great satisfaction. A revival of the activities of the philosophers forming the Philosophical Society of Oxford, the original members of which had close contact with the Royal Society in London, occurring, their meetings were held in the Ashmolean for some time, and were both profitable and inspiring.

Space will not allow reference to the vicissitudes which later waited upon the Old Ashmolean, ending in neglect and disrepair. Dr. R. T. Gunther has dealt with these points, and of a brighter period, bringing in its train appreciation of new uses and recognition of the historic past.

* On January 26, 1678/9, a fire in the Middle Temple destroyed Ashmole's library, and many curios, in all probability, destined for Oxford.

Obituary

The Duke of the Abruzzi

FEW men have led lives so full of interest and accomplishment as Prince Luigi of Savoy, Duke of the Abruzzi, who died on March 18 at the age of sixty years. Mariner, explorer, admiral, colonist, and man of science, he exhibited vision and initiative in every field of his numerous activities, and, by sheer tenacity of purpose, achieved success in the most arduous of ventures.

The Duke's connexion with the Italian navy commenced in 1879 when, at the age of six, he entered the service as cabin boy. From 1884 until 1889 he was occupied in study at the Royal Naval Academy. In those days Italy was not very well known in foreign countries and, to remedy this, the ships of the navy were sent on missionary work to distant lands and even round the whole world. Such patriotic propaganda found an enthusiastic supporter in the young Prince who, in the *Amerigo Vespucci*, the *Volturno*, and the *Cristoforo Colombo*, took part in several long voyages, ultimately attaining the rank of lieutenant. His first important naval command, in 1902, was that of the cruiser *Liguria*, in which he made a tour of the world lasting eighteen months. Further promotions followed, and the Duke commanded a squadron during the Italo-Turkish war of 1911–12, and was appointed to the supreme command of the Italian navy during the War.

As a traveller and explorer, the services of the Duke of the Abruzzi to science and to his country were outstanding. His early education in this direction was acquired during his teens in the Alps under the guidance of the well-known alpinist, Francesco Gonella. The Alps were also the scene of many of his later ascents and before he reached the age of thirty he had climbed, in some cases during the winter, all the most difficult Alpine peaks, some of which had not been previously conquered.

During his world-tour of 1894–96, the Duke saw the Himalayas for the first time and on his return to Italy he made preparations for an ascent of Nanga Parbat (8,115 metres). This expedition was, however, frustrated owing to an outbreak of plague and famine, which decimated the Punjab. The objective was therefore changed to a peak very different in character, Mount St. Elias in Alaska. Unlike Nanga Parbat, with a lower snow limit at about 5,000 metres, Mount St. Elias is covered from base to summit with glaciers, which debouch into the waters of the Pacific. The mountain—which is visible from the sea at a distance of 200 miles and has been known to navigators since the beginning of the eighteenth century—and its immediate surroundings were at that time completely unexplored. The expedition, consisting of the Duke and five companions, together with four Alpine guides, left Italy in May, 1897, and was joined at Yakutat Bay by ten American porters. Three days were occupied in crossing the wide plateau of the Malaspina glacier, and four laborious weeks in traversing the Seward, Agassiz, and Newton glaciers, fissured by enormous crevasses. Just over ten weeks after leaving Italy, the party camped beyond the Newton glacier at the foot of the great pyramidal mass of the mountain, and less than three days later reached the summit without casualty.

The observations made gave the altitude of

Mount St. Elias as 5,514 metres, in good agreement with the value (5,516 metres) calculated by Russell who, in 1891, reached a col situated at a height of 3,745 metres. Two unknown snowy peaks, observed in the west, were named Lucania and Bona, these being identified topographically and measured sixteen years later by American observers. A series of meteorological and glaciological observations was made, and collections of the minerals and minute fauna of the glaciers, and the first complete series of views of the St. Elias group were secured.

In the summer of 1898 the Duke visited Spitsbergen and in the following winter made an excursion by sleigh into Central Siberia. Preparations were then made—quietly, indeed almost secretly—for a north polar expedition. It was decided not to follow the plan adopted by Nansen in his earlier attempt, but to proceed by ship as far north as the currents allowed and then set out on foot. A Norwegian sealing vessel, re-christened the *Stella Polaris*, was acquired and the party of eleven Italians, with a Norwegian crew of nine, sailed in July 1899 from Archangel, where the sleigh-dogs had been shipped. Franz Josef Land was reached in three weeks' time and the ship proceeded through the archipelago to cast anchor off Prince Rudolph Island (lat. 82° 4′ N.), the most northerly island of the group. The ship narrowly escaped destruction in the ice, but was ultimately brought into a position of safety, and winter quarters were constructed on the island. During one of the trial sledge trips, the Duke was attacked by frost-bite, followed by gangrene, which necessitated the amputation of two fingers. It was not until about four months later that the weather allowed of the dispatch of the sleigh party. This was divided into three groups, to return at intervals. The first group of three, under Lieut. Querini, never came back, but Capt. Cagni's group, who were absent from the camp for 104 days, reached lat. 86° 34′ N., thus surpassing Nansen's record. In spite of the many difficulties encountered, the expedition was away only fourteen months, at that time the shortest period for a polar expedition.

Other expeditions organised by the Duke were those to Ruwenzori, in Central Africa, in 1906, when twelve peaks, all exceeding 4,600 metres, were ascended, measured and mapped; to the Karakoram Himalayas in 1909, when Bride Peak was climbed to a height of 7,500 metres (the highest altitude reached up to that time), the attempt to cover the remaining 150 metres having to be abandoned; and to the sources of the Webi Shebeli River, which flows through Ethiopia and Somaliland. On all these expeditions much valuable information of interest, not merely to geographers, but also to the whole scientific world, was collected and published. Their uniform success was due to the minute care taken in the preliminary preparations and, particularly, to the enthusiasm which the Duke showed and imparted to every one of his companions in every exploit he undertook.

The Italian Mission to the Abyssinian court in 1927 was led by the Duke, who later paid a second visit to the Webi Shebeli River and surveyed large areas in Abyssinia. Somaliland, where he had a large farm, claimed a good deal of his attention, and it was to his work on irrigation and on improvements in other directions that the opening up of this country was largely due.

Born in Madrid on January 29, 1873, shortly before the abdication from the Spanish throne of his father, Duke Amedeo of Aosta, brother to King Humbert of Italy, he passed away, after a life of ceaseless activity, in Somaliland, to the colonisation of which so much of his energy was devoted.

Dr. Julius Schmidt

We regret to learn from the *Chemiker-Zeitung* of the death of Dr. Julius Schmidt, extra-ordinary professor of organic chemistry at the Technische Hochschule in Stuttgart and director of the Chemistry Laboratory at the Höhere Maschinenbauschule in Esslingen, aged sixty-one years. A native of Baiersdorf in Bavaria, Schmidt studied under Knorr at the University of Jena and graduated in 1894. In 1900 he was appointed lecturer in organic chemistry at Stuttgart, where he carried out numerous investigations in the field of organic chemistry. His researches dealt particularly with nitroso-compounds, oximes and quinones, and with derivatives of phenanthrene and fluorene. He was also the author of numerous books and pamphlets on alkaloids, quinones, nitroso-compounds, organic magnesium compounds and pyrazoles. He also published a handbook of organic chemistry, which has been translated into English, and a yearbook of organic chemistry.

We regret to announce the following deaths :—

Prof. Victor Goldschmidt, honorary professor of mineralogy in the University of Heidelberg, on May 8, aged eighty years.

Dr. William H. Holmes, formerly chief of the Bureau of American Ethnology and director of the National Gallery of Art, Washington, distinguished as a geologist, and a pioneer in field work in the archæology of North and Central America, on April 21, at the age of eighty-six years, at Royal Oak, Michigan, following on a paralytic stroke.

Dr. Leonard Huxley, editor of the *Cornhill Magazine*, author of "Life of Huxley", "Life of Sir Joseph Hooker", "Thomas Henry Huxley, a Character Sketch" and "Charles Darwin", on May 3, aged seventy-two years.

Mr. John Mackereth, a deputy conservator in the Indian Forest Service, on May 5, aged thirty-four years.

Prof. J. T. J. Morrison, emeritus professor of forensic medicine and toxicology in the University of Birmingham, on May 10, aged seventy-six years.

News and Views

Temperature below 0·27° K. reached in Holland

As we go to press, the following communication signed by Prof. W. J. de Haas and E. C. Wiersma of Leyden, and Prof. H. A. Kramers, of Utrecht, and dated May 15, has been received: "Debije has indicated a method of reaching very low temperatures by means of the adiabatic demagnetisation of paramagnetic salts. We have applied this method to CeF_3 with complete success. We determined a susceptibility curve in the region of temperatures usually reached with liquid helium, and by extrapolation from this curve in such a way that the result can only be too high, we found that the temperature reached in the adiabatic experiment was certainly below 0·27° K., even when the saturation was not taken into account. The other method of lowering the temperature, by reducing the vapour pressure of liquid helium, has resulted in a temperature of 0·82° K. reached by Kamerlingh Onnes, and later in one of 0·71, reached by Keesom."

Wool Industries Research Association

THE report of the Council of the Wool Industries Research Association, Torridon, Leeds, for 1932–33 refers to the satisfactory working of the voluntary levy scheme, the yield from which during the year has increased by 10 per cent. Subscriptions from the industry have reached the record figure of £11,087, or £514 in excess of the previous year. Together with a further reduction in expenditure due to certain internal economies and a new arrangement for the printing of publications and abstracts, this increase has enabled the Association to show a surplus for the year in spite of a reduction of £2,500 in the grant from the Department of Scientific and Industrial Research. Owing to economies effected by the Association in its work on raw wool during the last two years, the Empire Marketing Board has been able to extend the period of the grant for this work until September, 1933. The activities of the Wool Fibre Research Committee have been continued and representative samples of New Zealand wools have been selected as standards and submitted to New Zealand.

TRIALS carried out in Great Britain and in all parts of the Dominions of a sheep-marking fluid devised by the Association have proved the ability of the fluid to meet all the requirements of both the farmer and the manufacturer, in that it withstands climatic conditions satisfactorily and yet is completely removed from the wool by ordinary commercial scouring methods. Attempts have been made to render the present jute wool pad innocuous by impregnation, using a cellulose and a rubber latex dope. Both gave very promising results on trial in Australia and further experiments are being conducted on the same lines. Other experiments indicated that no real saving could be made on the weight of the fabric if the strength and durability were to remain unimpaired. Work on the standardisation of the methods of testing the fastness of dyed materials has continued under the supervision of a joint committee of the Association and the Society of Dyers and Colourists, and light standards consisting of seven red and seven blue colours on wool have now been finally selected.

Study Group on Managerial and Administrative Problems

INCREASING attention is now being devoted to the scientific treatment of the problems which arise in the management and administration of industry, and with the object of promoting discussion on these problems, a study group has been inaugurated under the leadership of Mr. W. R. Dunlop. Membership is being drawn mainly from among those who have attended Mr. Dunlop's course of training for management, though others who possess a degree in natural science or its equivalent and have taken a comprehensive course in management will be eligible to join. The latter qualification may be waived in special cases where a scientifically trained man has had managerial or administrative experience. The group is to be in the nature of an informal society and will meet regularly every three months, and in between as may be arranged, at 57 Gordon Square, London, or some other suitable place. The main feature of the meetings will be the scientific discussion of managerial and administrative problems and difficulties, especially in those industries in which science plays a predominant rôle. A monthly bulletin sheet will be distributed privately to members. This will contain items of managerial interest and references to new literature, while, for the benefit of country members, there will be included a summary of the proceedings at each meeting.

International Congress of Anthropological and Ethnological Sciences

IN accordance with a previous announcement, a conference was held at Basel on April 20–22 with the object of organising an international congress of the anthropological and ethnological sciences. Local arrangements were in the hands of Dr. F. Speiser of Basel and those who attended were received by Dr. F. Hauser, director of education, on behalf of the city of Basel and by Prof. Ernst Staehelin, Rector of the University of Basel, on behalf of the University. Twenty-three delegates, representing nine nationalities, were present and promises of support had been received from a large and representative number of anthropologists. Prof. J. L. Myres (Oxford) was elected president of the conference and Dr. Speiser and Mr. Houghton Brodrick (London), secretaries. Although some of the delegates expressed a strong preference for two separate congresses, to cover the anthropological and ethnological sciences respectively, it was decided that: (1) an international congress of anthropological and ethnological sciences be established; (2) the first congress be held, if possible, in 1934, and thereafter at intervals of four years; (3) on the invitation of the Royal Anthropological Institute, supported by the Joint

Committee for Anthropological Research and Teaching, the first congress be held in England, probably in London, in 1934. Draft statutes prepared by the president, the secretaries and Profs. Krause and Mauss, following closely the lines of the statutes of the International Congress for Prehistoric and Protohistoric Sciences, were considered and adopted. After nominations to the *comité d'honneur*, the permanent council and the offices of national secretaries, and votes of thanks to the City, the University and those who had been responsible for the work of the conference, the conference dissolved. A report of the meeting will be found in *Man* for May.

Radio Research in Great Britain

THE facilities for radio research carried out by the Department of Scientific and Industrial Research on the advice of the Radio Research Board have been improved by the unification of the Wireless Division of the National Physical Laboratory and the Department's Radio Research Station at Slough into a new Radio Department of the National Physical Laboratory. Mr. R. A. Watson Watt, hitherto superintendent of the Radio Research Station, is the superintendent of the new department. On the formation of the Radio Research Board in 1920 the National Physical Laboratory was entrusted with all work which required a laboratory equipped with instruments of the highest precision. Such work included the development of radio frequency standards, the study of problems of selectivity, aerial arrays and the generation of extremely short waves, as well as methods for the measurement of fundamental quantities necessary in accurate circuit design. Work requiring measurements in the field or on isolated sites was carried out at the Radio Research Station at Slough. The latter, which now ceases to be a separate research establishment of the Department of Scientific and Industrial Research, has, during its independent existence, earned an international reputation mainly in connexion with the researches carried out there on the travel of wireless waves, the electrical properties of the upper atmosphere, and the nature and origin of atmospherics.

A London Super Power Station

THE Battersea Power Station, which forms such a prominent landmark on the south side of the River Thames, will soon come into operation. It has been erected by the London Power Co., which was formed to secure the co-operation of the London electricity supply companies so as to reduce the cost by concentrating the generation of electricity in more efficient stations. It is one of the 'selected' stations adopted by the Central Electricity Board to supply the south-east of England electricity area. A description of it is given by I. V. Robinson in *World Power* for May. At present the station possesses two 70,000 kilowatt turbo-alternator sets and a 100,000 kw. set has been ordered. There are six Babcock and Wilcox boilers each evaporating 330,000 lb. of steam per hour at a pressure of 650 lb. per square inch and a temperature of 875° F. A jetty has been built parallel to the wharf which accommodates two of the company's 2,000-ton colliers at once. The coal is extracted by grabs and deposited on conveyors which take it to the boiler-house. Owing to the vicinity of the Houses of Parliament, Westminster Abbey, etc., it was necessary to take precautions so that the fumes would not act harmfully on these buildings. By means of induced draught fans the products of combustion are forced through 'scrubbers', passing across vertical surfaces in which water is flowing. They next pass over the main scrubbers consisting of cases of iron filings over which a stream of water flows. The iron acts as a catalyst converting SO_2 into SO_3. On reaching the chimney the gases first pass down a central chamber containing more steel sections and so have more oxide of sulphur abstracted. They then meet water containing alkaline salts which completes the purification. It is computed that 90–95 per cent of the oxide of sulphur has been eliminated.

The Cahn Hill-Improvement Scheme, Wales

LAST summer Sir Julien Cahn came forward with his generous response to the appeal made by the Welsh Plant Breeding Station of the University College of Wales for assistance towards the important work in progress relative to the improvement of hill land. The work had arrived at the stage when it was essential to conduct large-scale experiments involving not only the improvement of the grazing but also the control and management of the animals on somewhat novel lines. It was therefore necessary that the Station should obtain possession of suitable lands for the purpose, and that Prof. R. G. Stapledon should have associated with him a man fully competent in the management and breeding of stock. Mr. Moses Griffith, recently the agricultural organiser for Merionethshire and a well-known breeder of Welsh black cattle, has, therefore, been appointed to assist Prof. Stapledon as lands director to the scheme. A lease has been entered into with the Hafod Estate, for an area of approximately 2,700 acres of hill land. This comprises a mountain sheep walk of more than 2,000 acres together with a hill farm consisting of hill and cultivated land. The area chosen is on an estate with a long pioneering history behind it; for already at the end of the eighteenth century Johnes of Hafod was planting trees amongst these inhospitable hills and devoting himself with enthusiasm to improving the agricultural conditions of the district. Operations have been started and it is hoped that at least 50 acres of hill will be grassed out during the next two months. Each succeeding year large areas will be taken in hand by the methods which have been developed as the result of experiments conducted by Prof. Stapledon in various parts of Wales during recent years. In addition to the land at Hafod, possession has also been taken of about 70 acres of hill land near Knighton, in Radnorshire, and operations will be started there in the autumn.

Spike Disease in Sandal

SANDAL has long been a valuable forestry product in southern India and the mysterious disease termed 'spike' has been the subject of investigation during

the past quarter of a century. Various bodies interested in sandal are collaborating, such as the Madras Forest Department, the Indian Institute of Science at Bangalore, the Forest Research Institute at Dehra Dun and others. A report on the progress made during the half-year ending September 30, 1932, entitled "Investigations on the Spike-Disease of Sandal" has been issued by the Institute of Science, Bangalore. The sporadic attacks of this pest have a strange parallel to those of foot and mouth disease in Great Britain. A recrudescence of the disease in an epidemic form has been noticed in the Beedamaruthupatti spike area. Pollarding, which has been carried out on a fairly large scale in the Galigattam and Manchi areas, has yielded significant data. So far, Manchi has the maximum percentage of disease-masking sandal plants. The entire freedom from infection of a few areas, Sanamavu and Thalli in North Salem and Chickabettakere in Coorg, has been established by pollarding. More detailed technical contributions will appear as scientific papers in the *Journal of the Indian Institute of Science*, *Dehra Dun Forest Research Publications*, and elsewhere. Meanwhile it is a valuable departure to issue progress reports so that the various investigators studying the pest, which causes so heavy a financial loss, should have early news of any results achieved.

Poison Control and its Effect upon Wild Life

IN California the control of the ground squirrel (*Citellus beecheyi*) by poison has given rise to strong protests in journals devoted to ornithology and bird protection, on account of the death by poisoning of numbers of wild creatures which are not injurious. We have already referred to some of these articles, and in fairness, it ought to be stated that the California Department of Agriculture, which is responsible for the organisation of the poisoning measures, accepts neither the "facts" nor the conclusions of the writers. In a summary of "The California Ground Squirrel Control Program", Eugene S. Kellogg states that those in charge of rodent operations were anxious to know what effect thallium, exposed on bait for ground squirrels, might have on other species of wild life, or how it might act as a secondary poison on predatory animals and birds. To check this point, the Biological Survey made a careful census of the wild life, then exposed baits far heavier than necessary for existing ground squirrel population in order to learn wild life tolerances. Careful checking by several observers during thirty days failed to show an appreciable effect on the beneficial animal life of the area. Hawks, quail and mourning doves, the species watched most carefully, appeared to be as numerous at the conclusion of the test as before (California Dept. Agr. Special Pub. No. 109). In this clash of opinion it is impossible for the outsider to discover exactly where the truth lies ; our impression is that there is a certain amount of bias on each side and an absence of the scientific detachment which would carry conviction. A basic fact which cannot be ignored is that ground squirrels are an economic pest which somehow must be controlled.

Smithsonian Field Expeditions in 1932

NONE of the many-sided activities of the Smithsonian Institute appeals so much to the imagination as the explorations and field work. During 1932, twenty-five expeditions were sent out or participated in for research in anthropology, biology, geology and astrophysics. These expeditions visited thirteen States of the United States, Europe, Canada, Alaska, Mexico, Hispanola, Jamaica, British Guiana and South-West Africa. Amongst the more interesting were a trip to various mining localities in Mexico for the collection of certain rare minerals and ores, a bird-collecting expedition to Hispanola, and a continuation of anthropological work in Alaska, where the characteristics of the living natives were studied, and the skeletal and archæological relics of an earlier civilisation were unearthed by excavation. The reduction in the Institute's income, both private and governmental, has occasioned strict economy in all lines and curtailment of some activities. Funds for publication have been cut nearly to one-half of the previous year's amount, with the result that valuable manuscripts have had to be refused or held up for a year, and the annual report, from which we have quoted above, has itself been cut to half its normal size. If the economies which must be enforced in other countries as well as in the United States, lead to the condensation of the published records of scientific work in some cases, and in other cases to more rigorous selection for publication, the experience will not be altogether wasted.

Agricultural History in Germany

THE Agricultural History Society of America, referred to in NATURE of March 19, 1932, p. 432, has a German counterpart in the Gesellschaft für Geschichte und Literatur der Landwirtschaft. Membership of this society is open to all persons interested, the subscription for persons resident outside Germany being 4 RM. per annum. The society's inquiries are not confined to central Europe. Investigation of the history of prominent agriculturists and of farms that have been in long-continued ownership by one family are noteworthy aspects of its activity. It publishes a small quarterly (free to members) containing articles, reviews and a list of current books and papers. Recent issues have included articles on the measures devoted to the development of Chinese agriculture under the Mongols, the Swiss Peasant Association, and the use of marl in ancient and medieval times. Information regarding the society can be obtained from Prof. W. Seedorf, Gosslerstrasse 16, Göttingen, Germany.

New Record for Deep Drilling

THE issue of the *Oil Weekly* of May 1 gives details of the establishment of a new depth record of 10,668 ft. for oil-well drilling, which has been achieved on the Kettleman Hills Field, California. This depth exceeds the previous record by 83 ft. The well has been drilled with standard rotary equipment and, so far, a 5⅝ in. hole is being made. It is destined to

go to 11,000 ft. or even deeper if an oil-producing zone is not discovered at a shallower depth. One of the geological factors influencing the depth of this well is the great thickness of the recent deposits overlying very hard shale (Kreyenhagen). Operators believe in the possibility of very deep production at Kettleman Hills, and this is the first really serious attempt which has been made to test the lower formations in this region.

Asparagus Growing

THE imposition of a tariff on certain imported fruits and vegetables has made it possible for English growers to produce certain crops which before were unprofitable. One of these is asparagus, and it is therefore particularly opportune that the Ministry of Agriculture has issued a Bulletin (No. 60, "Asparagus", 1*s*. net) which deals with its cultivation and marketing. A useful preliminary account traces the history of asparagus from Roman times and also outlines the botany of the plant. Varieties are described in fair detail and experiments on the use of unisexual plants are outlined. Male plants tend to give a large number of buds whilst female plants produce fewer but larger sticks. Methods of cultivation in Italy, France, Germany, the United States and England are given, and marketing is also discussed. The main pest of asparagus, the asparagus beetle, is described, as are also several fungus diseases. The canning industry is growing in England, and its needs have been borne in mind by the writer of the bulletin.

Legal Medicine in the United States

THE resources of the various States of the Union for dealing with medico-legal problems in the administration of justice have been examined by a committee of the National Research Council, and the results of this survey are contained in a volume recently issued (Bull. Nat. Res. Council, No. 87, National Academy of Sciences, Washington, D.C., 1.50 dollars). It is pointed out that the determination of the cause of death, when a medico-legal question is involved, is the work of the skilled pathologist, who should be in a position to call to his aid the resources of bacteriologist, toxicologist, chemist, and others. Determination of mental responsibility is the work of the skilled psychiatrist. The detection of crime may at times require the application of pure and applied sciences in addition to the medical sciences. In the United States, there is as yet nothing comparable to the first-class medico-legal institutes of Europe.

Relativity

THE addresses and discussions at the conference on relativity in May 1930, which Prof. P. Langevin organised and presided over, have been published by Messrs. Hermann of Paris in the form of pamphlets of 14–30 pages at 6 or 7 francs in their series of Actualités Scientifiques et Industrielles. The principal titles are:—"Cinématique de la Relativité" by M. E. Bauer of the Collège de France, "L'Inertie de L'Énergie" by M. F. Perrin of the Faculté, "Méchanique Ondulatoire" by Prof. L. de Broglie of the Sorbonne, "La Théorie Einsteinienne de la Gravitation" by Prof. G. Darmois of the University of Nancy, "La Théorie Unitaire du Champ" by Prof. E. Cartan of the Sorbonne and "La Relativité" by Prof. P. Langevin. In all cases the subject is presented in a very readable form and Prof. Langevin's address summing up the general results is especially interesting. He also contributes a simple proof of the Lorentz transformation to the discussion on the kinematics of the subject.

Announcements

THE Bakerian lecture of the Royal Society will be delivered on Thursday, May 25, at 4.30 p.m. by Dr. J. Chadwick, who will take as his subject "The Neutron".

ON account of alterations and repairs which are being made to Flamsteed House, the official residence of the Astronomer Royal, it will not be possible this year to hold the customary garden party at the Royal Observatory on the occasion of the annual visitation by the Board of Visitors on Saturday, June 3.

THE annual congress of the South-Eastern Union of Scientific Societies will be held at Norwich on June 7–10. The president-elect is Prof. E. J. Salisbury, Quain professor of botany in University College, London. The presidential address is entitled "The Influence of Man on Vegetation". The congress will be divided as usual into the following sections: geology, botany, archæology, zoology, and regional survey. Several interesting excursions have been arranged in connexion with the congress. The local secretary is Dr. H. A. Castigan, principal of the Technical College, St. George Street, Norwich.

THE fourth International Congress of Radiology will be held in Zurich, under the presidency of Prof. H. R. Schinz, professor of radiology in the University of Zurich, on July 24–31, 1934. Members of radiological societies in all countries, and other persons introduced by such societies, are eligible for membership. At the general meetings the following subjects will be considered, among others: radiation genetics; mitogenetic radiation; structure analysis; identical physical measurement of the dose in X-ray and radium treatment; hard gamma-rays, cosmic radiation, earth radiation; and short-wave therapy. During the Congress, an exhibition of apparatus, photographic accessories, chemical products and scientific books will be on view. The general secretary of the Congress is Dr. H. E. Walther, Gloriastrasse 14, Zurich.

THE third International Congress of Linguistics will be held at Rome on September 19–26. The Congress will meet in three sections, of which the first will deal with general questions, the second with the Indo-European languages, and the third with the

non-Indo-European languages. An organising committee has been formed, which is responsible for the arrangements for the meeting, of which the chairman is Prof. Matteo Bartoli and the secretary Prof. Bruno Migliorini. Subscriptions (members, 50 lire; associates accompanying members, 25 lire) should be addressed to the treasurer of the Congress, Prof. Vittore Pisani, Commizzione Nazionale italiana per la co-operazione intelletuale, via del Conservatorio, Rome (115). It is announced that the proceedings of the second Congress, held at Geneva in 1931, are in the press and will be issued shortly.

DR. WITMER STONE, vice-president of the Academy of Natural Sciences of Philadelphia and curator of its Department of Vertebrate Zoology, has been elected an honorary member of the British Ornithologists' Union. Dr. Stone has been president of the American Ornithologists' Union and for twenty-one years he has edited the *Auk*, the official organ of the Union. Last year he was awarded the Otto Hermann medal of the Hungarian Ornithological Society (NATURE, 128, 670, Oct. 17, 1931). He has written a number of books on birds and other animals, and, with Cape May as a base for observations, has for many years carried on an intensive study of bird migration. Last year he completed, as editor, a revision of the "Check List of North American Birds", a monumental work in which is listed a description of every bird known to North America.

THE council of the Institution of Electrical Engineers has made the following awards for papers read during the session 1932–33, or accepted for publication: Institution premium to Mr. J. M. Kennedy and Miss D. M. Noakes; Ayrton premium to Mr. A. B. Read and Dr. J. W. T. Walsh; Fahie premium to Messrs. J. H. E. Baker and E. P. G. Wright; Kelvin premium to Mr. P. Dunsheath; Paris premium to Mr. W. S. Burge; Webber premium to Messrs. C. E. Horton and C. Crampton; Overseas premium to Mr. G. Yoganandam; Extra premiums to Messrs. J. C. Besly and H. V. Higgitt, Mr. Andrew R. Cooper, Mr. E. A. Hanney, Messrs. P. Hunter-Brown and C. J. Hews, Lieut.-Col. A. G. Lee, Lieut.-Col. F. A. Cortez Leigh, and Mr. R. P. Smith. The Wireless Section premiums have been awarded as follows: Duddell premium to Mr. E. C. S. Megaw; Extra premiums to Mr. L. B. Turner, Messrs. W. Ure, E. J. Grainger, and H. R. Cantelo. The following Meter and Instrument Section premiums have also been awarded: Silvanus Thompson premium to Mr. J. McG. Bruckshaw; extra premiums to Messrs. F. P. Burch and R. V. Whelpton, Messrs. C. Midworth and G. F. Tagg.

IN the leading article entitled "The Utilisation of Coal" discussing a symposium on this subject arranged by the British Science Guild, in NATURE of May 6, p. 633, disappointment was expressed that the authors of some of the contributions neglected to provide "the audience with complete comparative data from which the experts and laymen present could have drawn their own conclusions". Capt. Bernard Acworth informs us that the paper he was asked to read by the British Science Guild had as its title "The Economic Significance of Coal with Special Reference to Legislative Differentiation unfavourable to the Natural Expansion of the Coal and Coal Gas Industries". He deals fully, and accurately, with every aspect of the fuel economics of transport and power on land, sea, and in the air, in his recent book "Back to the Coal Standard".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for abstracting work (chiefly engineering) at the Building Research Station, Garston (Department of Scientific and Industrial Research)—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 22). An assistant lecturer in engineering at the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (May 23). Two full-time teachers of engineering subjects at the Doncaster Technical College—The Secretary, Education Offices, Doncaster (May 23). A teacher in electrical engineering at the Technical Institute and Junior Technical School, Old Trafford, Manchester—The Principal (May 27). A head of the Department of Mechanical and Civil Engineering and a lecturer in geography at the Portsmouth Municipal College—The Registrar (May 27). A professor of mathematics at University College, Dundee (University of St. Andrews)—The Secretary and Registrar (May 31). A lecturer in biology at the Leicester College of Technology—The Registrar (May 31). An engineering assistant in the Engineering Department of the River Medway Catchment Board—The Engineer to the Board, 71A, Bank Street, Maidstone, Kent (May 31). An assistant lecturer in botany at the University of Birmingham—The Secretary, The University, Edmund Street, Birmingham (June 1). Visiting teachers in various branches of engineering, gas technology, mechanics and metallurgy at the School of Engineering and Navigation, High Street, Poplar, E.14—The Education Officer (T.1), County Hall, London, S.E.1 (June 7). A professor of dental surgery and director of the Dental Hospital at the University of Manchester—The Registrar (June 12). A reader (senior assistant) in pathology and a reader (senior assistant) in bacteriology in the Institute of Animal Pathology at the Royal Veterinary College—The Secretary, Royal Veterinary College, London, N.W.1 (June 30). A University lecturer in economics and politics at the University of Cambridge—Mr. E. A. G. Robinson, Sidney Sussex College, Cambridge. A woman lecturer in biology at the Lincoln Training College—The Principal. An organising secretary for the Association of Special Libraries and Information Bureaux—The Chairman of Council, ASLIB., 16 Russell Square, W.C.1. A technical assistant (Grade 3) for technical photography at the Royal Aircraft Establishment, Farnborough, Hants—The Chief Superintendent.

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.*]

Beryllium and Helium

MANY years ago it was found that the mineral beryl often contains much more helium than can be accounted for by the traces of uranium and thorium which are present[1]. Recently returning to the subject, I have examined some thirty-five or forty beryls from different parts of the world and from different geological horizons. The richest of these contains 29·2 cubic mm. of helium per gram of beryl. The helium atoms number $2{\cdot}41 \times 10^{-4}$ of the beryllium atoms present.

If helium has accumulated in beryl as the result of atomic disintegration of beryllium, we should expect large helium content to be found only in the beryls of ancient formations. If on the other hand it has been trapped in some way when the mineral was formed, or if it is due to a short-lived radioactive product initially present in the mineral, we should expect to find large helium content in the younger beryls, since the opportunities for its escape have been less. The experimental results decidedly support the former alternative. Beryls from the younger rocks have not in any case been found to contain much helium. Beryls from the oldest formations usually contain a relatively large amount.

The probability that the main component of beryllium Be^9 is undergoing spontaneous disintegration is much increased by the recent measurements of Bainbridge with the mass-spectrograph[2]. He finds a value for the mass of Be^9 $9{\cdot}0155 \pm 0{\cdot}0006$, whereas the added masses of a hydrogen atom and two helium atoms amount to 9·01210. There is thus a considerable excess of energy available for spontaneous disintegration.

It was of interest to examine whether any α-ray activity was present adequate to account for the accumulated helium. The first experiments were made on the mineral itself, using the helium-rich specimen above mentioned. The walls of an electroscope casing were coated with it. The range of the α-particles was assumed to be 1 cm. in air, and the possible activity of the beryl was estimated from the ionisation at not more than $1{\cdot}47 \times 10^7$ α-particles per gram of mineral per annum. At this rate the helium observed would take more than $5{\cdot}43 \times 10^{10}$ years to accumulate.

Further experiments were made on a sheet of beryllium-aluminium foil (70 per cent Be) measuring $7{\cdot}2 \times 9{\cdot}5$ cm. which was kindly lent me by Mr. N. Feather, of the Cavendish Laboratory. The number of α-particles from this was estimated from the ionisation current at not more than $1{\cdot}55 \times 10^8$ per gram of beryllium per annum. At this rate the mineral would require more than $1{\cdot}05 \times 10^{11}$ years to grow the contained helium.

Either of these periods is much more than can be allowed; for the lead ratios of radioactive minerals never indicate an age of more than 2×10^9 years. Thus the helium in beryl cannot be brought into relation with any existing emission of α-particles. This conclusion, so far as it rests on experiments made with the mineral itself, does not depend on whether beryllium or some other constituent is thought to be the parent element.

It has recently been stated by Lange and Raitt[3] that beryllium has an α-ray activity of 1 cm. range and a 'half life' (half value period ?) of 10^{14} years. These authors consider that this is in striking accord with the presence of helium in beryls. But the ratio of helium atoms to beryllium atoms in the beryl above mentioned is $2{\cdot}41 \times 10^{-4}$, and this is the fraction of beryllium atoms transformed. If the half value period of beryllium were 10^{14} years, the time required would be $3{\cdot}5 \times 10^{10}$ years; about seventeen times as long as can be allowed.

While it appears certain that the small α-ray activity of beryllium found by Lange and Raitt will not account for the helium in beryl, the activity itself, if real, is of considerable independent interest. My own measurements with beryllium-aluminium foil led me to place the limit of possible activity three times lower, and I did not consider them as affording positive evidence of any activity. The calculation of emission from a thick layer is, however, not very satisfactory, and this may vitiate somewhat the comparison between the two sets of experiments. My own tests could have been pushed considerably further if enough of the foil had been available to line the electroscope casing completely. It is hoped to do this later.

RAYLEIGH.

Terling Place, Chelmsford.
May 8.

[1] *Proc. Roy. Soc.*, A, **80**, 589; 1908.
[2] *Phys. Rev.*, **43**, 367; 1933.
[3] *Phys. Rev.*, **43**, 585; 1933.

A Theory of Fuel-Knock

IN an essay written three years ago[1] it was suggested that fuel-knock in an automobile engine might be associated with the presence of free hydrogen formed from the fuel used, and at that time the following facts were advanced in support.

(*a*) That in the combination of hydrogen and oxygen, variation of partial pressures, temperature and initial pressure produces rates of reaction of completely different orders of magnitude[2,3,4].

(*b*) That hydrogen in an engine cylinder gives rise to violent fuel-knock[6], while a fuel which does not contain hydrogen, for example, carbon monoxide, is not known to knock[5].

(*c*) That fuels comprising stable molecules, both liquid (for example, benzene[7]) and gaseous (for example, methane[6]) are not known to knock, whereas those comprising unstable molecules (for example, kerosene) knock readily.

The liberation of hydrogen from hydrocarbons and/or their primary oxidation products has been reported even during slow combustion[8,9,10,11], and conditions in an engine cylinder (where the advancing flame compresses unburned fuel ahead) are suitable for the breaking up of fuel molecules with a consequent liberation of hydrogen. If it be assumed that fuel-knock be caused by the rate of reaction between this free hydrogen and the available oxygen reaching a high order of magnitude (due to a favourable combination of partial pressures and/or temperature), certain effects should be noticed. In a knocking engine it should be possible to eliminate the knock by the

addition of small quantities of hydrogen (thereby taking the partial pressure of the hydrogen out of the critical range); it should be impossible to detect an intermediate stage in the formation of water vapour from the hydrogen (for example, OH molecules); and the temperature of the water vapour molecules formed in the knocking combustion should be considerably higher than in normal combustion. Evidence of these three effects has been forthcoming.

(1) In unpublished work performed at the Bureau of Standards early in 1921 it was found that the use of hydrogen in comparatively small amounts eliminated fuel-knock and the high pressures resulting therefrom.

(2) In a direct spectrographic comparison of the flames from knocking and normal combustion in an engine cylinder, OH bands in the ultra-violet disappeared from the knocking zone only when fuel-knock was present; in normal combustion they were detected throughout the cylinder[12].

(3) In work now proceeding at the Bureau of Standards on infra-red radiation from an engine cylinder (preliminary accounts of which have already appeared[13,14]) there are indications that the spectral distribution of the radiation during knocking and normal operation is essentially the same from the region where no knock occurs, while radiation from water vapour molecules on wave-lengths between 5μ and 10μ shows an increase when knocking conditions are compared with non-knocking in the region where knock occurs. The only change from knocking to non-knocking operation was the necessary variation in the proportion of benzole mixed with a fuel of low anti-knock value to eliminate the knock.

More complete data, and a discussion of this theory in its relation to existing theories of fuel-knock and knock-suppression will appear later, though it may be mentioned here that the combustion of hydrogen has been found to be remarkably inhibited by the presence of small amounts of anti-knock materials[15].

My thanks are due to Prof. S. Lees, from whom I obtained the original idea that hydrogen might be responsible for fuel-knock, and the acting director of the U.S. Bureau of Standards, for permission to publish this note.

SYDNEY STEELE.

Bureau of Standards,
Washington, D.C.
April 14.

[1] Steele, John Winbolt Essay, University of Cambridge, 1930.
[2] Hinshelwood and Thompson, *Proc. Roy. Soc.*, A, **118**, 170; 1928.
[3] Gibson and Hinshelwood, *ibid.*, A, **119**, 591; 1928.
[4] Thompson and Hinshelwood, *ibid.*, A, **122**, 610; 1929.
[5] Burstall, *Proc. Inst. Auto. Eng.*, **21**, 628; 1926–1927.
[6] Burstall, *ibid.*, **22**, 358; 1927–1928.
[7] Sparrow, *Nat. Adv. Com. Aero., Tech. Rep.* No. 205, p. 19, 1925.
[8] Bone and Cain, *Trans. Chem. Soc.*, **71**, 26; 1897.
[9] Bone and Stockings, *ibid.*, **85**, 693; 1904.
[10] Bone and Wheeler, *ibid.*, **85**, 1637; 1904.
[11] Bone and Andrews, *ibid.*, **87**, 1232; 1905.
[12] Rassweiler and Withrow, *Ind. and Eng. Chem.*, **24**, 535; 1932.
[13] Steele, NATURE, **128**, 185, Aug. 1, 1931.
[14] Steele, *Ind. and Eng. Chem.*, **25** (Indus.), 388; 1933.
[15] Nagai, *Trans. Farad. Soc.*, **26**, 216; 1930.

Hydrocarbon Combustion in an Engine

AN outline of a theory of the behaviour of 'anti-knocks', and of the character of the knocking type of explosion, was put forward in a lecture at the Royal Institution in 1928 (see supplement to NATURE of July 7, 1928). The ideas discussed were obtained by inference from a variety of experiments, rather than by direct demonstration. It was not demonstrated with any certitude, for example, that peroxides were formed during a knocking type of explosion in an engine cylinder; neither was it proved that the metallic 'antiknocks' were in an oxidised state before being effective as 'antiknocks' in the engine.

These and other points in agreement with the ideas then put forward have now been demonstrated, and, as then suggested, are of importance in connexion with the process of combustion of certain hydrocarbon vapours. By sampling the gases at various moments during the cycle of an internal combustion engine, by means of a special device which can be operated over a very small crank angle, the amounts of aldehydes and peroxides, etc., have been determined. Substances behaving as peroxides rise to a maximum, and then fall off in quantity prior to the passage of flame past the valve, whereas the aldehydes are at a maximum 1/240 second later, when the flame reaches the valve. The amount of 'peroxide' appears to be connected with the phenomenon of knocking. Benzene gave rise to no measurable peroxides, though aldehydes were present in considerable quantity.

It has also been demonstrated that thallium, which acts as an even more powerful 'antiknock' than lead, when let into the engine cylinder as vapour by a special valve, is only effective when previously oxidised.

It is intended to publish an account of these experiments on the completion of the investigation.

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May 10.

A New Type of Photoelectric Effect in Cuprous Oxide in a Magnetic Field

WHEN a plate immersed in liquid air and placed in a magnetic field parallel to its plane is illuminated by a beam of white light perpendicular to its plane, an electromotive force E is produced between A and B (Fig. 1). This electromotive force changes its sign when the magnetic field is reversed, its absolute value remaining unaltered. We investigated the dependence of E upon the intensity of the magnetic

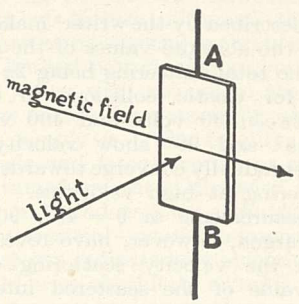

FIG. 1.

field H and found that up to fields of about 2,500 gauss, E is a linear function of H, the maximum electromotive force at this field strength reaching 2·7 volts. It may be noticed also that when the plate is illuminated from the opposite side, with the direction of the current in the electromagnet remaining unchanged, the electromotive force is reversed in sign. The existence of this electromotive force must evidently be looked upon as an indication of

the fact that electric current is flowing perpendicularly to the plane of the plate. An examination of the sign of the electromotive force observed proves that the direction of the supposed flow of the negative electrons coincides with the direction of the light beam, assuming that under the influence of the magnetic field the electronic current is deflected in the normal way.

A characteristic feature of the effect may be noted, namely, that it disappears completely when a source of red light is used. The electromotive force is nearly independent of the intensity of light. We could not find the effect at room temperatures. The whole of the facts observed involve the assumption that the effect represents a peculiar Hall-effect of the moving photoelectrons produced at the entrance of the beam of light into the specimen. The proportionality between the electromotive force and the field strength gives strong evidence in favour of this supposition. This idea is supported, moreover, by the fact that the electromotive force is nearly independent of the light intensity. For example, the increase of the intensity of light augments the number of photoelectrons, which makes the Hall constant decrease (the Hall constant R is inversely proportional to the concentration of the conducting electrons). The observed electromotive force is a product of both effects. We are investigating the new effect further and we hope to publish shortly a complete account of this work.

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March 31.

Elastic Electron Scattering in Gases

THE investigations by Arnot[1] and others of the scattering of electrons in gases show that marked diffraction minima occur in the angular scattering curves. Their measurements show also indications of an anomalous course of the velocity scattering curves. Still, as only the relative values of the scattering are determined, a comparison of the scattering through a constant angle for different electron velocities is subjected to incontrollable errors.

A method described by the writer[2] makes it possible to determine the absolute values of the scattered intensity I_θ—the total scattering being $2\pi \int I_\theta . \sin\theta . d\theta$. The results for elastic collisions in helium[3] for velocities between 30 volts and 400 volts and at angles $\theta = 45°$ and $90°$ show velocity scattering curves, which gradually converge towards the classical nuclear scattering at high velocities.

Recent measurements at $\theta = 45°$, $90°$ and $135°$ in neon and argon, however, have revealed marked anomalies in the velocity scattering curves. In Fig. 1 the value of the scattered intensity I_θ is plotted against the velocity (expressed in volts) of the electrons in a doubly logarithmic diagram, and the scattering through 90° observed in helium, neon and argon is shown as heavy lines. In this representation, the classical nuclear scattering curve $I_\theta = e^4Z^2/m^2v^4\sin^4\theta/2$ appears as a straight line. In Fig. 1 the dotted lines give the classical scattering for different values of the nuclear charge (Ze). It will be seen that at high velocities the scattering in all the gases, helium, neon and argon, converges towards the scattering of their nuclei, corresponding to $Z = 2$, 10 and 18 respectively. In neon, however, the scattering passes through a marked minimum at 90 volts, while in argon a discontinuity in the curve is found at about 250 volts.

While for high velocities the scattering in argon may be described as a scattering due to the total nuclear charge 18, the scattering at smaller velocities converges towards an effective nuclear charge of about 6. In scattering experiments with $\theta = 135°$, where the discontinuity in the argon curve is more marked, the scattering at smaller velocities follows the nuclear scattering curve for $Z = 5$, before converging towards $Z = 18$ at higher velocities. In the argon atom the outermost group of electrons consists of 8 electrons, and colliding electrons penetrating into this group will therefore be under the influence

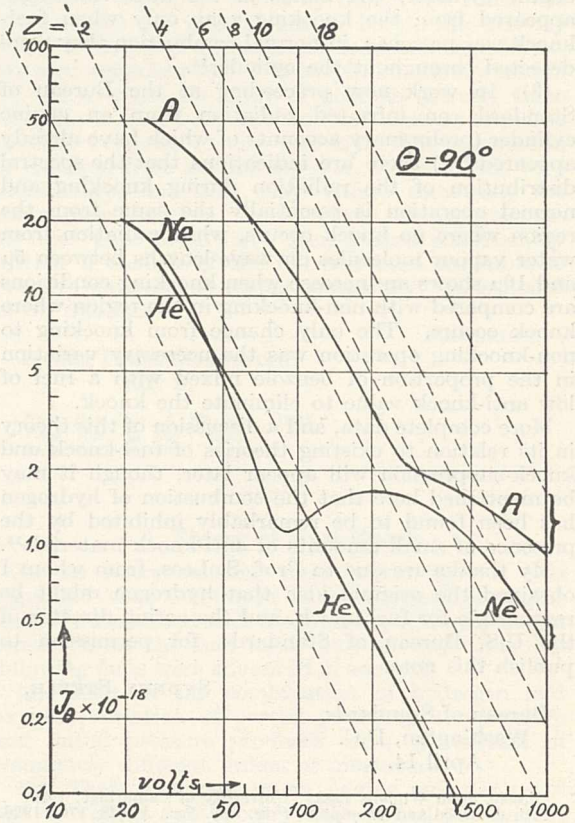

FIG. 1.

of an effective nuclear charge smaller than 8. If the velocity of the electrons is large, the electrons may penetrate through the outer group and the total nuclear charge 18 will determine the scattering. It seems as if this rough picture is to some degree justified by the measurements.

In neon the sharp minimum for velocities of about 90 volts allows of no such explanation and is probably due to some resonance effect of the same kind as that observed in the Ramsauer effect. The velocity (and potential) at which the minima or discontinuities are found changes with the scattering angle θ; as a rule they shift towards smaller values of the velocity when the angle θ increases. This may be connected with the fact that, according to the classical theory, the large angle scattering is due to electrons penetrating more deeply into the atom, and accordingly the total nuclear charge will govern the large angle

scattering down to smaller velocities than the small angle scattering. At small angles, therefore, the scattering due to the total nuclear charge is first found at comparatively larger velocities. A closer explanation, however, of the anomalies observed will, of course, require a detailed quantum mechanical treatment.

SVEN WERNER.
Universitetets Institut for Teoretisk Fysik,
Køpenhagn.
April 11.

[1] *Proc. Roy. Soc.*, A, **133**, 615; 1931.
[2] *Proc. Roy. Soc.*, A, **134**, 202; 1931.
[3] *Proc. Roy. Soc.*, A, **139**, 113; 1933.

Ideas of 'Time' and 'Events'

1. Is 'time' conclusively or adequately defined by the statement that the 'time' of an 'event' in systems in motion varies according to the position of the 'observer' of the 'event'? This implies (1) that 'time' is a characteristic or property of, and is inherent in, an 'event'; and (2) that both 'time' and 'event' are functions, so to say, of an 'observer'. Therefore, if no 'observer' function, an 'event' cannot occur and the property 'time' is eliminated. If, however, an 'event' be more scientifically defined as an electromagnetic relationship between two bodies or points in space, it will occur whether observed or not (for not all bodies are observers) and 'time' is again eliminated. The question may therefore be asked: Is 'time' a characteristic of Nature or merely an idea of the observer? (See 4 and 5 below.)

2. The statement above is also incomplete in that it does not indicate how the 'time' of an *observed* 'event' is related to other events in the experience of the same observer (whether or not he be in the same position relatively to the whole system), nor how it is related to those events he has not observed but which he knows have taken place. If 'time' consist of cross-calculations of *moving* 'events' as amongst a *number of observers*, how can I or my children determine which of us arrived 'first' in this world of change? A human being has memories of past, and expectations of future, experiences; but his consciousness of the three 'tenses of time' does not depend on that of other observers in space. The sense of the 'lapse of time', of 'before and after', is peculiarly human and individual. My sense of change and the passing of time is independent of the fact that day dawns earlier for observers to the east. I should remember the past and anticipate the future were there no inhabitants beyond my own neighbourhood.

3. Further: although we record 'periods of time' according to solar and lunar phenomena, we have no standard 'constant' by which to measure human conceptions of duration, of 'lapses of time'. These vary not only with individuals but also with the individual's mental state; and a man may even become oblivious of 'time' in reverie or day-dreaming and in states of intense mental concentration, of meditation on principles, *not* passing events, just as does an artist intent on some creative work. The idle day-dreamer and the active genius lose their consciousness of personal relationship with objective physical events and come back to awareness of 'time' with a start. The genius, however, usually has something to reveal to time-bound mortals from those regions of the mind that are 'beyond time' although he may have difficulty in expounding it for our comprehension. It is commonly known, too, that 'time is long' for those in pain or remorse but that there is no consciousness of the 'lapse of time' in states of deepest joy and happiness. Hell is the perpetuation of 'time', heaven its obliteration! 'Time' is thus something created entirely by ourselves; it is not a predicate conception, not something *a priori*. It is an individual affair, present or absent according to the molecular conditions of the frequency-levels in which the mind functions.

4. Is 'time', then, indeterminate, independent of moving events, an illusion of man? If a genius can annul 'time' in respect to the 'object' of *his* inner sense he must be able to distinguish between the *real being* of physically sensible objects and *our knowledge* of such objects as ordinarily assumed, stated or formulated by science. It is now admitted that *this knowledge, while dependent on, is limited by, the instrumental means of observation.* (For example, *vide* NATURE, March 25, pp. 422-3.) That is, we form an idea of the nature of an 'object' from the characteristics of the perceptible phenomena evoked by its invisible interactions with the measuring instruments; and this conception cannot, of course, represent, or be actually 'like', the *object itself*. This is true, also, even of those 'objects' which are reflected directly by our senses. But we have no warrant to conclude that there is no 'object' apart from our idea, that no 'object' exists independently of our observation by whatever means; for *neither we nor our instruments could have caused the sensible experience or the observed phenomena without a something with which to interact.* To deny the reality of the object's being is tantamount to denying that of the observer's! Nevertheless, it is claimed that 'time' is a *sine qua non* of any existence whatever, and there can be no 'matter' other than the physical mechanical motion of 'waves' or 'particles' because 'time' is relative and simultaneity impossible; and, consequently, that, beyond the perceptible physical, *nothing* exists that could function as, or constitute, an unthinkable absolute 'event' or 'standard time'. Thus 'events' close round human genius and shut it in a time-world of illusion, bound and blinded by the means of observation he has himself created. A spider caught in his own web!

5. Science has no evidence, however, that 'time' is a property of Nature, although the cosmos is doubtless in one sense a gigantic chronometer. What we with our limited powers of observation term the *past* and the *future* with respect to the universe or any particular cosmos, is potentially objective *now*. The universe *simply is*. The totality of its parts, frequency-levels and latent worlds or solar systems are a self-contained present. Otherwise, the recurring precipitation and condensation of *fundamental* types —stellar and terrestrial—would be impossible, unless, indeed, science can indicate how objectivity or manifestation could arise absolutely *ex nihil*. Discussions on simultaneity are irrelevant chimeras, for if the properties of bodies were absolutely identical they would be in the same 'place', as surely needs scarcely be said; that is, there would be no differences of 'potential' and no differentiated objective world. In that condition of space there can be no 'position', no location, no extension and no 'relativity'; but, as our ordinary human consciousness depends on concrete objective contrasts and has no experience of possible abstract subjective distinctions, we are unable to imagine or to describe in terms of present-

day scientific conceptions a state of self-subsistent spatial activity consisting throughout of uniform, synchronous pulsations or vibrations. Our only alternative is to try to explain scientifically, *without this 'hypothesis' ;* (1) how the universe coheres as one whole ; (2) how the cohesion of individual bodies is maintained ; (3) how different 'potentials' originate ; and (4) 'where' or in what kind of rare state of electrical accumulation that which manifests periodically is held in latency—including the *genius* of man.

W. W. L.

Light-Producing Powers of Sponges

In his letter published in NATURE of February 18, p. 242, Dr. Crossland directs attention to the interesting fact that the most remarkable polychæte worm, *Syllis ramosa*, first discovered by the *Challenger* expedition at a depth of 140 fathoms, was found by him at a depth of only 1 fathom. Dr. Crossland describes how he obtained the worm from a siliceous sponge, stating that his method is the only way by which the bulk of the smaller fauna inhabiting coral reefs and sponges can be obtained. I have used another method with very satisfactory results.

Examining the list of light-producing animals, in which sponges are frequently mentioned, I observed at Villefranche sur Mer the surprising fact that different sponges living in the shallow waters were giving a very beautiful light. By accident I found

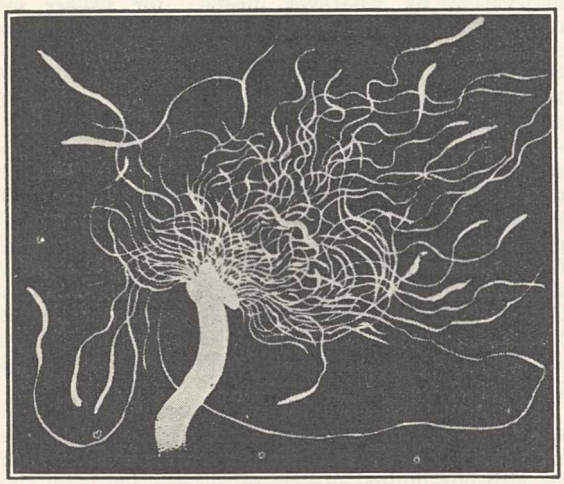

FIG. 1. *Polycirrus aurantiacus.*

one night a phosphorescent sponge of very fragile character ; breaking it and separating the two pieces very slowly from each other, I could see a number of very delicate shining threads stretching between the two pieces. I took some of these threads and brought them at once on a slide under the microscope. At the first glance I was able to identify the threads as branches belonging to a small phosphorescent annelid. Considering it probable that the animal, if short of water, would try to get again into its accustomed element, I poured the water out of the bowl, in which the 'light-producing' sponge was lying, and then attached the sponge to the edge of the inclined bowl in such a manner as to allow the water to drip slowly out of the sponge into the bowl. The next night I was amazed to see the abundance of small fauna assembled in the water, which had come out of the sponge, among it two little phosphorescent *Polycirrus aurantiacus* (Fig. 1), scarcely 5 mm. across, which were able to extend their branches to 40 mm. in all directions.

I used the same method to get small animals out of different hiding places such as pieces of porous rock, etc., and could also fix particularly delicate animals, which often suffer under a narcotic, without damaging them.

The question whether the sponges are to be included among the light-producing animals has thus been decided.

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The Dodo and the Aphanapteryx

THE paragraph in NATURE of April 29, p. 615, on the Edwards dodo painting reminds one that this famous picture has a double interest. If one examines it as it hangs in the Bird Gallery of the Natural History Museum, one notes that behind the dodo is figured a long-billed bird referable to no known species of stork or ibis. The unknown is straight-beaked and of a reddish hue varied with black, feebly recalling the plumage of a corncrake ; it holds a frog in its bill. The occiput is slightly crested and the legs sturdy as if for swift running.

Now all these characters except the bill occur in the poulet rouge or aphanapteryx as figured by Hoefnagel in his book of drawings of the imperial menagerie at Ebersdorf about 1610. Hoefnagel's bird had the bill curved instead of straight, but this may be due to sex or maturity ; the length in both specimens is apparently the same. It seems probable that in the Edwards painting one sees the second known specimen of this long extinct creature, and like the first one drawn from life by a competent artist. This bird, like the dodo, inhabited the Mascarene Islands and a figure of it—long unrecognised—appeared in Strickland and Melville's volume on "The Dodo and its Kindred".

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Fusion of Pycniospores with Filamentous Hyphæ in the Pycnium of the White Pine Blister Rust

THE pycnia of the white pine blister rust are of the sub-corticular type as described by Arthur[1]. They may be characterised as extensive crust-like layers without definite delimitation and not having a well-defined ostiole and paraphyses such as are common to many of the leaf-inhabiting rusts. The pycnial crust consists of a dense layer of stromatic tissue formed by the anastomosing of the rust mycelium. From this layer arise the slender, erect, pycniosporophores, which are closely compacted in a palisade arrangement. Occasionally, a filamentous hypha is seen that projects for some distance beyond the common level reached by the sporophores and, although similar to them in structure, its diameter is usually greater and it is more irregular in outline. No cross walls have been observed in these hyphæ. A single nucleus is present, usually near the base. Often the tips of such hyphæ are bent over into a procumbent position due to the pressure of the overlying host cells. These hyphæ were first reported by Colley in 1918[2], who mentions their presence without comment.

For cytological study, fresh pycnia of the white pine blister rust were fertilised by interchanging the pycniospores, and, after a period of 48 hours, were fixed in Flemming's weaker solution together with an equal number of unfertilised pycnia of similar age. A copious exudate of nectar containing pycniospores was present on both sets of pycnia. Sections of both fertile and infertile pycnia were made as thin as 3 μ and stained with a modification of the triple stain. Both contained a few of the filamentous hyphæ described above, but in the fertile preparations eleven cases of pycniospores fusing with these hyphæ have been observed, while no case of fusion was found in the sterile preparations. These fusions are similar to the unions recently reported by Craigie[3] for the sunflower rust.

The pycniospores were united to the ends of the hyphæ by short tubes that were longer and of a somewhat smaller diameter than those illustrated by Craigie[3]. A few of the pycniospores seemed to be empty while others contained nuclei in the usual position. Actual migration of nuclei through the short connecting tubes has not been observed. Whether these tubes are extensions of the filamentous hyphæ or germ tubes sent out by the pycniospores remains to be established. A more detailed account covering the investigations undertaken on this subject will be presented at a later date.

School of Forestry, University of Idaho.
March 28.

ROYALE K. PIERSON.

[1] Arthur, C. J., "The Plant Rusts", 1–446, 1929.
[2] Colley, R. H., "Parasitism, Morphology, and Cytology of *Cronartium ribicola*", *J. Agric. Res.*, **15**, 619–659; 1918.
[3] Craigie, J. H., "Union of Pycniospores and Haploid Hyphæ in *Puccinia helianthi* Schw.", NATURE, **131**, 25, Jan. 7, 1933.

Lignin Content of Cellulose Products

IN the working out of a new method of determination of cellulose, especially suitable for cereal straws, we have recently had occasion to determine the lignin contents of cellulose products obtained by various means. Chlorinations, either gaseous or in solution (as our new method involves) were continued until there was no trace of a characteristic red colour on the subsequent addition of sodium sulphite. In spite of this, however, the lignin contents of the products from a number of straws were, in general, between 2·5 and 3·0 per cent.

The lignin determination depends on the resistance of lignin, first to cold 72 per cent sulphuric acid, and later to boiling with more dilute acid. Pure cellulose under such conditions yields only a trace of apparent lignin, no doubt due to slight charring or caramelisation. Starch and glucose similarly yield only a trace of apparent lignin. A pentose sugar, on the other hand, gave with this treatment an appreciable quantity of some material as resistant as lignin and determined as such in the accepted methods.

Natural celluloses from woods and straws are known to consist of 'true' cellulose associated with other polysaccharide material, known as 'cellulosans'[1]. It seemed possible, therefore, that the lignin found in straw celluloses might be apparent rather than real, and be in truth derived secondarily by the action of the sulphuric acid, on the 'cellulosan' or pentosan fraction of the natural cellulose. Accordingly, by mild hydrolysis with 5 per cent acid for 1 hour, this fraction was largely removed. The apparent lignin content of the residues fell by 25–30 per cent in every case, indicating the correctness of this view. However, the residual lignin contents were even then much greater than the figures obtained on most wood celluloses, and, moreover, could not be reduced by gross over-chlorination and repeated sulphite extractions. We are, therefore, of the opinion that, while a part of the apparent lignin content of celluloses from cereal straws is secondarily produced from the cellulosan fraction, there is nevertheless a portion of true lignin (or some other acid-resistant material) very tenaciously retained by the cellulose itself and possibly in combination. We shall investigate this point further in an attempt to characterise or extract this small residual fraction.

In view of this observation that apparent lignin may be formed from the pentose grouping, we consider that the whole question of the determination of lignin by the 72 per cent sulphuric acid method must be critically re-examined. The results usually given for straws and hardwoods will probably be found to be too high. Those for softwoods, in view of the smaller content of pentose material, are probably much more nearly accurate. By submitting straws to an acid pre-treatment (5 per cent sulphuric acid for 1 hour) before the determination of lignin and removing thereby the major part of the pentose material present both as polyuronide hemicellulose and as cellulosan, the apparent lignin content was lowered by 25 per cent or more. It seems likely that this lower figure is the true value.

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S. H. JENKINS.

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[1] Hawley and Norman, *Ind. and Eng. Chem.*, **24**, 1190; 1932.

Whale Shark in the Waters Around Ceylon

WITH reference to Dr. Gudger's letter[1] on the above subject, I am inclined to agree with the view which his last paragraph implicates, namely, that *Rhineodon typus* is a rare visitant to the waters around Ceylon.

During a residence of nearly twenty-three years in Ceylon, I have neither seen a whale shark nor have I heard of one having been washed ashore. It seems scarcely likely that this shark, with its great size and peculiar characters, could have escaped the notice of the fishermen.

This negative evidence, however, is not altogether convincing. I am reminded of the occurrence of whales in South Indian waters. After considerable experience of marine biological surveying in the seas around Ceylon, I should have been prepared to say that although whales are occasionally seen they are relatively rare and could certainly not be fished profitably for commercial purposes; yet a whaling expert, who came to Ceylon two years ago with the intention of establishing a whaling station in Ceylon, assured me that whales were more common than I had supposed and that commercial whaling off the coast of Ceylon could be carried on successfully.

It is possible, therefore, that the giant shark *Rhineodon typus* may be more common in South Indian waters than the small number of reliable records would lead us to believe.

JOSEPH PEARSON.

Colombo Museum, Ceylon.
March 7.

[1] NATURE, **131**, 165, Feb. 4, 1933.

Research Items

Stone Age Culture in Uganda. A stone age culture discovered at Magosi in Uganda has been described by Mr. E. J. Wayland and its affinities discussed by Mr. Miles C. Burkitt (*J. Roy. Anthrop. Inst.*, **42**, pt. 2). The site of the discovery is a platform at the base of a granitic rock on the west side of a saddle in bold hills. Excavation revealed an ancient water-cistern of natural origin, mainly filled with brick earth and lined with an 18-inch layer of rock-rubble. In this latter and above it was a zone rich in microliths. Below the rubble was rock-sand representing the disintegrated sides of the cistern. The depth of the archæological deposits was found to be 11 ft. There was no definite stratification, and no great change in culture throughout the deposits; except that the implements of the bottom levels were rather more primitive, and the middle levels were the richest in well-made tools. Two groups occur side by side: (1) pygmy cores and tools; (2) discs and points, the latter tending towards the Still Bay type of South Africa. In South Africa the two groups, the pygmy (Wilton), a neanthropic group, and the Still Bay culture are not found in association and are of different age. It has been proved that the Still Bay culture is the result of a contact between an African Middle Stone Age people and a neanthropic people; and this appears also to be true of Kenya. The Magosi pygmies are much more like the true Wilton of Kenya and South Africa than the pre-Wilton pygmies of upper palæolithic and Elmenteitan levels of Gamble's Cave. Yet in both areas Wilton appears definitely later than Still Bay; while the archaic appearance of the Magosi industry suggests that it belongs to an older age than the true Wilton. This is borne out by its association with a Still Bay industry. A further suggestion follows. Uganda may be an area in which took place a fusion between a Middle Stone Age people, who had developed the Still Bay point, and a neanthropic race, the fusion producing a proto-Wilton industry which migrated south and developed into the true Wilton.

Prehistoric Gold-Mining in South India. A communication from Mr. L. Munn, of the Hyderabad Geological Survey, records personal observations of an ancient gold-mine in Hyderabad. In sending these notes, Mr. Munn expresses a fear that much information gained by engineers during the last fifty years, but unrecorded, may be lost unless action is taken, and hopes that his notes may elicit further information. Beyond a report by Maclarren in the *Records* of the Geological Survey and the book by that author, Mr. Munn is unacquainted with any information on the subject. His own experience was gained at Hoonkoni in the Deodrug Taluq of the Raichur District. Here the old workings are a series of pits, 615 ft. in length, which, judging from the debris, yielded a panning value of 5–8 dwt. to the ton. The reef was worked as an open-cut to a depth averaging 20 ft. by fire-setting and breaking with stone hammers. This is evident from the amount of wood-ash encountered and the curiously concave section of the portion of the reef remaining. After about 20 ft., a ridge of solid ground, about 5 ft. thick, was left. It is thought that this was intended to prevent rock from falling from above, as well as to avert flooding of the lower levels by the monsoon rain-waters. At intervals in this rib, shafts were opened, and when the shafts were sufficiently far through, lateral excavations were made. Evidently hammer-stones were freely used. Working by fire-setting in a narrow shaft, with the object of leaving the rib of solid earth, tended to produce the ever-increasing flattened oval. There is no evidence for the use of any implement but stone; but iron instruments of indeterminate age have been found, though only just under ground-level. The narrow underground workings are closely packed with stones and mud. It is probable that this was done by the ancient miners for the purpose of concealment, timbering being employed to avoid the necessity of filling the whole stope. The conditions of working the mines must have been so trying, that it is improbable that any but forced labour was employed.

Winter Territory amongst Birds. In the "Calendar of Nature Topics" (Jan. 14, p. 69) it has been pointed out that the winter flocks of crowned sparrows (*Zonotrichia*) seem to keep within territorial boundaries. Observation of another species, the western robin of America (*Turdus migratorius propinquus*), suggests that within the flock there may be individual territory recognised as the exclusive feeding ground of a single bird. John B. Price bases this suggestion upon the movements of two western robins, easily recognisable because of abnormalities in plumage, for otherwise individuals are difficult to observe. These birds appeared to roost nightly with others of their species in enormous flocks (which may number thousands), but during the day they appeared consistently each on its own plot in the campus at Stanford University (*Condor*, **35**, 52; 1933). One appeared daily (with three blanks) from January 19 until February 18, 1932; the other from February 12 until 18. The roost from which these daily visits were made was probably four or five miles away, and the regular appearance of the single birds at their own feeding ground (to which they returned before sunrise), their vigorous defence of their plots against new-comers (during a three-minute interval one was seen to join combat ten times) suggest that each western robin in a flock may have its own individual territory during the winter season.

A Virus Disease of Strawberries. The very descriptive name of 'yellow-edge' has been given to a new disease of strawberries ("The Strawberry 'Yellow-edge' Disease" by R. V. Harris, *J. Pomol. and Hort. Sci.*, **11**, No. 1, 56–76, March, 1933). The disease is transmissible to healthy plants by grafting, and it is suggested that a virus is the causal agent. The symptoms are a general dwarfing and a malformation of the leaflets, which have chlorotic margins. Petioles lack the normal red pigmentation. Infected plants degenerate in vigour, bear no fruit and ultimately die. Symptoms are apparently masked during the warm period of summer. Control methods are discussed, and the possible identity of the disease with an American disease of strawberries known as 'xanthosis' is indicated.

Batholiths and Ore Deposits. In the *Journal of Geology* for 1933, Prof. W. H. Emmons presents a valuable summary of our present knowledge of the relations between batholiths and the metalliferous veins commonly associated with them. He shows

that a normal batholith may be divided into (*a*) the metallised roof; (*b*) the metallised hood, which includes the ore-bearing margin of the igneous mass itself; and (*c*) the core, which is essentially barren of metals. It is believed that the magma of the batholith generated a strong vapour pressure on cooling and crystallising, after the manner illustrated by Morey's experiments on silicate melts. It is probable that this pressure was sufficient to shatter the roofs of some batholiths. Thus the magma may generate the forces responsible for the fractures that later become veins, as well as the metalliferous fluids from which the ores are deposited. The metals were expelled from the magma that formed the core after the hood had solidified. Deposition of ores is believed to have been accomplished before the solidification of the core was completed. Barren veins may form later in the core, but the batholith has now ceased to expel metals. The core appears to be no longer in communication with deep-seated sources of metals, presumably because of relatively early crystallisation at the roots of the batholith.

Flow of Water between Moving Boundaries. Cornish (*Proc. Roy. Soc.*, April) has investigated the flow of water between a revolving brass bush and a coaxial hollow cylinder. The clearance was of the order of 0·1 mm. When the flow was laminar, the resistance was unaffected by rotation at low speeds, but increased when the speed of rotation lay above a critical value. When the flow is turbulent the effect of rotation is found to diminish as the Reynolds' number increases. A set of curves is given which enable practical calculations to be made on flow through annular clearances of this type.

Semi-Conductors in a Magnetic Field. A quantum theory of conduction has been developed by A. H. Wilson (see NATURE, **130**, 913, Dec. 17, 1932). The energy spectrum of the electrons in an atomic lattice splits into a number of bands, which do not overlap in the case of an insulating crystal. If some of these bands are completely filled with electrons, transitions within the band are disallowed by Pauli's principle, and the energy of thermal agitation is insufficient to carry electrons into an upper band. The electrons cannot, therefore, acquire velocities in an electric field and the substance shows no conductivity. Atoms of a suitable impurity may have an energy state only a little below one of the upper unfilled bands, and these electrons may be transferred to the lattice by the effect of thermal agitation. The substance then behaves as a semi-conductor with a conductivity increasing with temperature. Since there are only a few electrons in this upper band, the electron gas is non-degenerate and may be treated by Maxwellian statistics. In a paper by J. W. Harding (*Proc. Roy. Soc.*, April) the effect of a transverse magnetic field on a conductor of this type is calculated. The electrons describe paths under the influence of the applied magnetic field, the applied electric field and the electric field produced by sideways transfer of electrons (Hall effect), together with the collisions with the lattice. An integral equation is set up expressing the condition that the distribution of electrons is steady under these forces. Solving this equation, the currents in different directions are calculated. Different methods are required for weak and for strong magnetic fields. The numerical results are in very reasonable agreement with the shape of the experimental curves for germanium in both strong and weak fields. The absolute value for the change of resistance is nearly right, and the variation with temperature is in the right direction. The Hall effect has not been measured for a semi-conductor but the variation with magnetic field predicted is similar to that observed for bismuth.

Inverse Sublimation. The December 1932 issue of the *Bulletin de la Classe des Sciences* of the Royal Academy of Belgium, which completes vol. 18, contains an interesting communication from M. Octave Dony. M. Dony describes the first of a series of experiments he has undertaken in order to investigate the laws which the crystallisation of a substance from a state of vapour appears to follow. Although this method of crystallisation is of great importance in industry, very little seems to be known as to the circumstances which influence the process. So far, M. Dony has experimented with phthalic anhydride and naphthaline, which were heated electrically in crucibles placed in large rectangular glass enclosures in one case low down, in another half-way up, and in a third near the top. The principal factor in determining the form of the crystals formed is found to be the intensity of the convection currents in the air of the enclosure. In the case of phthalic anhydride, the low position of the crucible tends to produce very long, thin, nearly parallel needles, the central position shorter crossed needles, and the high position very short needles scattered throughout light flocculent masses. There is also an optimum temperature for the crucible.

Radio Telephone Links. A large network of telephones in one part of the world is usually connected with networks in other parts by means of a radio transmission system called a radio telephone link. There are now more than fifty of these links but few of them are working to their full load capacity. The chief problem that has to be considered therefore is that of reducing operating costs. It is only on the few heavily loaded links that the expense of an improvement in the performance of the circuit would be justified. In a paper read to the Institution of Electrical Engineers on May 3, the advantages of using a single side-band system in short-wave telephone links are considered. The chief requirement of a radio-telephone link is that the average ratio of the speech signal to the interfering noises during the conversation must be as high as possible. It must be high enough to give easily intelligible speech over practically the whole period of the advertised service time. The chief advantage of the telephone is its immediate availability at any time required. Even breakdowns for a short period, although only occurring a few times a year, are quite serious. Atmospheric conditions and particularly those accompanying magnetic storms may put a link out of condition for one or two days. It is pointed out that to raise the ratio of the sound signal to the noise signal appreciably would help as the circuit could be kept in constant operation several hours longer although under bad conditions. With our present knowledge, it is impossible to avoid a complete 'fade-out' occasionally. The author gives a full technical discussion of the problem. In particular, he dwells on the many advantages of using short waves and applying the single side-band system to these links. He gives experimental results obtained between stations at Madrid and Paris which bear out his conclusions.

Pelvic Fins of the Lepidosiren

By G. E. H. FOXON, Department of Zoology, University of Glasgow

A REMARKABLE and unique feature of *Lepidosiren paradoxa* is the conversion of the pelvic fin of the male, during the breeding season, into a large gill-like organ. Much confusion exists both as regards the historical development of our knowledge of this phenomenon and also as regards its probable functional significance.

On March 10, 1894, Ehlers[1] pointed out that the pelvic fins of Lepidosiren are sexually dimorphic, those of the adult male being beset along their medio-dorsal surface with a thick growth of flattened papillæ arranged in bunches springing from a common base. Over the date March 20, 1894, Lankester[2] recorded and illustrated the same structures, and remarked that "whether tactile or respiratory they form a most remarkable feature". On June 19, 1894, Lankester[3] again figured the papillæ and, after examining them in microscopic section, suggested the possibility of their being erectile and of copulatory significance.

The discovery that the papillæ observed by Ehlers and Lankester are merely dormant rudiments which undergo active growth in relation to the breeding season was made by Prof. Graham Kerr on November 4, 1896; his diary referring to eight captured Lepidosirens contains the note, "Of these, two males appear to be assuming nuptial dress. The lateral papillæ which Lankester described are represented by branched filaments forming a thick fringe. Highly vascular and deep red in colour". On November 8 he recorded a female with rudimentary villi. A note written by Prof. Kerr during his stay in the Chaco but undated reads: "In many cases the fore limb is flattened and bears on its lower edge a series of flat papillary processes,—a rudimentary fringe. The fringe seems prominent in several males where fringe on hind limb: is there any connection between the two ?"

In his first paper on the Lepidosiren, Prof. Kerr[4] merely suggests that the fringes in question are nuptial developments comparable with those occurring not uncommonly in fishes and amphibians. In later papers, however, he shows himself more and more firmly convinced that the true physiological function of the filaments is as accessory organs of respiration, of special value to the male Lepidosiren which remains on guard over the eggs deposited in the burrow, as lessening the need of his temporarily leaving his charge unprotected in order to proceed to the surface to fill his lungs with air. Prof. Kerr indeed has a footnote to this effect in his first paper.

Agar[5] has added to our knowledge of these filaments and he was the first to describe those cases in which the pectoral fin shows similar developments to those of the pelvic fin. He also notes that the process of atrophy of the filaments coincides with the end of the period during which the male is guarding the young in the nest.

The possibility that the function of the filaments is connected with the emission of oxygen for the respiration of the eggs makes its first appearance in a paper by Budgett[6] published in August 1901. Budgett, who had been Prof. Graham Kerr's companion in the Chaco, and had intimate first-hand knowledge of the Lepidosiren and its habits, writes: "It is tempting to regard the vascular fringes on the pelvic limbs of *Lepidosiren* as in some way connected with the aeration of the eggs". Although mentioning the idea in print, Budgett with his practical knowledge did not adhere to it, but concluded that, "it seems more probable that the fringes are as Kerr holds, accessory organs of respiration".

Mr. J. T. Cunningham[7] in 1912 repeats Budgett's earlier suggestion: "it would seem more probable that the use of the filaments in the Lepidosiren is to provide for the respiration, not of the parent himself, but of the ova".

Dr. Carter and Mr. Beadle[8] in carrying out their investigations in the Chaco developed quite independently a distinct leaning towards the emissive significance of the filaments. The revival of interest in the 'emissive' hypothesis is due to the publication of two papers, by Cunningham[9] and by Cunningham and Reid[10] respectively. The first of these is mostly speculative and will not be referred to further, except to note that the statement that the filaments arise from the ventral side of the fin, instead of as described by Ehlers, Lankester and Graham Kerr, is incorrect. In the second paper, however, Mr. Cunningham and Mr. Reid support the emissive hypothesis by actual observations carried out on the Island of Marajo.

Before proceeding to indicate why the experiments of Cunningham and Reid are insufficient to prove that the function of the pelvic filaments is to emit oxygen, it will be as well to summarise why the probabilities lie in the opposite direction, that is, that under natural conditions the filaments are concerned with the respiration of the parent.

The nests lie at the bottom of the swamp; they are very variable in size, but generally extend for several feet horizontally, being about nine inches to one foot in diameter. The eggs are scattered at random in a single layer over the floor of the burrow, and it may be pointed out that the smooth surface of the egg-shells makes it physically impossible for them to be piled up in a heap round which the parent could lie coiled up. The suggestion that the filaments emit oxygen in the immediate neighbourhood of a pile of eggs or a mass of larvæ is not, therefore, consistent with the facts; and to raise the oxygen content of the water sufficiently to be of use to the developing young it would have to be raised throughout the burrow. In a burrow 2 ft. 6 in. long with a diameter of 9 in. the oxygen content of approximately 31 litres of water would have to be raised.

The nest lying at the bottom of the swamp, any breathing on the part of the male would, as Budgett pointed out, necessitate a journey through several feet of water to the surface. The male guards the nest, frequent absences would give opportunities for enemies to enter and make a meal off the eggs or young larvæ, and frequent coming and going would only serve to attract attention to the presence of the nest. Again, the vascular filaments themselves would be a juicy morsel for any enemy, and if they were lost in this manner, severe and probably fatal bleeding would result. Repeated excursions to the surface such as would have to be made if the male were in any way a means of supplying oxygen to the young, would be seriously detrimental to the welfare both of the male and to the offspring. It is entirely reasonable, therefore, to regard the filaments as a means of

diminishing the need of frequent absences from the nest.

The positive evidence adduced by Cunningham and Reid in support of the 'emissive' function is merely that in certain cases the amount of oxygen in water of low oxygen content is increased when a Lepidosiren with pelvic filaments is placed in it. That this is so is only to be expected, seeing that the fish had access to the air and were allowed to breathe at intervals throughout the experiments. It would be more remarkable if the oxygen content of the water did not rise, for Mr. Cunningham[9] himself has shown that in de-oxygenated water goldfish, perch and axolotls all allowed measurable quantities of oxygen to leak away. That oxygen is not given off by female Lepidosirens or by immature males is no doubt due to the epidermis not being thin enough to allow such diffusion to take place—even the gills are too thick (Fullarton[11])—while on the other hand the breeding male, in the pelvic filaments, possesses an organ through which such diffusion can take place. If a male Lepidosiren, with filaments, is submerged in de-oxygenated water but is allowed to keep up the oxygen tension in its blood by breathing air into its lungs, a rise in the oxygen content of the water is only what is to be expected.

Before reliable conclusions can be reached, information must be sought as to what happens when males with filaments are denied access to atmospheric oxygen. Prof. Graham Kerr found that Lepidosirens, if prevented from breathing air, quickly die; an instructive and perhaps conclusive experiment could be performed if the times taken by ordinary male Lepidosirens to drown were compared with those taken by males with filaments. If the 'emissive' hypothesis is correct then the breeding males must die more quickly than the others.

Finally, it should be borne in mind that in all cases where oxygen is actually excreted from the blood, as in the air-bladders of certain fish, glands for that purpose are present; in the Lepidosiren no such structural modifications have been described.

[1] *Nachr. Ges. Wiss. Göttingen*, Nr. 2; 1894.
[2] NATURE, **49**, 555, April 12, 1894.
[3] *Trans. Zool. Soc. Lond.*, **14**; 1898.
[4] *Phil. Trans.*, **192**; 1900.
[5] *Anat. Anz.*, **33**; 1908.
[6] *Trans. Zool. Soc. Lond.*, **16**, pt. 2, No. 5; 1901.
[7] "Animal Life", Gen. Ed. W. P. Pycraft. "Reptiles, Amphibia, Fishes and Lower Chordata", Ed. J. T. Cunningham, London; 1912.
[8] *J. Linn. Soc. Zool.*, **37**; 1930.
[9] *Proc. Roy. Soc.*, B, **105**; 1929.
[10] *Proc. Roy. Soc.*, B, **110**; 1932.
[11] *Proc. Zool. Soc. Lond.*, pt. 4; 1931.

Metals and Man*

THE first annual Research and Development lecture arranged by the British Science Guild was delivered, on May 16, in the hall of the Carpenters' Company, London, by Sir Harold Carpenter, his subject being "Metals in the Service of Human Life and Industry". Lord Melchett, who presided, said that the lecture had been instituted to direct attention to the importance of research—both purely scientific and technical—and the utilisation of its results for the benefit of mankind. The British Science Guild desired the lecture to be associated with the name of Sir Richard Gregory, who as Editor of NATURE, and in other activities, had done so much to secure increased recognition of the services rendered by science and scientific workers to progressive life.

Sir Harold Carpenter began his lecture by pointing out that, of the products of the physical universe which have contributed most to the comfort of the human race and the industrial progress of the world, metals are entitled to the first place. Man's most striking achievements have depended largely on the use of metals, as indicated by ships, bridges, railways, automobiles, power stations, aeroplanes, telegraph and telephone systems and broadcasting.

Leaving agriculture and fishing out of consideration, the beginning of metallurgy was the beginning of industry and also the beginning of civilisation. The material achievements of metallurgy constitute only a portion of its service to mankind, as it was in the practice of this art that man developed mental attributes which led to the foundation of science and modern thought. From the practice of this art men acquired the mental habit of inquiring into the phenomena observed in order to attain control over them and thus over Nature also. Chemistry developed from the old art of metallurgy, but engineering did not do so; yet in recent years the engineering, chemical, and metallurgical industries have reacted on each other in innumerable ways.

The core of the earth probably consists mainly of an alloy of iron and nickel, but the crust is of an entirely different composition. This crust has resulted from the gradual solidification of the earth from the state of a molten ball. During this solidification a sorting out of constituents has taken place, resulting in a layer of silicates on the surface containing originally very little metal, but during further cooling a differentiation of the constituents has taken place resulting in the separation of silicates and sulphides and the concentration of metals in certain parts.

The calculated composition of the accessible crust indicates that, of the metals, only aluminium and iron are present in appreciable amounts, and that all other metals taken together amount to less than half of one per cent. If these metals were uniformly distributed, metallurgy would not exist. The concentration of the metals in workable deposits in relation to concentration in the earth's crust varies from 4 to 5 times in the case of aluminium, to 4,000 to 15,000 times in the case of silver.

From the point of view of the rise and development of the metal arts from the earliest times, the industrial history of mankind may be divided into two major epochs—a stone age and a metal age. Between these there was a transitional period in which the metals, as found in their native state, were used as stones. The definite establishment of a metal age was due mainly to the discovery of the possibility of smelting metals from stones, and the importance of this discovery comes in the same category as the first method of producing fire artificially.

The metals gold and copper were the first to be used by man, and both were obtained from native metals. From the mere melting of a native metal

* "Metals in the Service of Human Life and Industry". Pp. 39. British Science Guild, 6, John Street, Adelphi, W.C.2. 1s., including postage, 1s. 1d.

to the smelting of an ore was a great advance, and this discovery was, in all probability, the result of an accident at the edge of a camp fire. The observation by the early workers that copper, as obtained from different deposits, had different properties, led to the mixing of other materials with the copper ore being smelted and ultimately to the production of bronze. It is generally recognised that so early as 3000 B.C., the Egyptians were skilled in the smelting and casting of copper, but the earliest authentic bronzes date from about 1600 B.C.

The next important discovery was the production of iron, and it is generally agreed that iron did not come into general use in Egypt until 1300 B.C., which may be taken as the beginning of the iron age. It appears that the Egyptians were acquainted with the carburising process for converting iron into steel about 1200 B.C., and with the quenching process for hardening steel about 900 B.C. After this, no important metallurgical discovery appears to have been made for a long time. Brass was first made at the beginning of the Christian era, and the next discovery of prime importance was that of cast iron, which was first made in the fourteenth century. This discovery was the outcome of the gradually increasing size of the furnaces used for making direct iron. The smelting of iron ores in large furnaces with the use of coke began early in the eighteenth century and marks the beginning of the modern iron and steel industry.

The next discovery of importance was the making of crucible steel at the end of the eighteenth century, but steel did not become available in large quantities until the invention of the Bessemer process in 1856. During the last seventy-five years the development has been rapid and during the past thirty years more metal has been used than in all previous time.

Sir Harold Carpenter traced the progress of casting metal from the first castings in stone moulds to the modern methods of centrifugal and pressure die castings. The properties of metals, including strength, ductility and malleability received attention, and the chemical properties, especially as regards their resistance to the chemical action of their environment during service, that is, corrosion, were shown to be of the highest importance.

The effects of science on metallurgy have been most marked and important. So recently as just over a century ago, changes in metallurgical practice were mainly the result of chance discoveries or the consequence of a reaction to changing economic conditions. Scientific attention began to be directed to the systematic search for new alloys, new methods of mechanical and heat treatment, more economical methods of manufacture, better plant and greater reliability of product. The most conspicuous illustration of the influence of science on metallurgy is found in the case of aluminium. It is the most plentifully occurring metal in the earth's crust and yet has become available only within living memory. To-day, iron and aluminium are the two most important metals, iron having been used by man for over three thousand years and aluminium for under fifty years. The application of the methods of science to the ancient art of metallurgy, and the increased knowledge gained thereby, will contribute ever increasingly to the amenities of human life and the progress of art and industry.

Spectra of the Planets

THE annual George Darwin lecture was delivered at the Royal Astronomical Society's meeting on May 12; the lecturer being Prof. V. M. Slipher, director of the Lowell Observatory. He chose as his subject the spectra of the planets, the study of which has been, from the first, an important feature in the work of the Lowell Observatory. He noted that the advent of the spectroscope made it possible to learn something about the chemical composition of other worlds, and gave a sketch of the early work carried out by Sir William Huggins, using visual methods.

The introduction of photographic methods made a great advance possible; when the method was first used, the plates employed were insensitive to red light, and the infra-red region was quite excluded. Of late, the makers of plates have triumphed over these difficulties, and a great extent of the infra-red spectrum can now be photographed. This is specially important in planetary work, as there are many interesting lines and bands in this region.

An initial difficulty is that of separating planetary lines from those due to the terrestrial atmosphere. Prof. Slipher described different methods of discrimination; comparing a planet with the moon at the same altitude, or comparing the planet's spectrum at high and low altitudes. Also the terrestrial lines can be weakened by going to a high station. Some photographs have been taken at the San Francisco Peak, 11,000 ft. high, which is near the Observatory.

Another method, needing considerable dispersion, makes use of the shift of the planetary lines due to radial motion. This has been applied to Venus, with the result that oxygen cannot be traced in its spectrum, but carbon dioxide is suspected. Great endeavours were made to test the rotation of Venus by the spectroscope. The slit was placed in various position angles, also with the spectroscope in two opposite positions, 180° apart; the plates were shuffled, and the measurer kept in ignorance of the conditions of exposure, to prevent any possible bias. Unfortunately, no positive result was reached, but Prof. Slipher considers that ten days might be named as a lower limit to the planet's period of rotation.

Some twenty-five years ago there was a controversy as to the presence of the *a* band, due to water vapour, in the spectrum of Mars. Lowell's book on the planet, published in 1909, included a reproduction of spectra taken by Prof. Slipher in 1908, showing the *a* band stronger in the Martian spectrum than in the lunar one. Some doubt was thrown on this by other observers, but the presence of a small amount of water vapour is now generally accepted.

Prof. Slipher then proceeded to discuss the four giant planets; their spectra resemble each other in showing series of conspicuous bands, which increase in strength as we go from Jupiter to Neptune. Spectrograms of Jupiter were shown, which exhibited bands far in the infra-red, to wave-length 10,000, but 8,600 was

the limit reached in the case of Uranus and Neptune. The origin of most of these bands is still unknown, but lines due to ammonia have lately been identified in the spectrum of Jupiter; a slide was shown in which they were visible. It is appropriate finding ammonia in Jupiter, as the name is taken from the temple of Jupiter Ammon in Africa, which appears to have been the earliest source of supply of this substance.

Allusion was next made to the determination of the period of rotation of Uranus by spectrograms taken at the Lowell Observatory in 1911. The equivalent focus used was 55 ft., and the usual precaution was taken of rotating the spectrograph through 180°, between two series of exposures. The deduced time of rotation was 10·7 hours. Some attempts are being made to see if Pluto shows any periodic variation of light, from which its rotation time can be deduced; but there is nothing as yet to report.

The suggestion, now generally accepted, that the stationary calcium lines in certain stellar spectra are due to light-absorption in interstellar space, not in the stars themselves, was made at the Lowell Observatory in 1909. Prof. Slipher spoke of some faint lines that were photographed on the dark side of Venus, but he is inclined to ascribe them to our own atmosphere. He expressed the opinion that there is a faint permanent aurora present in the atmosphere, and showed some plates taken with long exposures, on which the auroral lines could be traced.

At the conclusion of the lecture, the president, Prof. F. J. M. Stratton, presented the gold medal awarded by the Council to Prof. Slipher for his spectroscopic work on planets and nebulæ. He said that the lecture itself sufficiently established the grounds for the award, and dispensed with the necessity of a presidential address on the subject.

A. C. D. C.

The 'Catkin' Radio Valve

WITH the rapid growth in broadcast reception, the general public has become used to frequent changes in the types and design of receiving valves. These new types have usually been aimed at giving improved performance under modern conditions of radio communication, and in the past, they have invariably appeared in the familiar glass bulb form. A radically different type of construction is adopted in the 'Catkin' valve, which was placed on the market on May 18, by the General Electric Co., Ltd. and the Marconiphone Co., Ltd. This new valve is really a small model of the high-power type of 'Cooled-Anode-Transmitting' (C.A.T.) valve which was produced for wireless transmitting stations a few years ago.

In the new construction shown in the accompanying sectional diagram (Fig. 1), the amount of glass-work, with its fragility and dielectric losses, has been reduced to a minimum. The upper portion of the envelope is formed of the cylindrical copper anode which is sealed to the lower glass portion by a vacuum-tight joint. The other electrodes are rigidly mounted inside this envelope, using mica spacing and insulating pieces where necessary. In the glass type of valve the electrode system is usually carried in the glass 'pinch' near the base, an arrangement which makes it difficult to ensure definite location and gives rise to considerable dielectric losses in some valve circuits. In the new construction, the lower ends of the electrodes are held rigidly in a suitable steel clamp with mica insulation, and the leads are brought out through the glass ring at the base, being well spaced around its circumference. This arrangement makes it possible to obtain much greater precision in the electrode dimensions and spacing in manufacture, so that the mass-produced valves should conform much more accurately to a uniform performance than was possible hitherto.

The glass ring forming the lower portion of the envelope is supported in its base by a rubber clamp, which acts as an efficient sound insulator, thus reducing the susceptibility of the valve to microphonic effects. The much smaller diameter of the anode also results in comparative freedom from response to sound vibrations transmitted through the air, which sometimes form a source of trouble with glass valves.

Screen-grid and detector valves are, nowadays, usually metallised in order to avoid the effects of strong electric fields set up by charges on the glass envelope. The electric field within the anode of the Catkin valve is entirely uninfluenced by any surrounding charges. If further screening is required in order to reduce stray coupling to the anode itself, an octagonal tubular metal cover is provided fitting over the entire valve. In this form the valve is remarkably strong mechanically and its overall dimensions, including the standard four- or five-pin cap, are about 5 in. by 1¼ in. diameter.

Output valves do not require this outer screening

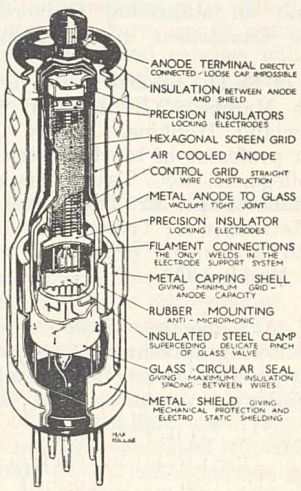

FIG. 1.

cover, and in this case the exposed anode is given a coating of black enamel insulation. In all cases, since the anode is exposed directly to the air, liberal heat-dissipation is provided and the electrode system as a whole runs at a lower temperature, thus reducing the liability of the valve to soften due to the release of gases occluded on the inner walls of the envelope.

The Catkin valve is at present being supplied in four types, the constants of which are similar to those of the corresponding glass valves, so that they are interchangeable with those in use in present-day receivers.

University and Educational Intelligence

BIRMINGHAM.—Shortly after the death of Prof. John Henry Poynting in 1914 a fund was subscribed by his friends with the object of providing a memorial to him. Part of the money thus raised was used for the publication (by the Cambridge University Press) of a volume of his "Collected Scientific Papers", of which a copy was presented to every university in the British Empire and to representative universities in foreign countries. Another part of the fund was used for the purchase of a portrait to be presented to the University of Birmingham and hung in the great hall of the University. The remainder, which was invested, together with the accrued interest, has been offered to, and accepted by, the Council of the University, for the foundation of a Poynting lecture, to be delivered at intervals of not more than two years by physicists of outstanding distinction.

CAMBRIDGE.—The Adams prize for 1931–32 has been awarded to A. H. Wilson, research fellow of Emmanuel College.

The managers of the Balfour Fund have made grants of £50 to Mr. C. Forster-Cooper, of Trinity Hall, for researches on the fauna of the Achenarass quarries and to I. T. Sanderson, of Trinity College, for researches on the vertebrate fauna of the Cameroons.

It is recommended by the General Board that a readership in physiology be established with a pensionable stipend of £850, and that the first holder of the readership be Dr. F. R. Winton, of Clare College, at present University lecturer in physiology.

It is recommended that an additional University lectureship and an additional University demonstratorship be established in the Department of Anatomy.

The degree of Sc.D., *honoris causa*, is to be conferred on the Marchese G. Marconi, and on Sir Frederick Gowland Hopkins, Trinity College, Sir William Dunn professor of biochemistry.

At Clare College, H. McC. Taylor has been elected to a research fellowship. Mr. Taylor was a wrangler (*B**) in the Mathematical Tripos Part II, 1930 and was elected to a Smith's prize and to an Allen scholarship in March 1932.

SHEFFIELD.—At a meeting of the Council, held on May 12, the following appointments were made : Dr. G. A. Clark, at present lecturer in physiology, to the chair of physiology, in succession to Prof. J. B. Leathes ; Mr. W. R. Maddocks, as lecturer in metallurgy ; Mr. J. Dick, as assistant lecturer in mechanical engineering ; Mr. A. J. Macdougall, as assistant lecturer in metallurgy.

WALES.—Dr. W. R. Ivimey-Cook has been appointed assistant lecturer and demonstrator in botany in University College, Cardiff.

The University of London's activities during 1932–33, as reviewed in the Principal's report, presented on May 10, showed steady progress despite the necessity laid upon it in common with all other institutions in the country of exercising the utmost care in husbanding its resources. The Bloomsbury site figures prominently in the report. The general design for the whole site was completed by the architect, Mr. Holden, and exhibited in the form of a sketch model. Building is to begin at the southern end, next to the British Museum, the material employed being Portland stone with a brick core. The foundation stone is to be laid on June 26 by H.M. the King. In this connexion an outstanding event of the year was the gift of £100,000 by the Corporation of the City of London towards the cost of a new Ceremonial Hall, and this gift was followed by others toward the same purpose by many other City companies, the aggregate total to date being £166,000. In a long list of other important benefactions, including £48,000 from the Rockefeller Foundation for the endowment of clinical research in connexion with University College Hospital and the Medical School, an interesting item is the gift by the editor and proprietor, Dr. William Page, of the copyright and material of the "Victoria County History" of which ninety-one volumes have already been issued and as many more are projected. The Pilgrim Trust has granted the University £1,500 towards the cost of completion. The total admissions to the University in 1932–33 were 11,891 as compared with 6,295 in the first year after the War and 11,018 in 1931. The roll of internal students comprises 12,219 names, an increase of 529 compared with the preceding year, while those registered as external students have been steadily maintained at about 13,000.

AMONG the awards of Commonwealth Fund fellowships tenable by British graduates in American universities for the two years beginning September 1933 are the following : Mr. J. W. L. Adams (Oxford) to the University of Chicago, in economics ; Mr. J. F. Danielli (University College, London) to Princeton University, in Chemistry ; Mr. J. E. Harris (London and Cambridge) to Columbia University, in zoology ; Mr. S. H. Jones (Swansea) to Johns Hopkins University, in geology ; Mr. B. B. Kinsey (Cambridge) to the University of California, in physics ; Dr. J. H. Lamble (Liverpool) to the University of Michigan, in engineering ; Dr. Andrew McLean (Edinburgh) to the University of Illinois, in chemistry ; Mr. C. E. Marshall (Durham) to the University of Pittsburg, in geology ; Mr. H. S. A. Potter (Oxford) to Princeton University, in mathematics ; Mr. E. A. Radice (Oxford) to Columbia University, in economics ; Dr. H. C. Rowan (Birmingham) to the Massachusetts Institute of Technology, in engineering ; Dr. J. C. E. Simpson (Liverpool) to the Rockefeller Institute, in chemistry ; Miss P. M. Skinner (Cambridge) to the University of Wisconsin, in mathematics ; Mr. R. H. Stoy (Cambridge) to the University of California, in solar physics ; Mr. I. W. Tervet (Glasgow) to the University of Minnesota, in botany ; Mr. E. L. Trist (Cambridge) to Yale University, in psychology. Mr. G. G. Cillié (Stellenbosch and Oxford) has been awarded a Dominion fellowship, for astrophysics, and will go to Harvard University. The following have been appointed to fellowships tenable by candidates holding appointments in government service overseas : Dr. C. M. Focken (Melbourne and Oxford), of the Department of Education, Government of New Zealand, to the Colorado School of Mines, in engineering ; Dr. H. W. Mulligan (Aberdeen), of the Indian Medical Service, to the University of Chicago, in medicine ; Mr. R. McI. Tyndale-Briscoe (Cambridge), of the Department of Mines and Public Works, Government of Southern Rhodesia, to Harvard University, in geology.

Calendar of Nature Topics

Weeds

The unceasing battle against weeds has now reached the spring phase, when the innumerable seedlings breaking through the newly-drilled cornfields and root breaks are receiving special attention. The aim is to disturb and weaken as many weeds as possible in the hope that the crop will master the remainder. Light harrows are used, and, even if some corn is uprooted or potato sprouts knocked off, the loss is more than compensated by the cleaner crop. In the corn crops little further is done, for horse-hoeing between the narrow rows of cereals, one of the most skilled and exacting jobs of the agricultural worker, is now seldom practised. In roots, the struggle continues until the plants meet in the rows.

Although hoes and harrows have been increased in size and improved in design, no alternative to the mechanical treatment of weeds is yet in general use. Two new methods of approach have been tried and are making headway. The best known consists in spraying the weeds in the standing crop of corn with corrosive solutions or dusts. The success of these methods depends on the fact that the upright, waxy leaves of the corn are much less damaged than the flat leaves of the infesting weeds. Another possibility is the use of stronger doses of more toxic compounds when the ground is unoccupied by a crop. The problem here is to discover a substance that is cheap enough to use on an acre scale. It must also decompose in the soil to leave the land fit to be cropped at the proper time.

The extension and perfecting of weed control by chemical means is highly desirable, but it must not be overlooked that certain indirect benefits accrue to the cultivator by his mechanical efforts against weeds. The soil is maintained in a well-aerated and crumbly condition, the loss of water is reduced, and active production of nitrates is encouraged. The value of these conditions is difficult to assess, bnt something would have to be done to attain them in any event. The farmer's best ally in his cleaning operations is a dry season. The extraordinary summers of 1911 and 1921 enabled some of the most obstinate land to be set in order. But success is never complete; dormant weed seeds resist all efforts to make them germinate, and survive to open a fresh attack at some later season.

Kangaroo Mouse of Western America

In the high grounds of Nevada, Oregon and California, at an altitude of 4,000–6,000 ft., lives "one of the most remarkable of the many new and interesting mammals that have been discovered in North America during the past few years", the kangaroo mouse (*Microdipodops megacephalus*). Probably the newly born young have never been seen in the nest, but the discovery of pregnant females in Nevada by E. Raymond Hall and Jean M. Linsdale showed that the breeding season reached its climax in May and early June and tailed off in July. The young are relatively large at birth and number one to six in a litter (*J. Mammalogy*, **10**, 298; 1929). The mice, six inches in length, progress rapidly by hopping along on their hind feet, and so great is the power and accuracy of their jumping that a young individual repeatedly leapt out of a can, ten inches in diameter and seventeen inches high, without touching the sides of the can. During the day, kangaroo mice live in burrows excavated in fine sand, and the entrances to these they appear to block with sand when they enter them in the morning, so that they become invisible. Whenever an open burrow was discovered it was empty. The habit of living in loose fine sand results in spotted distribution where the type of soil varies markedly, and the distribution is further restricted because of the need of plants yielding the seeds which probably form the main part of the diet of the mice.

Phæocystis and Herrings

Usually in May the sea becomes a brownish-green colour in patches owing to the presence of the colonial flagellate *Phæocystis*. On examination, this organism is found to exist in the form of spherical gelatinous masses containing numerous small greenish-brown cells. Later on, these balls of cells become sausage-shaped. Multiplication is very rapid, and at this season naturalists' tow-nets become so clogged up with *Phæocystis* that all the catches are spoiled. Its maximum occurs between the end of April and the beginning of June but there may be a secondary maximum in autumn. At Plymouth it appears regularly—nearly always in May—stays for a few weeks, and then disappears.

Water coloured by *Phæocystis* or diatoms has been given many names by fishermen in different places, such as 'weedy water', 'stinking water', and 'baccy juice'. It has been shown that the presence of *Phæocystis* in the North Sea may have an important effect on the herring fishery. Herring avoid a large mass of this 'coloured water' and will make a wide detour rather than go through it. In this way the shoals of fish may sometimes be deflected from their normal haunts and turn up in some other place where unexpectedly good catches will result while poor catches are obtained on the usual and generally highly productive fishing grounds.

Societies and Academies

LONDON

Royal Meteorological Society, April 26. C. S. DURST: The intrusion of air into anticyclones. An examination of the dynamical equations of a rotating fluid on a rotating globe shows that the descent of air in an anticyclone will cause an inflow towards the centre of the right order of magnitude to balance the outflow of air due to friction near the surface. An explanation is given of the empirical forecasting rule that warm-cored anticyclones are likely to endure. H. M. VERNON: The estimation of solar radiation in relation to its warming effect on the human body. The globe thermometers described consist of globes of copper, glass or pasteboard, painted black or covered with cloth, and with an ordinary thermometer fixed so as to have its bulb in the centre. Up to a certain point, the larger the size of such globes the higher the temperature indicated on exposure to solar radiation, but the limit is practically reached with globes 6–9 in. in diameter. The temperature then indicated corresponds with the warming effect of the solar radiation on the human body. Globe thermometers are considerably influenced by wind velocity. J. GLASSPOOLE: The rainfall over the British Isles of each of the eleven

decades during the period 1820 to 1929. Maps are given defining the rainfall experienced over the British Isles during each of the eleven decades 1820–29 to 1920–29. The rainfall of each locality is given as a percentage of that for the standard period 1881–1915, so that each map presents a fairly simple distribution. The main feature of the distribution of rainfall during the decade 1920–29 was that excesses were most marked in the west of Great Britain, while during the decade 1910–19 the excesses were most marked in the south of England.

Geological Society, March 22. W. WICKHAM KING: The Downtonian and Dittonian of Great Britain and north-west Europe. The discovery of a shell fauna (seven genera) and a gastropod in stages I. 5 to I. 9 of the English Downtonian series is described. The fishes and crustaceans known in the British Silurian rocks, and the fauna common to the Downtonian and Dittonian series, are set out. These, when combined with an examination of the physical conditions in the Siluro-Devonian period, afford a solution of the problem of the boundary between these two systems which is in agreement with the views of Norwegian geologists in relation to the Red Bay series of Spitsbergen. F. R. COWPER REED: Downtonian fossils from the Anglo-Welsh area.

DUBLIN

Royal Irish Academy, Feb. 27. R. W. DITCHBURN: The transmission of resonance radiation through a gas. In the first section the problem is formally reduced to a problem of transmission by absorption and scattering (as in a 'foggy' atmosphere). In the second section two general equations for this type of transmission are deduced. The relation $\nabla^2 E = K E$ (where E is the radiation density and K is constant) is shown not to be true. In the third section two special cases are considered: (*a*) transmission outwards from the centre of a sphere: (*b*) transmission outwards from the centre of a long cylinder.

PARIS

Academy of Sciences, April 3 (*C.R.*, 196, 973–1056). CAMILLE MATIGNON, HENRI MOUREU and MAURICE DODÉ: The causes of the simultaneous production of 1-butene and 2-butene in the course of the catalytic dehydration of butyl alcohol by alumina. The variations in the proportions of the two isomeric butenes obtained in this catalytic reaction have been traced to the presence of impurities in the alumina. Traces of acid favour the production of the 2-butene. J. CABANNES: The depolarisation of diffused light by a uniaxial crystal when the optic axis is parallel to the diffused ray. Experimental study and theoretical considerations. JEAN BAPTISTE SENDERENS: The catalytic decomposition, in the gas phase, of the esters of the fatty acids by sulphuric acid pumice. Jules Haag was elected *Correspondant* for the Section of Mechanics, Gustave Binger for the Section of Geography and Navigation and Henri Devaux for the Section of Botany. SERGE FINIKOFF: Surfaces the lines of curvature of which correspond with equality of the principal homologous radii of curvature. ST. GOLAB: The conformal representation of two Finsler spaces. SOULA: An integral equation. A. TSORTSIS: The integration of a class of linear partial differential equations of the second order with an unknown function of n independent variables. HENRI CARTAN: Groups of pseudo-conformal transformations. TORSTEN CARLEMAN: A differential inequality in the theory of analytical functions. F. E. MYARD: An absolutely general linkage between any two axes of rotation in space. A. MAGNAN: The optical determination of the direction of threads of air in motion. JEAN BAURAND: Periodic progressive waves at the surface of a basin of small depth. P. DUMANOIS: Concerning the classification of liquid combustibles for internal combustion motors, with mechanical injection. EMILE SEVIN: The absorption of the cosmic radiation by the atmosphere. F. PRUNIER: Concerning the equations of electromagnetism. J. GRANIER: The conducting properties of india-rubber heavily loaded with lamp black. Vulcanised rubber containing 50 per cent of lamp black acts as a conductor for alternating currents and this conductivity appears to be electronic as it is not a function of the time and the electrodes show no trace of corrosion. The resistance varies with the pressure and various applications of this property are suggested. J. LECOMTE: The infra-red absorption spectra of some halogen derivatives of methane, studied with a recording spectrometer. A new type of instrument is described in which the photographic paper is fixed: the only moving part is the prism with an attached mirror. Data are given for eleven halogen derivatives of methane. P. FLEURY and G. A. BOUTRY. The exact measurement of photographic densities. Use is made of a photoelectric cell working at constant deviation, thus eliminating the phenomena of lag and hysteresis. The negative (of density X) and a wedge (of variable density D) are superposed, realising the condition $X+D=$constant. The accuracy obtained is of the order of 0·1 per cent. F. BOURION, E. ROUYER and MLLE. O. HUN: The cryoscopic determination of the hydration of ions in solution. JEAN COURNOT and MLLE. LOUISE HALM: The measurement of the degree of polishing in view of the determination of the amount of corrosion of rustless steels. It has been shown that in studying the corrosion of chrome-nickel rustless steels the exact condition of the surface must be capable of definition. An apparatus based on the use of a photoelectric cell is described which has given satisfactory results. AUGUSTIN BOUTARIC and MLLE. MADELEINE ROY: The influence of radioactive radiations on the flocculation of colloids. The experiments described clearly establish that the sensibility of the flocculation to the action of the radioactive radiation does not depend on the chemical constitution of the granules but only on their electric sign. PIERRE SÜE: The determination of niobium by orthoxyquinoline. Under conditions detailed, niobium pentoxide forms a microcrystalline precipitate with orthoxyquinoline: the niobium thus separated can be determined either gravimetrically or volumetrically. GUICHARD: Remarks on the atomic weight of iodine. The author gives reasons for preferring 126·91 to the International Commission figure, 126·932 and maintains the trustworthiness of direct determinations based on the use of iodine pentoxide. A. TCHAKIRIAN: The preparation of germanous iodide and the action of silver nitrate on the halogen derivatives of methane. GUY EMSCHWILLER: The action of gaseous hydrogen iodide on some iodine derivatives of hydrocarbons: new methods of preparation of ethylidene iodide, vinyl iodide and methyliodoform. The reactions of gaseous hydrogen iodide with organic iodine compounds differ from those of aqueous hydriodic acid. Some new reactions are described leading to the preparation

with good yields of ethylidene iodide, vinyl iodide and methyliodoform. MARTIN BATTEGAY and ELSAYED HÉGAZI: The chloride of thiourea, chloride of thionecarbamic acid or thiocarbamyl chloride. RAYMOND FURON: New observations on the extension of the Cretaceous and of the Eocene in the Niger Colony. D. SCHNEEGANS and G. EMILIANOFF: The presence of Tertiary strata in the Gabon basin (French Equatorial Africa). PIERRE URBAIN: The relative impermeability of the plastic sediments towards rain water, spring water and various alkaline solutions. Clays or marls may be impermeable to rain water and very permeable to spring water: hence the term impermeability has only a relative significance. NICOLAS MENCHIKOFF: The Devonian of Menakeb (Western Sahara). GEORGES and BORIS CHOUBERT: New tectonic observations on the Tabor massif. H. COLIN and J. AUGIER: The soluble glycides of *Lemanea nodosa*. Floridoside and trehalose have been isolated from this alga. MULLER and DESMAREZ: The differential microscopic characters of the bone of adult *Cynocephalus* and of human bone. It has been generally assumed that it is difficult, if not impossible, to differentiate the bone of the ape from human bone. The bones of the baboon, however, show characters clearly different from those of man. ABEL DESJARDINS: The whirling vibrations of the organism. EUGÈNE DONARD and HENRI LABBÉ: The co-existence in the rootlets of barley of hyperglycemiant and hypoglycemiant bodies. ANDRÉ PACAUD: An attempt at raising *Simodaphnia* and *Moina* in a synthetic medium. R. GUILLEMET and C. SCHELL: The sulphur of wheat, its nature and distribution. Correlation between the ratio of sulphur to nitrogen in wheat and the baking value of the flour. GASTON MÉNIER: Researches on the purification of air. A purifying apparatus.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **19**, 1–207, Jan. 15, 1933). ALBERT ERNEST JENKS: Minnesota Pleistocene *Homo*—an interim communication. On June 16, 1931, a skeleton was found in constructing a new road some three miles north of Pelican Rapids, in Pelican township of Ottertail county, Minnesota. The site showed no signs of a burial and was in laminated silt in the bed of a glacial lake (Glacial Lake Pelican). The skeleton is practically complete, possibly that of a woman aged seventeen years. The skull is that of an early form of *Homo sapiens*, of a generalised Mongoloid type, but shows noteworthy peculiarities. The skeleton was in sediment of late Pleistocene origin and has been named 'Minnesota man'. Photographs are reproduced. C. JUDSON HERRICK: The functions of the olfactory parts of the cerebral cortex. In primitive types the olfactory system is the dominant feature of the cerebral cortex but in primates it is reduced to a subordinate position. At all stages of cortical differentiation, an important function of the olfactory cortex is to serve as a non-specific activator for all cortical activities. G. KARL HUBER and ELIZABETH C. CROSBY: A phylogenetic consideration of the optic tectum. The tectum reaches its greatest morphological development in the reptiles and birds; in mammals, the sensory centres of the cerebral cortex have taken its place as the major sensory correlation centre. S. R. DETWILER: Experiments upon the segmentation of spinal nerves in salamander embryos. Reduction in number of ganglia following removal of somites and increase following insertion of an additional somite, support Lehmann's view that normal segmentation of spinal ganglia is determined by mesodermal metamerism. HARLOW SHAPLEY: A contribution to the study of galactic dimensions. Data from observations on isolated cluster type Cepheids in high latitudes indicates that these Cepheids outline the galactic system and may be so much as 30,000 light years from the galactic plane. Along the galactic plane the dimensions are probably greater, but direct measurement is rendered difficult by absorption. PETER M. MILLMAN: The theoretical frequency distribution of photographic meteors. DONALD H. MENZEL: A simple derivation of the dissociation formula. The argument starts from Boltzmann's formula for the distribution of atoms in different energy states. DEAN B. MCLAUGHLIN: A suggested mechanism of class *Be* stars. The spectra of these stars show wide emission lines of hydrogen divided by absorption lines, and cyclic changes of the relative intensities of the two components of each emission line occur. The stars are considered as having atmospheres so extensive and rarified that, to a first approximation, their atoms pursue independent orbits as satellites of the star, while the star itself is a temperature variable. E. B. MAINS: Host specialisation of *Erysiphe graminis Tritici*. Two physiological forms of the powdery mildew of wheat have been found. CARL D. LARUE: Regeneration in mutilated seedlings. Cotyledons and hypocotyls of many different families rooted in nutrient solutions. The effect of light is different in different species and sometimes even for the cotyledon and hypocotyl of the same species. When the cotyledons were removed, the remaining plumules failed to develop. B. S. HOPKINS and L. L. QUILL: The use of non-aqueous solvents in the study of the rare earth group. Differences in solubility of rare earth salts in water are small and separation is therefore difficult. Various alcohols and ethers have been tried as solvents. Ethyl ether proved useful for the separation of neodymium and praseodymium nitrates. L. O. BROCKWAY and LINUS PAULING: The determination of the structures of the hexafluorides of sulphur, selenium and tellurium by the electron diffraction method. A beam of electrons of uniform velocity intersect at right angles a jet of the gas, and the electrons scattered at right angles to the original beam are recorded photographically. The results indicate octahedral models and the following interatomic distances: S—F, 1·58 ± 0·03 A.; Se—F, 1·70 ± 0·03 A.; Te—F, 1·84 ± 0·03 A. WILDER D. BANCROFT and JOHN E. RUTZLER, JR.: The agglomeration theory of sleep. Sleep of various forms is postulated as due to reversible coagulation of some of the proteins of the centres of consciousness; it can be counteracted by the irritability of the sensory nerves. A peptising agent such as sodium rhodanate decreases this sensory irritability, but an overdose may affect the centres of consciousness and prevent sleep. HENRY EYRING: The zero point energy and the separation of isotopes. A theoretical discussion based on the view that separation of isotopes in processes involving velocity of adsorption is a special case of the general influence of zero point energy on reaction velocity. JOHN R. BATES: The reaction of hydrogen atoms with oxygen and the hydrogen chlorine reaction. WILDER D. BANCROFT, ROBERT S. GUTSELL and JOHN E. RUTZLER, JR.: Reversible coagulation in living tissue (11). Chronic alcoholism has been benefited by treatment with sodium rhodanate (peptisation therapy). (*To be continued.*)

Forthcoming Events

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

Monday, May 22

VICTORIA INSTITUTE, at 4.30—(in the Central Hall, Westminster, S.W.1).—Prof. Albert Fleischmann: "The Doctrine of Organic Evolution in the Light of Modern Research".

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Squadron-Leader A. R. M. Rickards: "The Towns of Wadi du 'An and Hadhramaut" (Geographical Film).

Tuesday, May 23

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 3.15.—Dr. L. P. Lockhart: "Industrial Medicine as a Function of Public Health".*

INSTITUTE of PHYSICS, at 5.15—(at the Royal Institution, 21, Albemarle Street, W.1).—H. Bradley: "Physics in the Boot and Shoe Industry".

Wednesday, May 24

UNIVERSITY OF CAMBRIDGE, at 5.—Sir Charles Sherrington: "Mechanism and the Brain" (Rede Lecture).

KING'S COLLEGE, LONDON, at 5.30.—J. L. Hammond: "The Growth of Common Enjoyment" (Hobhouse Memorial Lecture).*

GEOLOGICAL SOCIETY OF LONDON.—Discussion on "The Falling Water-Level in the Chalk under London", to be opened by H. Dewey.

SOCIETY OF CHEMICAL INDUSTRY (Food Group).—Annual General Meeting.

Thursday, May 25

ROYAL SOCIETY, at 4.30.—Dr. J. Chadwick: "The Neutron" (Bakerian Lecture).

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Dr. C. J. Thomas: "Physically Defective Children" (succeeding lecture on May 29).*

COURTAULD INSTITUTE OF ART, at 5.30.—P. Pelliot: "Recent Progress in Chinese Archæology".*

CHEMICAL SOCIETY, at 5.30—(in the Meeting Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Prof. H. E. Armstrong: "Chemistry at the Cross Roads" (Hugo Müller Lecture).*

Official Publications Received

GREAT BRITAIN AND IRELAND

University Grants Committee. Returns from Universities and University Colleges in Receipt of Treasury Grant, Academic Year 1931–32. Pp. 26. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

British Chemical Abstracts. Issued by the Bureau of Chemical Abstracts. Index 1932. Pp. 578. (London: Society of Chemical Industry.)

Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 36: Experiments on the Suitability of some Rectifier Photo Cells for the Measurement of Daylight. By Dr. H. H. Poole and Dr. W. R. G. Atkins. Pp. 537–546. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 2, No. 9: The Intellectual Resemblance of Twins. By Louis Herrman and Prof. Lancelot Hogben. Pp. 105–129. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s.* 9*d.*

City of Leicester Municipal Libraries. Catalogue of Books on Gardening, Poultry and Bees. Pp. 15. (Leicester.)

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1931–1932. Pp. 32. (Littlehampton.)

The Carnegie United Kingdom Trust. Nineteenth Annual Report (for the Year ending December 31, 1932) approved by the Trustees on Saturday, March 11, 1933. Pp. ii+88. (Dunfermline.)

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 47, Part 1, March. Pp. xx+91+21. (Edinburgh: Douglas and Foulis.) 7*s.* 6*d.*

The Institution of Professional Civil Servants. Annual Report of Council for the Year 1932. Pp. xiii+60. (London.)

The National Physical Laboratory. Report for the Year 1932. Pp. vi+277+17 plates. (London: H.M. Stationery Office.) 14*s.* net.

Journal of the Chemical Society. April. Pp. iii+329–471+vi. (London: Chemical Society.)

The Proceedings of the Physical Society. Vol. 45, Part 3, No. 248, May 1. Pp. iv+367–491. (London: Physical Society.) 7*s.* net.

The Ross Institute and Hospital for Tropical Diseases. Annual Report and Accounts for 1932. Pp. 96. (London.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 3, March. Abstracts Nos. 374–577. Pp. 73–108. (London: H.M. Stationery Office.) 1*s.* 6*d.* net.

Journal of the Royal Microscopical Society. Series 3, Vol. 53, Part 1, March. Pp. xii+108. (London: Royal Microscopical Society.) 10*s.* net.

The Annual Report of the Visitors of the Royal Institution of Great Britain for the Year ending December 31, 1932. Pp. 25. (London: Royal Institution.)

OTHER COUNTRIES

Smithsonian Miscellaneous Collections. Vol. 89, No. 4: Scouting for a Site for a Solar-Radiation Station. By A. F. Moore. (Roebling Fund.) (Publication 3212.) Pp. 23+4 plates. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 10, No. 3, March, Research Papers Nos. 531–539. Pp. 289–426. (Washington, D.C.: Government Printing Office.) 25 cents.

University of California Publications in Zoology. Vol. 37, No. 17: The Occurrence of Streptostyly in the Ambystomidæ. By Theodore H. Eaton, Jr. Pp. 521–526. 25 cents. Vol. 38, No. 6: Amphibians and Reptiles from Lower California. By Jean M. Linsdale. Pp. 345–386. 35 cents. Vol. 38, Nos. 7 and 8: An Unrecognised Shrew from New Jersey, by Morris M. Green; A Relic Shrew from Central California, by Joseph Grinnell. Pp. 387–390. 25 cents. Vol. 38, No. 9: New Mammals from St. Lawrence Island, Bering Sea, Alaska. By E. Raymond Hall and Raymond M. Gilmore. Pp. 391–404+plates 5–6. 25 cents. Vol. 38, Nos. 10 and 11: A New Lake-side Pocket Gopher from South-Central California, by Joseph Grinnell; A New Pocket Gopher from New Mexico, by E. Raymond Hall. Pp. 405–413+plate 7. 25 cents. Vol. 38, No. 12: Remarks on the Affinities of the Mammalian Fauna of Vancouver Island, British Columbia; with Descriptions of New Subspecies. By E. Raymond Hall. Pp. 415–423. 25 cents. (Berkeley, Calif.: University of California Press.)

Royal Zoological Society of New South Wales. Bibliography of Australian Entomology, 1775–1930; with Biographical Notes on Authors and Collectors. By Anthony Musgrove. Pp. viii+380. (Sydney.)

Memoirs of the Queensland Museum. Vol. 10, Part 3, March 14. Pp. 131–156. (Brisbane.)

Legislative Assembly: New South Wales. Report (together with Appendices) of the Minister of Public Instruction for the Year 1931. Pp. 39. (Sydney: Alfred James Kent.) 2*s.* 6*d.*

Liverworts of the Western Himalayas and the Panjab Plain. Part 1, Supplement. By Prof. Shiv Ram Kashyap. Pp. 10. Part 2. By Prof. Shiv Ram Kashyap, assisted by Ram Saran Chopra. Pp. iii+137+31 plates. (Lahore: University of the Panjab.)

Report of the Haffkine Institute for the Year 1931. By Lieut.-Col. J. Taylor. Pp. 72. (Bombay: Government Printing and Stationery Office; London: High Commissioner for India.) 6 annas; 8*d.*

Proceedings of the Imperial Academy. Vol. 9, No. 2, February. Pp. iii–iv+31–81. (Tokyo.)

Government of India: Department of Industries and Labour. Functions and Organisation of the India Meteorological Department, 1933. Pp. 19. (Simla: Government of India Press.)

Ontario Research Foundation. Report for the Year 1932. Pp. 39. (Toronto: Herbert H. Ball.)

Union of South Africa. Report of the South African Museum for the Year ended December 31, 1932. Pp. 18. (Pretoria: Government Printer.)

Cornell University: Agricultural Experiment Station. Bulletin 548: Corn and Soybeans for Silage. By R. G. Wiggans. Pp. 36. Bulletin 552: The Effect of certain Mineral Elements on the Color and Thickness of Onion Scales. By J. E. Knott. Pp. 14. Memoir 143: Studies on the Downy Mildew of Onions, and the Causal Organism, *Peronospora destructor* (Berk.) Caspary. By Harold Thurston Cook. Pp. 40. Memoir 144: The Physical Volume of Production in the United States. By G. F. Warren and F. A. Pearson. Pp. 72. (Ithaca, N.Y.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 11, No. 8: Observations on the Life History of the Marbled Salamander, *Ambystoma opacum* Gravenhorst. By G. K. Noble and M. K. Brady. Pp. 89–132. (New York City.)

University of California Publications in American Archæology and Ethnology. Vol. 31, No. 5: The Cocopa. By E. W. Gifford. Pp. 257–334. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1 dollar.

U.S. Department of Agriculture. Technical Bulletin No. 345: Biology and Morphology of the Spindle Worm or Elder Borer. By J. C. Silver. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 82, Art. 17: A New Nematode from the Rhea. By Everett E. Wehr. (No. 2958.) Pp. 5. (Washington, D.C.: Government Printing Office.)

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