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CONTENTS

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Co-ordination in Research

ONE of the most significant passages in the recent report* of the Advisory Council of the Department of Scientific and Industrial Research is that which is concerned with the policy the Council has followed in regard to grants for scientific and industrial research. As announced in last year's report, the policy adopted under the stringency imposed by the demand for national economy has been to concentrate available funds on work of the most immediate practical value to industry. In pursuance of this policy, some reduction has been made in the value of individual grants as well as in the number of new awards. This decision was taken with regret, and the Advisory Council has to be content with the knowledge that it has at any rate preserved intact for a more favourable time the organisation for the pursuit of more fundamental inquiries.

It is obvious that the Advisory Council regards this economy with considerable misgivings. As it points out, pure scientific research is not merely the gratification of intellectual curiosity but indeed an essential step in an economic process which results in applications to the practical issues of the day. Withdrawal of financial support may seriously circumscribe the work of men who are often responsible both for the scientific discoveries which, later, may prove to be the basis of radical industrial developments, and for assisting in decisive ways through their training in scientific research in the solution of current practical problems.

There can be little doubt that the Advisory Council is fully justified in its contention that, in assisting promising scientific investigations and in providing young investigators with opportunities of serving their apprenticeship to research under the inspiration and guidance of leading investigators at the universities, the Department is rendering valuable services to the advancement of scientific knowledge. There is much to be said for concentrating fundamental research in the free and unfettered atmosphere of the universities, and for the view that in such centres and under such conditions the young graduate can best acquire a thorough knowledge of the principles which must inspire scientific work. Such a policy has, however, its own dangers, and not the least is the tendency to divorce scientific from industrial research and

*Department of Scientific and Industrial Research. Report for the Year 1931–32. (Cmd. 4254). Pp. iv+193. (London: H.M. Stationery Office, 1933.) 3*s.* net.

to establish barriers to free contact and interchange of personnel and ideas.

There are other dangers in the policy which call more particularly for comment at the present time. In the first place, the restriction of grants for research by the Department of Scientific and Industrial Research is only one of the ways in which such expenditure is being curtailed at the present time. In the supposed interests of national economy, the numerous other Government organisations such as the Ministry of Agriculture, the Development Fund and the Forestry Commission, which make grants for research, are also curtailing their expenditure. It is one of the dangers of the lack of co-ordination in our national expenditure on scientific research that, just as in a time of expansion the lack of control may lead to lavish and wasteful expenditure in certain directions, so in time of economy the same lack of co-ordination and absence of planning may lead to a series of small economies which cripple almost all scientific research irrespective of its relation to national needs. Apart from this question of co-ordination to which we have referred on previous occasions in these columns, the policy of restricting grants on scientific research can only be truly assessed when it is remembered that the resources of the universities have themselves been impoverished at the same time. Simultaneously, therefore, both the need for assistance in training for a career of scientific research is increasing and the resources available to afford such assistance are seriously shrinking.

No one who realises the importance of trained intelligence in every department of life to-day can view such a position without concern. In the conduct of research, as of industry and national administration, quality is all-important, and growing attention is being directed to the selection of personnel. Neglect of this factor is responsible for many of the serious difficulties with which certain of our industries are confronted to-day. Even in comparison with France, many of our small firms in the textile and dyeing and finishing trades, for example, show a lamentable absence of technical and scientific knowledge on the part of those in control. On the other hand, success in research and in industrial enterprise is largely dependent upon the selection of those possessing not merely the necessary scientific and technical qualifications but also the temperament and wisdom essential in the direction of a team or group of investigators. Under efficient management, moderate expenditure with a limited but well-chosen and highly qualified staff will yield far more valuable results than lavish expenditure with an unsuitable staff.

If in research quality is most important, the factor of quantity must not be ignored. It is important that the basis from which selection is made should be as wide as possible, and moreover, that the training given should be varied and appropriate. Similarly, the barriers which under modern conditions appear to be springing up to the exchange of personnel between industry and industry, and industry and the universities, have untoward consequences in hindering the supply of men qualified by reason of wide and varied experience to undertake the direction of industrial research. It is not so easy as it should be for an industrial investigator to return to an academic post and utilise his actual experience of industry in the training of its recruits; nor is it so common as it once was for a man to move from one industry to another and acquire a mature and wide outlook which should be invaluable alike in the direction of actual industrial research or of the training of recruits for an industrial career. In addition, the tendency for the technical man with administrative and industrial ability to be diverted to positions in which his technical interests are definitely subordinate to commercial ones is another factor making for difficulties in filling the higher positions of industrial research with men of the requisite all-round ability.

In spite, therefore, of the parallel which has been drawn between the national organisation of research and that depicted by Francis Bacon in "The New Atlantis", it is unwise to regard anything approaching the conception of Salomon's House as yet existing in Great Britain. Apart from the lack of co-ordination in the financing and direction of research and in the training and selection of personnel, development has been too unbalanced, and the relations between applied and fundamental research are too easily disturbed for us to believe that we are yet living in the New Atlantis. Laboratories, it is true, have been created in which can be acquired "the knowledge of causes and the secret motion of things" and in them scientific workers are steadily "enlarging the bounds of human empire to the effecting of all things possible". Though many of the inventions and ideas outlined by Bacon among the treasures of Salomon's House are now commonplaces of our civilisation, it cannot yet be said that scientific

research has been accorded a position in national life even faintly approximating in influence to that enjoyed by Salomon's House and its fellows.

Fundamentally, this position must be ascribed to the absence of any adequate conception of a national structure of research ministering to the needs of society as well as of industry, of the extent to which scientific research can serve our industrial and social life. If there has been little attempt to rationalise even the grants made by Government to particular fields of research, there has been no attempt as yet to assess the place of research in the broadest sense in the structure of our national life—to evaluate its contribution in each department of State as well as in industry, to assess the relations of fundamental and applied research on a systematic and thorough-going basis and to correlate the contributions from the national exchequer and those from industrial or private sources.

Such an effort is fundamental to the evolution of a national research organisation on a scale commensurate with our needs and with the spirit embodied by Bacon in the "New Atlantis". Only then can we be secure, within the limits of human wisdom and judgment, that our national resources in research are planned to the maximum advantage, that even in times of national emergency those activities are maintained unimpaired which are destined to yield the nation as a whole the richest argosies of discovery, learning, culture or wealth. Then indeed may we be satisfied that under the plea of national economy there is no choking of channels through which industry and society draw their recruits to the cause of science, no diversion for temporary advantage of the effort which should be laying the foundation of future development and advance. But for that day we may look in vain until we have learnt in the spirit of the New Atlantis to render honour where honour is due and to accord to those engaged in the manifold activities of science, whether as investigators in its pure or applied branches, as administrators, interpreters or expositors, or prophets, a status and respect commensurate with that which the citizens of Bacon's imaginary commonwealth accorded to the Fathers and Fellows of Salomon's House, until in the minds of those who pursue the vocation of science, whether pure or applied, there is dominant the spirit of service and, on the part of the community, a generous recognition of that spirit in science and her followers.

Scientific Theory and Religion

Scientific Theory and Religion: the World described by Science and its Spiritual Interpretation. By Dr. Ernest William Barnes. (The Gifford Lectures at Aberdeen 1927–1929.) Pp. xxiv+685. (Cambridge: At the University Press, 1933.) 25*s*. net.

LORD GIFFORD died in 1887 and left his estate to the four Scottish universities, to furnish lectures in natural religion; since when, every year, many lectures have been delivered on the subject. To judge by some of them, the subject shows some signs of exhaustion; but that may be because it touches two branches of knowledge—natural philosophy and religion—and the people who are competent and willing to speak on their relationship are very few.

Scientific men ought to give a cordial welcome to this volume. Dr. Barnes thinks it time we ceased to talk in a vacuum, as though science did not exist. Consequently a considerable part of the book is devoted to "as full an account as ignorance will allow of the conclusions of natural science, and their spiritual interpretation". Needless to say, no signs of "ignorance" are discernible. The word is merely a polite apology for a task that is really encyclopædic. Two successive entries in the index refer to Moses and Mosses. Necessarily, Dr. Barnes has had to depend upon the writings of others, but he has taken great pains, over several years, not only to be accurate but also to be up to date. Still, no one can be an expert in everything, when the range is from adiabatics to anthropology, geology to genetics, physics to prehistory, not to mention ethics, philosophy and religion. To give the cream of each subject is, no doubt, required of a man who must be modern. The danger is in underlining what is sensational and ephemeral. Against this the best guard is a good judgment. It may be said at once that the book is extraordinarily well done. It is long, but it is balanced, and any difficulty there is in reading it results solely from its range.

Moreover, it is what Montaigne offered in his essays, "un livre de bonne foy". Dr. Barnes ranges himself definitely in the scientific camp, and no scientific man would question his title to do so. He disclaims explicitly the "evasions" which scientific men condemn, and which they would not dream of using. He can do so freely,

as we do, because, after all, science is only speculation. No one is tied to any statement. Whether one speaks of the reality of time and space, or the existence of genes, any statement is held for what it may prove to be worth. Behind this random plan, we know that there is a subtle method for searching out truth. We may not know in which direction truth lies, but by unprejudiced and numerous trials, we find out in which direction it does *not* lie. After many years of trials, this gives the sense of freedom and security that scientific men enjoy. We may not know how evolution works. Some think natural selection inadequate; some may condemn it altogether; others may speculate on the inheritance of acquired characters: but consistently with this variety of view, there is a confidence, that really does not brook questioning, that some form of evolution contains the truth.

Some of the subjects with which Dr. Barnes deals cannot be treated without mathematics. They remain, of course, none the less speculative. Dr. Barnes, as one who has undergone the discipline of mathematics, quotes Roger Bacon's dictum: "he who knows not mathematics cannot know any other science; what is more, he cannot discover his own ignorance or find its proper remedies". We remark that Roger Bacon lived a long time ago. Anyhow, we get a good deal of mathematics in this book. It is to be feared that it will not be read. Many of those who are able to read it will skip the demonstrations and jump to the conclusions. Still more people, when they see a page of mathematics before them, will say: "This is Chinese to me", and skip it altogether. Some of them are by no means negligible as reasoners. It was Bishop Creighton, I believe, who said he could *do* mathematics all right, but he never knew what they were about. Some hold that mathematics, with its hypotheses and exclusions, is merely misleading, and that nothing that has happened recently has altered the fact.

Turning from mathematics to physics, the world has of late seen many novel spectacles, but surely none more novel than in the polytechnicum of physics. Once on a time the man in the street could pass by its uninviting doors, sure only from the busy sounds that reached him that there was harmony within and that the denizens were conning their tasks. But now they rush out of the doors upon him, eager to tell him, in as many voices as he will hear, not that they have found the key to his puzzles, but that they have lost the hope of finding it, and don't know what to do about it. Physics, in fact, has reached an issue that might have been, and was, foreseen long ago—that the atomic view and the continuum are not consistent, and cannot be made so, unless we use the same word in two meanings.

Moreover, the trouble is complicated by a breakdown in causality. Of course, there is still an enormous amount of descriptive and empirical detail to be done, by those who like that kind of thing. But they, too, are faced by the same prospect, when, if ever, they bring their subject to a rational basis. The philosopher, who saw this impasse clearly long ago, may look with some amusement on the confusion that has appeared in the scientific camp, when what he already knew was discovered. But incidentally, a consequence is that modern physics is very interesting to talk about, and Dr. Barnes has not failed to use the fact.

All this is common form to the scientific man. He may read it again, and very pleasantly, in this book. But it is only one side of the question. What really matters is, how it fits on to the other side. Does the progress of physical science, containing as we feel it, unquestionable truth, indicate, and indicate indubitably, where spiritual truth lies? One thing is certain—it indicates many directions where spiritual truth does not lie. Dr. Barnes has no tenderness for the errors of these hoary impostors. He speaks of the "legendary Flood associated with the story of Noah's ark". Indeed the style of the book, never heavy in spite of its subject, is a little relieved by certain 'digs'—not unknown in clerical circles—at those who would willingly have made him smart; as when he says "the existence and cause of appendicitis are singularly difficult of explanation by those who contend that man was specially and directly created by God". In a more serious way, he underlines the statement (p. 522): "*In the end all attempts to take from God responsibility for the nature of His creatures must fail.*" One is reminded of Job's question: "If it be not He, Who then is it?"

The only one of these questions that seems to the reviewer both important, and also liable to solution, is that of the reality of time. Dr. Barnes states quite clearly that he holds time to be real. But there must be very great doubt about it. Relativity has laid hands upon it and united it with space, nor could it otherwise have performed the feats that make us believe in it. If we settle down to the belief that time is after all an illusion,

a subjective addition to our perceptions, and not exact at that, we are faced with a greater revolution than that which displaced the earth from the centre of things. *All* our ideas fetch loose. Causality is only one of them. Evolution and ethics go too. The scheme, without which we cannot make *any* statement, becomes no more than a makeshift.

Finally we may ask: Has science any positive message? Evidently it cannot have, the whole of science being hypothesis, including the foundations. Science and religion are in different regions. No bridge can be made between the two. The errors which science can and does point out consist exclusively in misguided attempts from the other region, to impose upon us a dogmatic pseudo-science, as when the statement about the creation of man is faced with the problem of explaining his appendix. Dr. Barnes puts the body first, but if I understand him aright, that is only because it falls under his subject, and there is more that is definite to say about it.

The work of branding pseudo-science is far from ended. As to what remains:

"Also fragen wir bestaendig,
Bis man uns mit einer Handvoll
Erde endlich stopft die Maeuler—
Aber ist Das eine Antwort?"

R. A. S.

Exploration of Mongolia

The New Conquest of Central Asia: a Narrative of the Explorations of the Central Asiatic Expeditions in Mongolia and China, 1921–1930. By Dr. Roy Chapman Andrews. With Chapters by Dr. Walter Granger, Clifford H. Pope, Nels C. Nelson; and Summary Statements by G. M. Allen, R. C. Andrews, C. P. Berkey, R. W. Chaney, A. W. Grabau, W. Granger, F. K. Morris, N. C. Nelson, J. T. Nichols, H. F. Osborn, C. H. Pope, C. A. Reeds and L. E. Spock. (Central Asiatic Expeditions: Natural History of Central Asia, Vol. 1). Pp. 1+678+128 plates. (New York: American Museum of Natural History; London: G. P. Putnam's Sons, 1932.) 63*s*. net.

THE expedition of the American Museum of Natural History to Central Asia left Peking for its first journey in Mongolia on April 17, 1922. Its object, as formulated by Dr. Roy Chapman Andrews in his narrative of the expedition, of which he was the leader from first to last, was "the study of the geological history of Central Asia; to find whether it had been the nursery of many of the dominant forms of animals, including the human race, and to reconstruct its past climate, vegetation, and general geographic conditions, particularly in relation to the evolution of man".

So long ago as 1900, Prof. H. Fairfield Osborn, now honorary president of the American Museum of Natural History, writing in *Science*, predicted that Central Asia would prove to have been a great centre of dispersal for northern terrestrial mammalian life. At that time no fossils had been found in Mongolia, and their occurrence in China was known only from the fossil teeth exposed for sale as medicine in Chinese shops. It was from this source came the tooth, detected by Schlosser in 1903, which ultimately led to the discovery of Peking man.

Preparations for the journey of 1922 had been begun in Peking by Dr. Andrews in the preceding year; and two members of the expedition, Dr. Clifford H. Pope, herpetologist, and Dr. Walter Granger, palæontologist, had already been at work in Hunan and the valley of the Yangtze respectively during the winter months. It was not Dr. Andrews's first experience of scientific work in China: he had engaged in zoological exploration on two previous occasions; and he was personally acquainted with conditions in Mongolia.

If it was Osborn's scientific insight that inspired the expedition, it was Andrews's experience that ensured its successful issue; it had convinced him that solid scientific achievement was possible only for an expedition operating over a series of years and consisting of a body of specialists in the various branches of science concerned, working in co-operation in the field at one time. It was on these lines that he planned the expedition; and to palæontologist, geologist and zoologist, he added palæobotanist, archæologist and cartographer, varying the personnel as the plan of the season's campaign required. With motor expert, photographer and other members, the expedition in 1925 totalled forty men, its highest number in any one year, twelve being Americans, two British, and the remainder Chinese or Mongolian.

Owing to the harsh winter climate of Mongolia, the expedition could work only in the summer; but the use of the motor-car, supported by a camel train, made it possible to cover, it is estimated, ten times as much ground as had been covered by any previous expedition, and to increase the

volume of work in proportion. On several occasions members of the expedition worked in China during the winter months in accordance with an arrangement with the Geological Survey of China, by which the expedition's sphere of activities was defined to avoid overlap.

The scheme of work provided for one year's reconnaissance, to be followed by a year of intensive field-work, based on the information obtained in the previous season. Five journeys of exploration were made—in 1922, 1923, 1925, 1928 and 1930. In 1928, unfortunately, differences arose with the Chinese authorities, which brought the expedition's work to a close in 1930, leaving many problems unsolved.

Although Dr. Andrews was confident of the success of his expedition, its prospects were not regarded as hopeful by others. With the exception of the "rhinoceros" tooth brought back by Obruchev from his expedition of 1894–96, no trace of fossils had been found in Mongolia. This confidence was speedily justified. On the first journey, within 265 miles of Kalgan, where the party passed through the Great Wall, Granger discovered at Iren Dabasu a rhinoceros tooth, and "the first Cretaceous and the first dinosaur in eastern Asia" were brought to light. The first fragment of the famous dinosaur's eggs was found at Shabarakh Usu in what came to be regarded in 1925 as "the most important deposit in Asia if not in the whole world".

In "The New Conquest of Central Asia" Dr. Andrews recounts the work of the expedition in travel and research from day to day. His narrative is illustrated by a collection of remarkable photographs, which in conjunction with his vigorous descriptions, conveys a vivid impression of the country and the conditions in which the expedition worked. In addition, to complete his picture, he notes the appearance and character of the inhabitants, as well as the more striking features of their culture. Present political conditions, in which in Outer Mongolia Russian influence plays a predominant part, forced themselves on his attention and call for comment.

This first volume of the series of twelve "Final Reports" which are to cover the scientific results of the expedition, is intended to serve the double purpose of an introduction to the series and a semi-popular account which will give the layman a comprehensive view of the expedition as a whole. Hence, in addition to Dr. Andrews's narrative, it contains a summary of the results in general by the editor of the series, Dr. Chester A. Reeds, and an outline summary by each specialist in his own subject. The problems awaiting future exploration are also enumerated.

The expedition has been commendably prompt in publishing its results. Vols. 3 and 5 of the final reports, dealing with geological material, have already appeared; but while the expedition was still in being, publication went hand in hand with discovery through the Museum's *Novitates* and *Bulletin*. One hundred and fourteen papers have already appeared and are being reissued in volume form as "Preliminary Reports", to which additions will be made when descriptions of the material still unexamined are available. A full bibliography to date appears as an appendix to the volume under notice.

As the results of the expedition have already been made known to the scientific world by these publications, they do not require detailed mention here in connexion with this descriptive narrative. In their more general aspect, it is possible to say that the geological and palæontological exploration of Mongolia has revealed a new continent, old in time, but new to science. For this continent Dr. Grabau has suggested, appropriately enough, the name of "Gobia".

A new light has been thrown on the geological and palæontological history of the Asiatic continent. The prediction of Prof. Osborn as to the significance of Central Asia as a dispersal area of terrestrial mammalian life has been fully confirmed; while the deposits of an inundation of marine waters of Middle Permian age has produced many marine forms previously unknown. In all, more than a thousand forms new to science have been described. Yet much material has still to be examined.

Towards the solution of the problem of man's origin and evolution the expedition has made no contribution; while the geological and geographical observations combine to show that from late tertiary times to recent, climatic conditions have become increasingly unfavourable to the development of culture. Of the archæological discoveries, the mesolithic culture of the dune dwellers is the most interesting. As evidences were found of seven stages of culture, of which six were prehistoric—eolithic, upper palæolithic, mesolithic, neolithic and metal—it may well be that, notwithstanding the somewhat disappointing results recorded here, Mongolia will ultimately fall into place as a contributory source of evidence for

the growth of civilisation with the development of archæological investigation in the Far East.

It is something of a work of supererogation to commend a volume such as this which surveys the work of an expedition already widely recognised as having made a vast contribution to scientific knowledge. It is, however, at once a duty and a pleasure to say that Dr. Andrews and his collaborators have accomplished what they set out to do. They have made for the benefit of the scientific world and the general public a lasting record of a great undertaking which has produced epoch-making results.

Science in the Petroleum Industry

The Scientific Principles of Petroleum Technology. By Dr. Leo Gurwitsch and Harold Moore. New edition. Pp. xii+572+9 plates. (London: Chapman and Hall, Ltd., 1932.) 30*s.* net.

FEW industries have expanded more rapidly than that of petroleum. The enormous demand for motor spirit has brought about both an increased production of crude oil and an overhaul of the methods of distillation and refining, including cracking and hydrogenation, so as to produce a petrol of high quality suitable for use in the automobile of to-day. Whilst there has been much progress on the mechanical side, including the design of stills, of cracking plant and of apparatus for the storage and transport of very large quantities of oil and gas, there has also been a great deal achieved on the chemical side of petroleum technology. The numerous members of the four classes of hydrocarbons—saturated, unsaturated, aromatic and naphthenic, are found in varying proportions according to the origin of a petroleum: they can be separated by rational treatment with various chemicals and by systematic fractional distillation. Such preparations are laborious and research in the main is directed to the separation of the four principal classes, as it is on the proportions of these that the value of a petroleum for a particular purpose depends. Thus Pennsylvania and Galicia oils are rich in saturated hydrocarbons, the Baku oils contain naphthenes, Borneo crudes are rich in aromatics—indeed at one time toluene was extracted from them.

This is a second edition, the first being a translation by Harold Moore of a German work by Prof. Gurwitsch. Owing to the death of the German author the new edition is entirely the work of Harold Moore; in extending the book he has now paid special attention to the American developments.

The method adopted is to deal first with the chemistry and then the physics of the raw material, secondly with the manufacture from crude under the headings preliminary treatment, distillation, refining, and thirdly with the products.

It is of advantage to have a book of this kind in which the scientific practice and principles are separated from the oil-field technique with its particular jargon. The subject is fully and clearly treated in the chemical and physical sections, which are provided with copious references to the original literature. Technicians will perhaps find greater interest in the manufacturing section, where there is much which is stimulative and thought provoking, as for example, the sections on chemical processes in distillation and destructive distillation and on pyrolysis.

Oil cracking is a little industry of its own. It was at first brutal in its efforts to achieve any kind of cracking of a crude oil to products of lower boiling point. Now that the process is better understood and has been brought much more under control, it is possible to effect the simplification of the large molecules into smaller ones without creating undue quantities of coke or gas representing small fragments of the molecule. Indeed the latest processes of high-pressure cracking are so efficient that upwards of eighty per cent of merchantable petrol is obtained from a suitable crude.

The competitive market requires a high, though often purely arbitrary, standard of quality in petrol, so that refining has become an important operation. It affects colour, specific gravity, flash point and viscosity. Among chemical methods one of the most interesting is that of Edeleanu, which makes use of liquid sulphur dioxide as a solvent for aromatic and unsaturated hydrocarbons, and thus effects a partial separation of these from the naphthenes and saturated hydrocarbons.

Sufficient has been said to indicate the wide and ample scope of the work. The oil industry is not standing still, the present intensive competition being a spur to the utilisation of a crude oil to the last per cent. This can only be achieved by the application of science to every operation in the chain of production, manufacture, transport and distribution.

E. F. A.

Spectra and Hilbert Space

Linear Transformations in Hilbert Space: and their Applications to Analysis. By Prof. Marshall Harvey Stone. (American Mathematical Society Colloquium Publications, Vol. 15.) Pp. viii+622. (New York: American Mathematical Society; Cambridge: Bowes and Bowes; Berlin: Hirschwaldsche Buchhandlung; Paris: Albert Blanchard; Milano: Nicola Zanichelli, 1932.) 6.50 dollars.

THIS most welcome treatise fills a serious gap in English mathematical literature. It provides for the first time a comprehensive account of the general transformation theory which steadily dominates theoretical quantum mechanics and is guiding the development of more than one branch of pure mathematics.

The book is ambitious in plan and eminently successful. Starting from abstract Hilbert space, the author develops the linear transformation theory in full panoply through some four hundred pages. Pride of place is naturally taken by the spectral theory initiated by Hilbert in his classical work on integral equations and developed in recent years by J. v. Neumann and others, including the author himself. An occasional short descent to more special illustrations helps the reader to adapt himself without distress to the rarefied air of Hilbert space and prepares for the final section.

That the theory is, in Polya and Szegö's happy terms, a generalisation "by condensation" and not "by dilution", is abundantly proved when we come to its applications in more special fields. These occupy the last third of the book. First, we are shown in detail how the Carleman theory of integral operators can be brought under the general theory of symmetric transformations. Next, ordinary differential operators of the first and second orders are discussed at length, with a side-glance at the Heaviside operational calculus. Finally, Jacobi matrices, continued fractions and the moment problem are fitted into the general scheme.

The printing and general layout are attractive, but it is a great pity that the work was not issued in two volumes. Its present form is cumbersome. Even so, there will be few analysts who will not wish to possess a copy. E. H. L.

Short Reviews

Fortschritte der Botanik. Herausgegeben von Fritz von Wettstein. Band 1: *Bericht über das Jahr 1931.* Pp. vi+263. (Berlin: Julius Springer, 1932.) 18.80 gold marks.

THIS attempt to present a brief report each year of the progress made in different fields of botany would be a useful addition to the voluminous literature of the subject if it saved the reader's time in delving into other and lengthier communications, or if it guided him to interesting work he had otherwise missed.

The present volume is intended to review the literature of 1931 with just sufficient analysis of earlier work to indicate the significance of the contributions of 1931. On the whole, the reviewer finds it disappointing. The fact that Continental work mainly is considered may be an advantage to the English reader, who is probably already familiar with English and American work, but the field to be covered is so vast that the brief summaries that alone are possible do not seem adequate and many fields of work are entirely neglected. Thus there is practically no mention of the modern work, with physical methods, upon the structure of the cellulose wall, and plant anatomy receives very cursory mention. Cytology can receive but very inadequate treatment in 10 pages, of which more than half refer to the Protista and in which there is curiously frequent reference to unpublished work in view of the fact that the review is for 1931.

Botanical work is reviewed in 16 contributions by 15 different authors under the following main heads: morphology, systematic, metabolism (including water movement), physiology of organ formation, ecology. It is proposed to issue a similar volume annually but it is questionable whether a volume on the lines of the old *Progressus Rei Botanicæ* would not be more valuable. In *Progressus* the same field was not reviewed each year but each review was more exhaustive, with adequate bibliographic treatment, so that the subject could then well be left to await re-examination after a suitable interval when the work since done in this field justified its reconsideration.

Egyptian Government. *Views of Typical Desert Scenery in Egypt.* Prepared by the Geological Survey of Egypt. Presented to the International Geographical Congress at Paris 1931, by Command of His Majesty King Fouad I. Pp. xiv+34 plates. (Giza: Survey of Egypt, 1931.)

THIS album of views of typical desert scenery in Egypt was prepared at the desire of His Majesty King Fouad I for presentation to the International Geographical Congress at Paris in 1931. The selection, arrangement, and descriptions of the

photographs are the work of Dr. W. F. Hume and the present director of the Geological Survey, Mr. O. H. Little. The plates, some of which include up to five figures, measure 20 in. by 14 in.; they have been executed in sepia by the rotary photogravure process, and in them the varied scenery of the Egyptian deserts with their high mountains, broad valleys, wind-swept plateaux and vast areas of sand, is magnificently portrayed. The popular impression of the deserts as broad flat expanses of sand stretching away from the Nile valley in monotonous uniformity is speedily corrected by this fascinating album, which is designed to bring out the great variety of the features displayed by a wilderness where in many places geological structures and geographical contrasts are to be seen on a strikingly conspicuous scale.

In a well-written introduction the various features of interest presented by each group of related plates, from those devoted to the Mediterranean coast, the depressions, oases and mountains, to those showing wells, mining centres and other aspects of human activities, have been simply but adequately described. In every respect the album reaches a high standard of achievement and congratulations are due to all who have been concerned in its production.

On the Mechanism of Oxidation. By Prof. Heinrich Wieland. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. x+124. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1932.) 15*s.* 6*d.* net.

Über den Verlauf der Oxydationsvorgänge. Von Prof. Dr. Heinrich Wieland. Pp. viii+96. (Stuttgart: Ferdinand Enke, 1933.) 7.80 gold marks.

AMERICAN universities are fortunate in being able to use the income derived from various legacies to attract distinguished European savants across the Atlantic to lecture to them. Prof. Heinrich Wieland of Munich gave six Silliman memorial lectures at Yale University last year, which are now available in both English and German in book form. The lectures follow familiar lines in this subject, dealing with oxidation and autoxidation in general, the activation of hydrogen, acetic acid fermentation, the dehydrogenase of milk and the catalytic effect of iron. The subject is expounded in a clear manner, and it is useful to have Wieland's explanation of it in English, particularly as much of the original German literature on the subject is, for some unknown reason, somewhat difficult to follow. It is remarkable how varied are the ways in which the simple oxygen molecule reacts with different substances and how much has still to be discovered before an adequate understanding of what occurs during the oxidation processes in the living cell can be achieved. All that has so far been accomplished forms but an introduction to this problem.

Institutional Revenue: a Study of the Influence of Social Institutions on the Distribution of Wealth. By H. D. Dickinson. Pp. 264. (London: Williams and Norgate, Ltd., 1932.) 10*s.* 6*d.* net.

MOST economists in discussing the subject of inequality in the distribution of wealth have been content to give either a descriptive account of social institutions affecting distribution or an analysis of income into rent, interest, wages and profits. Mr. Dickinson attempts to combine the institutional and analytical points of view. Defining an institution as a set pattern of social behaviour with respect to some function or functions, he puts forward the theory that certain social institutions, though not necessarily only those embodied in definite organisations or associations, maintain the existence of non-competing groups which by means of limitations on entry, secure an 'institutional revenue' akin to a monopoly revenue for the more favoured of these groups. There is of course considerable mobility between the groups since Western society is not rigidly divided into orders or castes like that of old Japan or modern India. Members of the more favoured groups, however, are only subject to outside competition from exceptional persons in less advantaged groups.

The author makes no reference to Nicholson's "Principles of Political Economy", with its important discussion of the institution of private property, but otherwise the book is of exceptional interest and will well repay reading.

Grundzüge einer Konstitutionsanatomie. Von Prof. Dr. Walter Brandt. Pp. iv+382. (Berlin: Julius Springer, 1931.) 29.80 gold marks.

THIS presentation of the fundamentals of constitutional anatomy breaks new ground. It is a laudable attempt to synthesise into a whole the work in the various fields of bodily habitus, constitution and racial characters, attention throughout being focused on the underlying biological basis. At the same time, from the analytical side the problems of constitution are dissected in terms of structure, growth and differentiation. The comparative treatment of "Entwicklungsmechanik" is traced in animal forms ranging from the invertebrates to man, with numerous references to analogous processes in the plant world.

The presentation of our state of knowledge as regards breeding of horses and cattle is related to the different types of bodily habitus in man. The main phenomenon of intersexuality in amphibians and birds is discussed in terms of the endocrine glands, with special reference to the particular time at which the endocrine factors reach their maximum potency.

The wealth of illustration in this book, together with the broad view of problems in constitution throughout animate forms, cannot fail to remind one of the distance traversed since Andrias Vesalius described the anatomy of the dissected corpse.

Liquid Crystals

BY holding a conference on "Liquid Crystals and Anisotropic Melts" at the Royal Institution on April 24–25, the Faraday Society has rendered a service not only to the cause of international science but particularly to science in Great Britain, for it has long been a regrettable fact that this interesting and important subject has been practically unknown here. So much so, that in the symposium volume on liquid crystals published by the *Zeitschrift für Krystallographie*, there was not one contribution from an English worker in the field. In part, this neglect has been due to the apparent multiplicity and complexity of the phenomena of liquid crystals, and in part to the prolonged and violent controversies to which their interpretation gave rise. This is a situation to which the holding of the Faraday Society conference has definitely put an end. We now have, as a result of the discussions, a fairly coherent picture of the nature and importance of liquid crystals: and though differences still remain, they will now, far more than in the past, lead to fresh fields of research rather than to controversy.

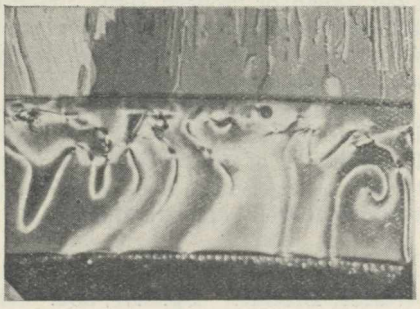


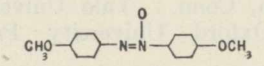
FIG. 1.—Anisaldazine showing solid crystals, nematic liquid crystals with singular points, and isotropic liquid.

Since their discovery by Reinitzer in 1888, and the pioneer work of Lehmann, Friedel, and Vorländer—of whom the last was present at the conference—liquid crystals have been intensively studied chemically, physically and mathematically, and their essential nature is now well established. The great majority of known chemical substances on melting pass abruptly at a sharp temperature from a crystalline solid with well-defined anisotropic properties to a mobile liquid in every way—optically, magnetically, electrically—isotropic. In some substances, however, a number of intermediate states are interposed between these ultimate ones.

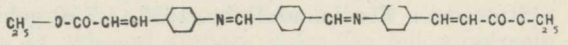
The properties of these states are just as definite as those that distinguish the crystalline and liquid states, but they partake, in different degrees, of the nature of both. Their most striking character, though by no means an essential one, is their optical anisotropy, which betrays itself in their spontaneous turbility in thick layers, and by the colours they show between crossed nicols. Another significant property is the possession of a variety—bewildering at first—of internal structures, threads, rods, cones, stepped and faceted drops, oily streaks and iridescent colours, recalling the appearance of biological rather than physical objects.

Direct observation early established two principal types of liquid crystal. The first, apart from optical anisotropy, behaves like a normal liquid of high mobility, with convection currents and Brownian motion. This phase, characterised by the appearance of mobile threads in the body of the liquid, due to lines of optical discontinuity, was called by Friedel *nematic* (from νῆμα, a thread; Fig. 1). The second type, called *smectic* by Friedel, is much more oily in consistency, and shows only limited internal mobility, but a great complexity of internal structure. When in bulk, it consists entirely of the characteristic focal conic structure (see Fig. 2), but when spreading on surfaces or in small free drops it tends to form flat terraces, the terraces of Grandjean, of unequal thickness and rounded outline (see Fig. 3)[1].

The physical explanation of these two types is now fairly clear. In the first place all liquid crystals have very anisotropic molecules, usually—as emphasised by Prof. Vorländer—with one dimension much greater than the others, for example, the classical *p*-azonyanisol



or the diethyl-*p*-xylylidene-bisamino cinnimate



This leading dimension determines the mutual relation of neighbouring molecules to a greater or less extent, according to the temperature. If we limit our consideration to a very small volume, the following main cases will arise (see Fig. 4): In I the molecules are completely at random: this is the case for the normal isotropic liquid. In II all the molecular axes are parallel, but the centres of the molecule are as irregularly arranged and as free to move as in case I. This corresponds to the *nematic* state. In III as in II the molecular axes are parallel, but the molecular centres have lost one degree of freedom, and are now restricted to a set of regularly spaced parallel surfaces. This corresponds to the typical *smectic* state. In V, which is the case for the crystal, the molecules are parallel, and their centres form a regular three-dimensional network. (Two cases may arise here: either (*a*) the molecules are arranged in planes, or (*b*) interleave each other. The first type (smectogenic crystal) tends to give rise to smectic and the second (nematogenic crystal) to nematic.)

That these explanations are essentially correct is proved by the examination of liquid crystals by X-rays; particularly by the work of K. Hermann

and Kast, where sharp Bragg reflections are obtained in the smectic case, but only liquid haloes in the nematic.

A question discussed at the Conference was that of the existence of further liquid crystal states. One other has long been recognised, that typical of cholesterol esters, but which in fact occurs whenever optically active substances form liquid crystals and is called the *cholesteric*. Friedel considers it a variant of the *nematic* type, but it has many properties also of *smectic* states. It is characterised by the production of spectral colours by reflection, with the peculiarity that only right- (or left-) handed circularly polarised light is reflected. This Friedel considers to be Bragg reflection from Grandjean planes regularly spaced, 1000–10000 A. apart in different cases together with a spiral arrangement of molecules. Oseen, in a paper to the Conference, attempted to prove, by rigorous use of electromagnetic theory, that the latter assumption is sufficient to account for all the phenomena, and that the Grandjean planes are in this case an optical illusion. Friedel maintains that there are no liquid crystal phases apart from nematic, smectic and cholesteric: however, Vorländer has long claimed that he has produced substances with no less than four intermediate states between solid and liquid, and more recently K. Hermann has established that among them there exist, besides normal smectic states, some characterised by faceted drops, showing sharp reflections other than those due to the main plane spacing, and indicating regular arrangement of molecules in each layer of the smectic substance (case IV in Fig. 4).

Such arrangement is geometrically possible; in fact, it is one of C. Hermann's theoretically derived eighteen intermediate forms between crystal and liquid, but whether it should be called 'liquid crystal' may well be only a matter of convention, as it is difficult to draw the line sharply between a liquid with some regular arrangement of molecules and a crystal with some freedom of molecular movement.

The chief business of the Conference was not, however, the discussion of the intermolecular structure of liquid crystals, on which moderate agreement already exists, but the more intricate problem of explaining the texture of liquid crystals, particularly under the action of surface forces and that of magnetic and electric fields. Two rival views were upheld with some vigour, with the aid of a wealth of experimental and theoretical material. The upholders of the 'swarm' theory—Ornstein and Kast—consider that in nematic substances the strictly parallel arrangement of molecules only holds for groups of about 10^{15} molecules, which form independent swarms in the free interior of the liquid with their axes arranged at random, but can be oriented in parallel by surface or electromagnetic forces. Where such forces are not present, any considerable volume

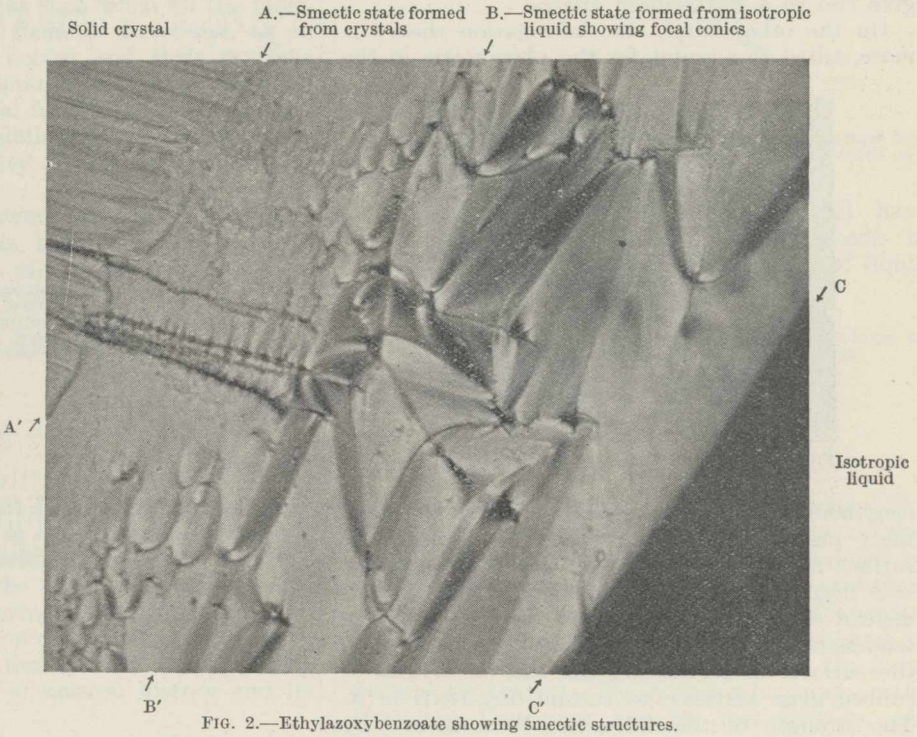


FIG. 2.—Ethylazoxybenzoate showing smectic structures.

(greater than 0·001 cub. mm.) is considered on this theory to resemble a polycrystalline solid, and thus to appear translucent instead of transparent.

The other view, of which the chief protagonist was Zocher, recognises also the limited range of the parallelism of molecules due to their interaction, but considers that the molecular orientation varies continuously from point to point, due not to any intrinsic cause, but to convection currents and Brownian motion in the fluid. The two theories are formally analogous to the ideas of turbulence or stream line motion in hydrodynamics, or to those of mosaic structure or continual deformation in overstrained solids. There are certain ranges of experiment that seem to be more simply explained by one or the other theory. In particular, Kast's work on orientation of pazoxyanisol in alternating electric fields points

to the existence of critical frequencies of 10^5–10^6 per sec., above which parallel orientation of the molecules is impossible. This frequency is much too low for simple molecular movement which is usually of the order of 10^{10} per sec., and certainly suggests the existence of swarms.

As Foëx points out, there is an extremely close parallel between the phenomena of orientation in liquid crystals and those of magnetism, a nematic liquid corresponding to a ferromagnetic, and a normal liquid to a paramagnetic substance, with the transition point between the two corresponding to the Curie point. The basis for this comparison is plainly geometrical and not physical, and depends on the existence in both cases of blocks in parallel orientation, such as in magnetism give rise to a Barkhausen effect.

On the other hand, the deformation theory is more suited to account for the phenomena in the

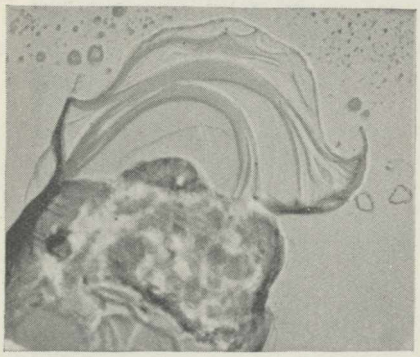
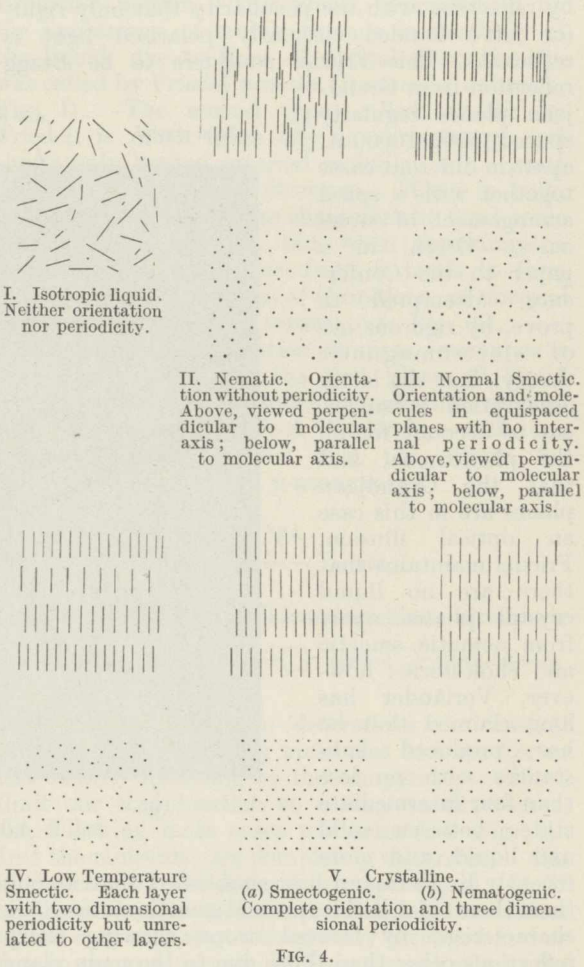


FIG. 3.—Drop of thallium stearate showing Grandjean planes.

neighbourhood of surfaces. Liquid crystals in all their phases exhibit the range of influence of surface forces to a far greater extent than either true liquids or crystalline solids, a range of 10^{-2} instead of 10^{-6} cm. In general, there is a strong tendency to orientation of molecules parallel to the surface, or further, in the case of crystal or rubbed glass surfaces, to certain directions in it. The strength of this force can be measured by opposing to it magnetic or electric forces, as has been done particularly in the beautiful and ingenious experiments of Freedericksz and Zolina. The theoretical treatment of these cases by Zocher shows that they can be explained by continuous distortion up to a point beyond which the structure breaks down sharply as in an overloaded pillar. It became plain as the Conference progressed that the swarm and distortion theories were merely apparently antagonistic, and needed only an effort of synthesis to weld them into a more comprehensive theory.

The nature of smectic structures was not discussed in any paper presented, but the Conference was delighted by the unexpected intervention of Sir William Bragg, who in a few words, explained the *raison d'être* of the focal conic structures which has so long remained a puzzle to students of liquid crystals. These structures consist in general of a pair of cones inclined to a common elliptical base, and having as a singular line a hyperbola in a plane at right angles to the ellipse, each conic having its focus at the vertex of the other (Figs. 2 and 5). Friedel had shown that the molecular axes lay on lines joining the ellipse to the hyperbola, and that the smectic planes lay in surfaces normal to these lines, the so-called cycloids of Dupin. Sir William now showed that this arrangement is a structure that combines minimum surface and minimum inclination of molecular axes, avoiding the great divergence that would occur at the centre of a simple sphere of



I. Isotropic liquid. Neither orientation nor periodicity.

II. Nematic. Orientation without periodicity. Above, viewed perpendicular to molecular axis; below, parallel to molecular axis.

III. Normal Smectic. Orientation and molecules in equispaced planes with no internal periodicity. Above, viewed perpendicular to molecular axis; below, parallel to molecular axis.

IV. Low Temperature Smectic. Each layer with two dimensional periodicity but unrelated to other layers.

V. Crystalline. (*a*) Smectogenic. (*b*) Nematogenic. Complete orientation and three dimensional periodicity.

FIG. 4.

radial molecules, by spreading it along the two singular lines of ellipse and hyperbola. Such structures will not, of course, fill space, but the interstices are filled with smaller and smaller focal conics, down to submicroscopic dimensions.

The behaviour of such smectic liquids in motion is naturally quite different from that of true liquids. It is misleading in this case to speak of a viscosity. As Lawrence has shown, the distribution of velocity follows a law much more complicated than that of Newton, in some cases even elastic forces coming into play. The practical values of such studies are obviously great, as many lubricants approximate to liquid crystal conditions.

It remains to point out the widespread importance of liquid crystals in Nature. This was considered in a paper by Prof. Rinne, whose recent lamented death overclouded the proceedings at the beginning of the Conference. The liquid crystals mostly studied are provided by melts of pure substances: far more, however, are to be found in two-component systems, where greater or less concentration in a solvent is equivalent to a rise in temperature. Such liquid crystals show all the phenomena observed in melts, besides others due to their disperse nature, and are widespread, indeed universally found in biological structures.

Most of the protein, fat and myelinic substance of living bodies exists in liquid crystals, but this is only directly visible as such when all the molecules are oriented in definite directions, as in spermatozoa, muscles, nerves and their myelinic sheaths. Indeed the liquid crystal state seems the most suited to biological functions, as it combines the fluidity and diffusibility of the liquid while preserving the possibility of internal structure of crystalline solids.

The spontaneous structures—threads, cones, etc.—of liquid crystals have dimensions intermediate between those of molecules and those of living cells, so that we may say that the liquid crystal has as much right as the colloid to be considered the basis of vital activity.

The existence of this virtually new state of matter will have to be taken into account in any modern comprehensive picture of the material world, whether physical, chemical or biological.

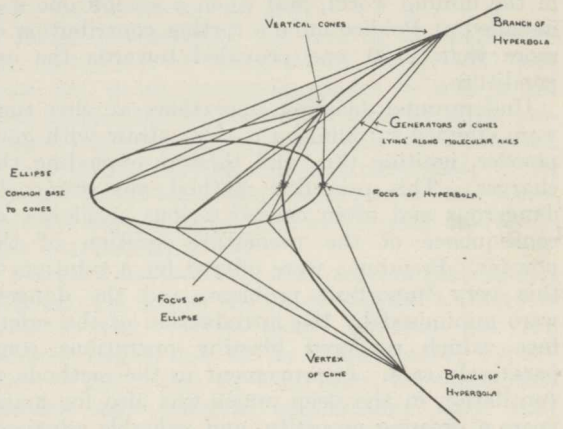


FIG. 5. Focal conic structure. The ellipse and hyperbola must be imagined in planes at right angles. Each cone has its vertex on the hyperbola and its base on the ellipse.

The Faraday Society Conference will have well fulfilled its purpose if it succeeds in provoking further research in the field of liquid crystals.

[1] The photographs reproduced as Figs. 1, 2 and 3, were taken by Dr. Lawrence at the Colloid Physics Department, Cambridge.

Royal Cornwall Polytechnic Society

THE Royal Cornwall Polytechnic Society was instituted in 1833 to encourage and stimulate the ingenuity and inventive faculties of Cornishmen and others, with the view of introducing new inventions and improving the mechanical appliances of the age, also of discovering and assisting persons talented in the fine arts and those showing aptitude in the study of natural history and its allied subjects.

The credit for the Society's inception must be given to Robert Were Fox, F.R.S. and his daughters, Anna Maria and Caroline Fox, who were ably and enthusiastically supported by Lord de Dunstanville, M.P., F.R.S., Sir R. R. Vyvyan, M.P., F.R.S., and a company of the most distinguished gentlemen of the county. Lord de Dunstanville was elected its first patron. In 1835, His Majesty King William IV graciously consented to become patron, and from that date the Society has enjoyed the patronage of succeeding sovereigns. Davies Gilbert, president of the Royal Society, was its first vice-patron. Since 1856 the Society has been honoured by Royal vice-patrons, the present holder being H.R.H. the Prince of Wales and Duke of Cornwall. Viscount Clifden of Lanhydrock, the president, follows in office many distinguished and learned men.

At the time of the Society's foundation there was great mining activity in Cornwall, some four hundred mines working, chiefly for copper. The county was the world's chief producer of this metal, the exploitation of which was attended by considerable financial gain. The lodes contained minerals rich in copper, comprising chiefly oxides, arsenides and grey sulphides, these passing in depth to yellow sulphides below which the lodes became tin-bearing. The richest mines were in the Gwennap, Camborne, and St. Just districts, and millions of pounds sterling were paid in dividends. John and Richard Taylor, and members of the Williams of Scorrier House, Bolitho, and the Fox families, were the principal mine owners; these men joined the Society at its foundation, thereby assuring its close association with the mining industry.

Early in the Society's history, its attention was attracted to the extreme exertion demanded of miners who, in the deep mines, had to descend and ascend 1,200–1,500 ft. by means of ladders. This daily recurring exercise materially impaired the miner's energies, and was very detrimental to his physical well-being. In view of this, valuable premiums were offered for inventions devised to eliminate these conditions and thereby make the lot of the miner less laborious. Interest in this subject was greatly stimulated and led to the invention of the 'man-engine' by Michael Loam. This appliance was first installed at Tresavean

mine and the sum of £500 was contributed by the Society in order that it should be thoroughly tested. The successful outcome of the trials resulted in the man-engine coming into general use in the mining world, and when a second one was installed at Poldice mine a further contribution of more than £100 was provided towards the expenditure.

Underground blasting operations at this time were effected by filling a reed or straw with gunpowder, igniting this, and thereby exploding the charges. This primitive method was extremely dangerous and often caused serious accidents, in consequence of the premature ignition of the powder. Premiums were offered for a solution to this very important problem, and the dangers were minimised by the introduction of the safety fuse, which rendered blasting operations comparatively safe. Improvement in the methods of ventilation in the deep mines was also for many years a pressing necessity, and valuable advances were made through the auspices of the Society.

Some ninety exhibitions have been held by the Royal Cornwall Polytechnic Society, at which many important inventions of the past century were first shown. Among those which received valuable awards were: the dipping needle deflector, by Robert Were Fox, F.R.S., which was later adopted by the Navy, 1834; the mining theodolite, by William Wilton, 1835; the safety fuse, by William Bickford; the steel wire rope, ventilation appliances, gas and oil engines, electrical machinery, rock drills, etc. Prior to 1864 a sum of more than £4,000 had been awarded as premiums for inventions, exclusive of medals and other prizes.

The Society was the first institution to organise scientific education in the county; a considerable amount of valuable work of this nature was later carried out by the Miners' Association of Cornwall and Devon, which had its inception in the Society, under the superintendence of Robert Hunt, then the secretary of the Polytechnic Society. Evening classes for instruction in mining and allied subjects were instituted in many towns of Cornwall, the lecturers being Sir Clement le Neve Foster, J. H. Collins, Dr. Richard Pearce, and Benedict Kitto. A Science School, established at the Polytechnic Hall, Falmouth, existed for many years and opportunities were afforded for exhibition of the work of its students.

The Falmouth Meteorological Observatory, established by the Board of Trade in 1867, was placed under the local control of the Polytechnic Society; grants for its maintenance being made by the London Meteorological Council from 1868 until 1921. The present Observatory building was erected by the Society in 1885, and through the generosity of the Royal Society and the British Association, a set of recording magnetographs was added to its equipment and it became one of the three magnetic observatories of England. Its work was carried out for many years under the superintendence of Edward Kitto, ably supported by Wilson Lloyd Fox. At the invitation of the Falmouth Council, responsibility for the control and maintenance of the Falmouth Museum has been assumed by the Society, and the exhibits have been transferred to the Polytechnic Hall.

During recent years the depression in the mining industry, resultant from the low market value of metals, has necessitated the suspension of operations at many of the Cornish mines. It is hoped, however, that the present higher price for metals will be maintained, in which case the prospect of considerable increase in mining activities appears promising. The Society watches this improvement with satisfaction and is ever ready to assist in the advancement of the interests of industry.

The Royal Cornwall Polytechnic Society has now completed its first hundred years' service in the interests of science and industry; and its centenary celebrations will take place on July 18–21 inclusive. The Royal Society, Royal Institution, Institution of Mining and Metallurgy, British Association, and other learned and professional bodies are sending delegates. The programme for the meeting includes visits to places of historical and geological interest, engineering works, etc., and papers presented by eminent men of science, including Sir John Cadman, Sir Richard Gregory, Sir William Napier Shaw, Dr. G. C. Simpson and Prof. S. J. Truscott. H. C. G. NEWTON.

William Froude (1810-1879)

THOUGH the name of William Froude has long been a household word among naval architects, and his methods of studying the resistance of ships have been adopted in all important maritime countries, yet it may safely be said that few who are familiar with his pioneering experiments know anything of his life and character. This is not to be wondered at for, so far, the only sources of information regarding him have consisted of brief sketches. There will therefore be many who will read with interest the presidential address delivered to the Devonshire Association at Ilfracombe on July 4 by Sir Westcott Abell, who took for his theme "William Froude—His Life and Work".

Like Froude, Sir Westcott is a Devonshire man and for many years was in the service of the Admiralty. He has thus had ample opportunities of familiarising himself with the career of Froude. Froude was the fourth son of the rector of Dartington, near Totnes, and the brother of Richard Hurrell Froude (1803–1836) and James Anthony Froude (1818–1894). He was born at Dartington on November 24, 1810, and after attending a school at Buckfastleigh, he went to Westminster School and entered Oriel College, Oxford, in 1828.

Graduating in 1832, he took up civil engineering, and a few years later became assistant to Brunel. He retired from professional work in 1846 and for the next thirteen years lived with his father.

In 1859 Froude removed to Paignton and in 1867 to Chelston Cross, Cockington, near Torquay, and there, with funds provided by the Admiralty, built the first experimental tank. In 1878 he went for a cruise to South Africa in H.M.S. *Boadicea*, was stricken with dysentery and died on May 4, 1879, at Admiralty House, Simons Town, and was buried in the naval cemetery there. He had married in 1839 and had five children, of whom Richard Edmund Froude was his assistant and successor.

At Oxford, Froude had as tutor his brother Hurrell who, writing in 1831, remarked: "W. continues very steady, getting up at half-past five and working without wasting time till two or three." A little later Hurrell remarked that his brother's "interleaves and margins are scribbled over with lug sails".

The sea was in William's veins and by 1833 he had already begun his study of the resistance and propulsion of ships for which he is remembered. At Dartington in 1850 he made screw-propeller tests on the River Dart above Totnes, and after his removal to Paignton, he made further experiments in a storage tank on the top of his house. Towing experiments with a steam boat were first made off Dartmouth in 1867.

Froude contributed the first of his papers to the Institution of Naval Architects in 1861 and there are, in all, seventeen papers by him in the *Transactions* dealing with the rolling of ships, propellers, resistance, horse power and other matters. It was largely through the instrumentality of Sir Edward Reed, then chief constructor of the Navy, that the experimental tank at Torquay was built. This was opened in 1871.

Froude's services were always given gratuitously although his son at the start received a salary of £150 a year. When asked whether his own services ought not to be remunerated, Froude said: "The value of such services enormously outruns any possible expenditure they may involve. The cost of a single disaster, the loss of the *Captain*, exceeds immeasurably any kind of expenditure that could be devoted to the improvement of the science of naval architecture."

Sir Westcott Abell's address, it may be added, includes lists of all the papers of Froude and his son to the Institution of Naval Architects.

News and Views

Beit Memorial Fellowships for Medical Research

AT the annual meeting held on July 11 of the Trustees of the Beit Memorial Fellowships for Medical Research, an important change of policy was announced. The Trustees have decided to institute a professorial fellowship of tenure similar to that of a university chair. No award has yet been made. This action is the result of a proviso in the original trust deed, whereby the trustees are empowered, after the expiration of twenty years, to modify the regulations for the award of fellowships. When the Beit Memorial Trust was created, the opportunities for medical research in Great Britain were scanty; Sir Otto Beit's gift, followed by Lord Iveagh's benefaction for the building of the Lister Institute, enormously improved the situation. Then came further openings through the Medical Research Committee and its successor, the Medical Research Council. The late Sir Walter Morley Fletcher now became the dominant figure in the development of medical research, and the obituary notice of him which appeared in our issue of July 1 (p. 17) is the story of its progress. The policy of the Beit trustees has been to provide opportunities for junior workers, many of whom have passed into posts, such as chairs of physiology and pathology, where their research work could be continued. Prolonged clinical research has, however, not been provided for. The Medical Research Council has maintained a senior post for clinical research since 1916, the holder of which, Sir Thomas Lewis, has made noteworthy contributions to knowledge. This post has recently been endowed by the Rockefeller Foundation and the Medical Research Council has created another. Now the Beit trustees are adding a third post, to be held at a medical centre in Great Britain where facilities for clinical research are available.

THE following elections have been made by the Trustees of the Beit Memorial Fellowships for Medical Research, the subject being indicated after the name:—*Senior Fellowship* (£700 a year): Dr. C. L. Cope, to continue work on the excretion of non-threshold substances and of sugars in nephritis (Medical Unit, St. Thomas's Hospital, London); *Fourth Year Fellowships* (£500 a year): Mr. J. McMichael, to continue researches on enlargement of the spleen in human disease and its relationship to diseases of the liver (Medical Unit, University College Hospital, London); Dr. J. N. Myers, to continue work on biochemical changes in hearts of guinea pigs poisoned by diphtheria toxin and also on the production of active immunity through the slow absorption of oil emulsions of bacterial toxins (Pharmacological Laboratory, University of Cambridge); Dr. C. A. Ashford, to continue studies of the utilisation of carbohydrate by brain tissue (Dunn Institute of Biochemistry, University of Cambridge); Dr. F. H. Smirk, to continue studies on water diuresis and the formation of œdema fluid, and to develop his urinary test for early renal damage in man (Medical Unit, University College Hospital, London); *Junior Fellowships* (£400 a year): Mr. A. S. McFarlane, for work on the physicochemical nature of protein solutions and of suspensions of bacteria by measurement of

the light scattering capacity and of the sedimentation velocity in the field of the ultracentrifuge (Institute for Physical Chemistry, The University, Uppsala, Sweden); Dr. E. S. Horning, to investigate by micro-incineration the relative distribution of the inorganic radicles of normal and tumour cells that have been exposed to various types of radiation (The Laboratory of the Imperial Cancer Research Fund, Queen Square, London); Dr. W. J. Dann, for work on the transmission of food vitamins by milk and the placenta, and the possible function of ascorbic acid (vitamin C) in oxidation mechanisms of the cell (Nutritional Laboratory, University of Cambridge); Mr. B. G. Maegraith, for work on methods of diagnosis and treatment of cerebrospinal meningitis (Dunn School of Pathology, University of Oxford); Mr. P. J. G. Mann, to investigate the functions of peroxidase as being chiefly an anabolic enzyme, and the action of vitamin B as a possible co-enzyme of the lactic dehydrogenase system (Dunn Institute of Biochemistry, University of Cambridge); Dr. M. Stacey, to investigate carbohydrates yielded in the growth of moulds and of bacteria (Department of Biochemistry, London School of Hygiene and Tropical Medicine); Mr. A. H. Hughes, for work on surface films of molecules of biological importance, dealing in particular with hæmoglobin and the enzymes responsible for snake venom hæmolysis (Department of Colloid Science, University of Cambridge); Alison Sarah Dale, to investigate processes underlying the staircase phenomenon in amphibian and mammalian hearts (Pharmacological Laboratory, University of Edinburgh).

Public Museums and Galleries in Great Britain

IN its first report, the Standing Commission on Museums and Galleries, appointed in 1931 on a recommendation of the Royal Commission on the National Museums and Collections, fully justifies its existence (London: H.M. Stationery Office. 6*d*. net). The report is a document which merits the close attention of all who are interested in the promotion of scientific and cultural studies or are concerned with the broader problems of education. It surveys the position of British public collections and museums from three aspects. It deals first with the steps which have been taken to remedy the deficiencies to which the Royal Commission pointed, and to carry out the recommendations of that body. It then passes on to consider improvements in the utilisation of existing resources; and finally sketches an outline of further progress. It is plainly evident that the Committee, as a body composed largely of experts, which, as it were, holds a watching brief on behalf of the public and reports progress from time to time, is capable of fulfilling an increasingly useful function. As its work becomes more widely known, it should serve as a court of first instance for examining proposals to facilitate the fuller utilisation of museum collections by the public. In the period under review, for example, the Committee has had under consideration a scheme submitted by the Museums Association for promoting greater co-operation between the national collections and provincial institutions. The Committee has been in a position to consult the authorities responsible for the national collections on these proposals, and as a result regional federations of provincial institutions are being established which will not only encourage freer and fuller intercourse between the institutions within each group, but will also further co-operation with local education authorities. Among suggestions for the future, the proposal that publicity officers should be added to the museum staff opens up a wide vista of possibilities.

Scientific Utilisation of Coal

THE economic production of liquid fuel and other products from coal is a subject which has received wide publicity. It formed the theme of Lord Rutherford's maiden speech delivered in the House of Lords a little more than two years ago, when as chairman of the Advisory Council of the Department of Scientific and Industrial Research he outlined the position and its prospects. Later in the same year Dr. C. H. Lander, then director of fuel research for the same Department, gave an informative Friday evening discourse at the Royal Institution (see NATURE, April 30 and May 7, 1932), in which he gave figures showing the technical and economic aspects of the problem. It is of interest to note that the Miners' Federation also has the matter under consideration. At the final session on July 7 of the annual conference at Scarborough of the Federation, Mr. Sadler, of South Wales, moved a resolution urging the Trade Union Congress and the Labour party to press the Government to provide capital for establishing on an industrial basis the extraction of oil and by-products from coal. Coal, he said, made Great Britain the workshop of the world, and he asked the Conference to be prepared to make use of all the aid that science can give in utilising coal. Mr. Peter Lee (president) stated that he wanted to see coal used instead of oil wherever possible, but he emphasised also the importance of the scientific use of coal, adding that the Miners' Federation is fully aware of the possibilities. Mr. Sadler's resolution was adopted.

American Museums of Natural History

UNDER the title "The American Museum and Defeatism", the American Museum of Natural History, New York, in its annual report for the year 1932, records the strenuous and successful endeavour of the trustees and staff to "defeat defeatism", to use Prof. H. Fairfield Osborn's slogan. Notwithstanding the adverse conditions prevailing in the United States, the Museum carried on its various activities with a conspicuous measure of success, although some curtailment, involving reduction and retirement of staff and closure of some exhibition halls, proved unavoidable. Fortunately scientific exploration was affected only to a limited degree. Although the trustees were not able to continue the scientific explorations financed from their general funds, seventeen expeditions were sent out to various parts of the world for work in zoology, palæontology and anthropology, provision for these

having been made by specific endowment. Advantage was taken of this enforced restriction in the activities of certain members of the scientific staff to proceed with research work and publication of results. The South Oceanic or Witney Wing was completed, one floor being adapted to house the Rothschild collection of birds, which has been acquired for the Museum by the widow and family of the late Mr. Harry Payne Witney. At the close of this, the twenty-fifth year of his tenure of office as president of the Museum, Prof. Osborn tendered his resignation, much to the expressed regret of the trustees and the authorities of the City of New York. Prof. Osborn has been succeeded as president by Prof. F. Trubee Davison; but in recognition of his great services to the Museum, Prof. Osborn has been elected honorary president for life.

Excavations in Iraq

ACCORDING to a statement issued by Prof. J. H. Breasted and circulated by Science Service (Washington), after a visit to the various excavations in the Near East now being conducted by the Oriental Institute of Chicago, the tablet containing the list of kings of Assyria recently discovered at Khorsabad by the expedition under Dr. H. Frankfort, will shortly be shipped to the United States for study and publication. The lists are in cuneiform on two sides of a baked clay tablet and contain the names of ninety-three kings. They end about 730 B.C. just before the reign of Sargon II, which began in 722 B.C. As the lists cover a period of thirteen or fourteen hundred years, they carry back Assyrian history to about 2200 B.C. and add an unbroken line of eight new kings preceding Ushpia, previously the earliest known king, who ruled not long before 2000 B.C. Prof. Breasted also refers to the discovery at Khorsabad of the temple of Nabu or Nebo, mentioned by the prophet Isaiah, which he regards as one of the most important finds made by the expeditions of the Institute during the past season. As Nabu was the god of writing, his temple should, Prof. Breasted expects, contain records of importance. At Persepolis, where the excavations are in charge of Dr. E. N. Herzfeld, what would appear to be a library of records in the Elamite language has been unearthed in moving the field railroad. Although at present only very imperfectly examined, the tablets would appear to contain records connected with the building of the palaces.

SOME further particulars of the results of the excavations of the Oriental Institute are given by Dr. H. Frankfort in a preliminary account in the *Times* of July 10 and 11. At Tell Asmar, a site on the east of the Tigris and Diala, fifty miles from Baghdad, identified with the ancient Eshnunna, in the course of a successful search for evidence which might afford chronological relation with the tombs of Ur, buildings were discovered belonging to the Akkadian period which have afforded the first view of the arrangements, domestic and other, of structures of the time of Sargon I. Dr. Frankfort notes that certain features of the elaborate sanitary system follow the European rather than the oriental type. A temple, "the House of Abu", Lord of Vegetation, originally founded in pre-Akkadian times but twice reconstructed, has yielded some remarkable reliefs, among which one represents the central mystery of the fertility cult, the marriage of the god and goddess, a subject of which there are hints in Babylonian texts, but no representation known elsewhere. Equally noteworthy are representations of the god partly in the form of a snake and of a deity attacking a seven-headed monster with a spear, probably the oriental prototype of Heracles and the Hydra. A hoard of jewellery in a building of considerable size shows survivals from the period of the tombs of Ur. At Kafaje, a site 15 miles south-west of Tell Asmar, was found the earliest known example of town planning, in which closely packed houses of Sargonid date formed a long street running the whole length of the town from north-west to south-east, with side streets running at right angles from it. Dr. Frankfort considers that the evidence points to a closer relation of the region east of the Tigris to the mountaineers to the east and the north than to the Babylonians of the plains.

Megaliths of the Trent Basin

BY the publication of the map of the Trent Basin (Ordnance Survey Office, Southampton. 4*s*. net) the scheme for a complete survey of the megalithic and allied remains of England and Wales is nearly half-finished. It is, in fact, the fourth of the series of twelve half-inch maps to be issued; and two more are in course of preparation. The survey of the Trent Basin is the work of Mr. C. W. Phillips. In one respect his work is especially noteworthy. It has resulted in the discovery of a previously unknown group of long barrows on the Lincolnshire Wolds, centred on two areas, the valley of the Swinhope Beck in the north and the terminal massif between Alford and Spilsby on the south, their distribution being rigidly confined to the chalk. Happily, it would appear, they have not been disturbed, except in two instances, in which digging does not appear to have penetrated to the deposit. It is regrettable that the same cannot be said of the western of the two groups into which the megalithic monuments of the area fall. In Derbyshire and on the confines of Cheshire and Staffordshire, the monuments, though not numerous, are among the most famous and interesting of their kind in England. Unfortunately, Arbor Low is the only one which has been investigated scientifically. The others were examined in the eighteenth or nineteenth century, and in some instances it is now impossible to determine their exact character archæologically, either from examination of the monuments themselves or the records where any exist. One feature in which the map of the Trent Basin differs conspicuously from its immediate predecessor, the map of Neolithic Wessex, is in the absence of any indication of ancient vegetation. This is due to differences of opinion among 'vegetarian experts'.

Race and the Precipitin Test

CONCLUSIONS of some considerable interest to physical anthropologists and students of questions of race are drawn by Prof. V. Suk of the Anthropological Department of Masaryk University, Brno, from the results of work on racial immunity on the basis of the precipitin test (*Act. Soc. Sci. Nat. Moraviae*, 8, fasc. 4, sig. 5). The author's objective was the differentiation by biological experiments between micro- or meso-diacritical races and the fully established pan- or macro-diacritical races. The material for sera and anti-sera was derived from Eskimo, Kalmuk, Nordic (Slovakia and Bohemia), Baltic, Alpine (Czech), Gipsies and Jews. Four hundred and five experiments, with eight dilutions, thus giving more than three thousand precipitations, were made. Without going into details, it may be said that the highest degree of reaction was given by the compared Eskimo-Kalmuk groups, hence regarded as pan-diacritical and fully established races, and the lowest by Jew-Nordic. On the basis of his results, Prof. Suk enters into a discussion of racial types at some length, taking into account, in particular, the work of Keith, Parsons and of Ruggles Gates on Amerindian crosses in Canada. He offers the opinion that the various groups among Europeans are not fully established races, but inconstant variations in process of making, while the modern racial history of Europe shows no visible trend to develop types such as 'Nordic', 'Dinaric', 'Alpine', etc., into true races, but rather to form new groups, according to geographical distribution, such as 'English', 'North American', 'German', 'Italian', and so forth. It is regarded as doubtful if such groups will ever attain the status of true races. The present investigation seems to show that all these types are of one stock and that Europeans in general are a very old variation of the species *Homo*.

Walnut Production in England

SOME account of the steps that are being taken to promote and improve walnut production in England is given by J. B. Hammond in the annual report of the East Malling Research Station for 1932. As the outcome of a large and successful walnut survey and competition in 1929, propagation studies have been started with carefully selected trees from different parts of England. Material has also been collected from other countries, notably France and California, including scions from trees known to produce the 'burred' type of wood valuable for cabinet making. Up to the present, grafting has only proved successful if carried out under glass, a frame with bottom heat of 60°–70° F. being used, but the plants can be hardened off after three weeks and, if grafted in June, are ready to be planted out by the end of August. Nuts may be produced after 3–5 years. A good nut should contain at least 50 per cent oil, for if the value is lower the water content is correspondingly increased, which results in impaired flavour and a tendency to shrivel during storage. The methods of storage are of the first importance. Cold storage at 38° F. combined with 90 per cent humidity prove entirely satisfactory. If, however, a higher temperature is maintained, a fungicide is necessary. Common salt, preferably mixed with coco-nut fibre or sodium phosphate to take up the moisture absorbed from the atmosphere by the salt, may be safely used, and nuts placed in earthenware crocks in alternate layers with this salt-mixture keep in good condition until the following spring.

Report of the Empire Marketing Board

IT is encouraging to learn from the Report of the Empire Marketing Board for 1932–33 (H.M. Stationery Office, 1*s*.), that in spite of the economic depression during this period, twenty-four new records in the shipment of Empire products to Great Britain have been set up. Among the outstanding examples where the increase in the import has been nearly or even more than doubled are Australian eggs, Canadian tobacco, British West Indian bananas and New Zealand pears. Although a reduced vote has precluded any extension of its research programme, the Board has in general been able to maintain its grants, and a full account of the work in hand at the various institutes benefited is given in the report. Progress continues in the planning of joint programmes of research, and suggestions of special problems requiring investigations have been received from India and the Colonial Advisory Council of Agriculture and Animal Health during the past year. The market intelligence services have been continued and far-reaching developments in this direction are anticipated since the inauguration of an Empire broadcasting service at the invitation of the B.B.C. Considerable success has attended the Board's publicity activities, and both the number of films available and the public demand for them has been trebled during the year under review.

Exploration in the Gobi Desert

ATTENTION may be directed to an article by Dr. R. C. Andrews on "Exploration in the Gobi Desert" (*National Geographic Magazine*, June 1933) which recounts the work of the Central Asiatic Expedition under his leadership in various years between 1922 and 1930. The importance of the article lies in the fine pictorial record of the Gobi Desert and Inner Mongolia. The pictures illustrate the topography and anthropology but are of interest mainly in their relation to the extraordinary palæontological discoveries, including a number of early mammals as well as the eggs of the dinosaur (see also p. 81 of this issue). Many of the pictures are colour photographs.

The Antarctic Continent

IN a lecture to the Royal Institution delivered on March 3 on the new polar province in the Antarctic, Sir Douglas Mawson, after pointing out the extent of the antarctic that has been placed under the administration of the Australian Commonwealth, outlined the most recent ideas with regard to the

antarctic continent. His own discoveries in the Australian province confirm the belief, previously held, of the continuity of the southern land mass. The rocks are pre-Cambrian and early Palæozoic in the main but on the Pacific side there is a large tract of Permian to Triassic beds lying almost horizontally on the older formations. South of the American continent, however, a region of different tectonic structure is found with folded beds of secondary and tertiary age. This region, known generally as Graham Land, appears to be an island chain bound together and to the continent by a permanent shelf-ice sheet of great thickness. Sir Douglas Mawson pointed to the possibility of the Ross Barrier at the head of the Ross Sea extending unbroken to the barrier at the head of the Weddell Sea. If this is the case, the archipelago of Graham Land is not part of the antarctic continent but is joined to it by a vast sheet of floating shelf-ice. The lecture has recently been made available in pamphlet form.

Treatment of Pernicious Anæmia

THE treatment of pernicious anæmia by a diet containing large amounts of liver or by the oral administration of an extract of liver or of desiccated stomach tissue is now the standard treatment for this disease. For patients who are severely ill and cannot tolerate oral administration, the intramuscular or intravenous injection of a potent extract of liver may be a life-saving measure; moreover, by the parenteral route, smaller doses are required and the response of the blood is quicker. The British Drug Houses, Ltd., London, N.1, are now issuing an extract of liver for intramuscular injection. Each cubic centimetre contains the anti-anæmic principles of 50 gm. of fresh liver, whilst its depressor effect does not exceed that of a 0·0005 per cent solution of histamine acid phosphate when introduced by the intravenous route into an etherised cat. In addition to Liver Extract B.D.H., and Liquid Liver Extract B.D.H., preparations for oral administration in the treatment of pernicious anæmia, the British Drug Houses also issue the product 'Livogen', which is a highly concentrated liquid preparation containing in one fluid ounce the whole of the hæmotopoietic principles (including vitamin B) of four ounces of fresh liver. It contains additional vitamin B extract equivalent to one ounce of fresh yeast in each fluid ounce, together with five grains of hæmoglobin. For the specific anæmias, in which massive doses of iron are indicated, iron ammonium citrate may be dispensed with Livogen, the two products being in every way compatible. Livogen is recommended for use in convalescence from severe illness as well as in both primary and secondary anæmias.

Odour of Vulcanised Rubber

As the rather unpleasant odour of vulcanised rubber limits its applications, the Rubber Growers' Association has instituted an investigation into its causes and prevention (*Bull. Rubber Growers' Association*, May, 1933). When rubber goods were made from inferior grades of wild rubber, their smell was due to putrefactive changes, but in these days of plantation rubber, the trouble arises mainly from the accelerator employed, although macintoshes and other proofed goods owe their smell to the low-grade petroleum and coal-tar naphtha products that are used as diluents when the rubber is manufactured. Vulcanised goods can often be temporarily freed from odour by steaming them, but permanent freedom can only be secured by removing the substances that give rise to odour, whether they be constituents of the raw rubber or added to it in the course of manufacture. The smell due to accelerators may be of the 'sulphide' or of the 'amino' type, according as they contain sulphur or amino-nitrogen. So far, no good accelerator that is free from these constituents has been found, but Messrs. H. P. Stevens and E. J. Parry, the chemists in charge of the investigation, have discovered that the presence of zinc carbonate in the compounding mixture reduces the smell to a minimum. The slight 'amino' smell characteristic of the unvulcanised plantation rubber has been traced by them to the proteins, and not to the resins, present in the raw material; and it can be practically eliminated if the latex is purified by such methods as digestion with dilute caustic, centrifuging, creaming, ultra-filtration, or dialysis. When the problem has been definitely solved, it will be possible to use vulcanised rubber for lining food-containers and brewers' vats, and in the preparation or packing of foodstuffs in general.

Heating of Domestic Pendant Lamp Fittings

THE usefulness of scientific research on everyday domestic devices is shown by a paper read to the Institution of Electrical Engineers by P. D. Morgan, H. G. Taylor and W. Lethersich on April 20. The problem they had to solve was to find the best way of keeping the heating of lamp fittings and their connecting flexible wires at such a low value that the rubber insulation would not deteriorate. This deterioration takes the form of hardening and making brittle the rubber surrounding the wire. In this case a slight disturbance may cause it to crack off and expose the bare conductor. This may lead to a short-circuit and so possibly to igniting the 'flex'. It would be a rare occurrence but it would be advisable to prevent it. The deterioration of the rubber is due to its oxidisation, which is accelerated by heat. The introduction of gas-filled lamps has appreciably raised the temperature of the flexible wire connected to the holder and thus the problem has become more urgent.

The solution adopted in the United States is to use flexible cords capable of withstanding higher working temperatures than the usual standard rise of 23·4° C. at a distance of $\frac{5}{8}$ in. from the terminal. A lampholder and its connecting leads receive heat by conduction through the cap from the hot gas in the lamp and dissipate it by radiation and convection. It is necessary to make the heat conducted through the cap of the lamp smaller and facilitate the

dissipation of heat from the surface. The authors' experiments show that by putting a 6 in. metal disc above the conical shade of a 60 watt lamp, the final steady temperature was reduced from 57·5° to 23° C. With a 200 watt lamp in a 14 in. enclosed bowl and canopy, the temperature rise was 83·5° C. By removing the domed top of the canopy, replacing it by a flat metal disc 6 in. in diameter, putting the holder mainly outside the canopy, placing a disc in the base of the canopy, putting a mica disc in the lamp and using a moulded holder, the temperature rise was only 23° C.

Microscope Technique

THE current issue of the *Journal of the Royal Microscopical Society* (vol. 53, pt. 1) contains Mr. Conrad Beck's presidential address on microscope illumination, which should be read for its useful observations on the substage condenser in relation to the objective. In the same issue Dr. P. Gray summarises and classifies in convenient form the methods of fixation of animal tissues which have been found most successful for different purposes, and Mr. D. P. Wilson describes a simple and inexpensive apparatus for trimming paraffin blocks, which can be used upon a Cambridge rocking microtome and will be found particularly useful for trimming small blocks so as to ensure a straight ribbon of sections when the block is being cut.

International Congress of Anthropological and Ethnological Sciences

ARRANGEMENTS are well forward for giving effect to the decision of the international conference held in Basel recently (see NATURE of May 20, p. 719) that an International Congress of the Anthropological and Ethnological Sciences should be established and that the first meeting should be held in London in 1933. It has now been decided that the session will take place on July 30–August 4, 1933. An executive committee will be responsible for the preparations for the Congress. At a meeting of the Royal Anthropological Institute held on July 4, Capt. T. A. Joyce was elected chairman of the Executive Committee, Mr. H. Beazley, treasurer, and Prof. J. L. Myres and Mr. Alan H. Brodrick, joint honorary secretaries with Mr. Adrian Digby as assistant secretary. Accommodation for the meetings of the Congress offered by University College, London, and the Wellcome Historical Medical Museum, has been accepted provisionally.

Announcements

PROF. F. PANETH, formerly director of the Chemical Institute of the University of Königsberg, has recently been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston.

DR. W. L. BALLS, director of the Botanical Section, Ministry of Agriculture, Egypt, has been appointed cotton technologist to the Ministry of Agriculture, Egypt. Dr. J. Templeton has been appointed director of the Botanical Section in succession to Dr. Balls. Dr. Templeton has been in the service of the Egyptian Government since 1921, prior to which he was a lecturer in the Botanical Department of the University of Edinburgh.

MR. A. JONES has recently been appointed by the Secretary of State for the Colonies to be assistant superintendent of agriculture, Gold Coast.

THE British Pharmaceutical Conference will be held on July 24–28 in London, with its headquarters at Grosvenor House, Park Lane, W.1. The president of the Conference will be Mr. John Keall, president of the Pharmaceutical Society of Great Britain. Some thirty papers of scientific interest will be presented and a discussion will be held on the Pharmacy and Poisons Act, 1933. Further information can be obtained from the Secretary, Pharmaceutical Society of Great Britain, 17, Bloomsbury Square, London, W.C.1.

IN the article entitled "Plaice Fishery of the North Sea" (NATURE, July 1, p. 35, par. 5), the following sentence appears: "In both England and Holland, too, a considerable industry is said to exist in supplying small fish to fish meal and fertiliser factories." This is incorrect. Miss D. E. Thursby-Pelham in her "Report on the English Plaice Investigations during the Years 1926 to 1930", on which the article was based, refers to "Germany and Holland". In Germany this industry is very considerable, whereas in England it is practically non-existent.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the Mining Department of the North Staffordshire Technical College—The Clerk to the Governors, Education Offices, Town Hall, Hanley, Stoke-on-Trent (July 17). A lecturer in mechanical engineering at the Rutherford Technical College, Newcastle-upon-Tyne—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (July 20). A lecturer in the Department of Physiology and Biochemistry at University College, Gower Street, London, W.C.1—The Secretary (July 21). A full-time lecturer in mechanical engineering at the Leeds Technical College—The Director of Education, Education Offices, Calverley Street, Leeds (July 24). A head of the Engineering Department of Cheltenham Technical College—The Secretary (July 24). A director of the Warrington Museum—The Clerk to the Committee, The Museum, Warrington (July 31). A teacher for workshop processes of printing on textiles and a teacher for the design of woven fabrics in the School of Applied Art, Giza, Egypt—The Director, Egyptian Education Office, 39, Victoria Street, London, S.W.1 (Aug. 10). An assistant lecturer in applied mathematics at University College, Swansea—The Registrar (Sept. 5). A lecturer in psychology at King's College of Household and Social Science, Campden Hill, London, W.8—The Secretary.

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.*]

Gonadotropic Hormones and Cancer

INTEREST in the relations between the anterior pituitary and tumour growth has been considerably stimulated of late by the claim of Zondek, Zondek and Hartoch[1] that the growth rate of the Ehrlich carcinoma in mice is greatly retarded by the administration of large quantities of 'prolan'. In a subsequent paper, Gross[2] described previous experiments in which he found that administration of 'prolan' had no appreciable effect on the growth of a transplantable sarcoma beyond a doubtful acceleration.

We have carried out some preliminary experiments on the effect of pituitary and pregnancy urine extracts on the growth of the Jensen rat sarcoma implanted in rats of the hooded Reading stock. The tumour strain was kindly given by Dr. J. A. Murray, and we have to thank Dr. S. K. Kon of Reading, and Miss E. Gilroy of Edinburgh, for supplying the animals.

In a group of twenty-four rats, bovine anterior lobe extract—prepared by the ammonia method of Wiesner and Sheard[3]—was administered before and after tumour inoculation. The present state of the standardisation problem makes it impossible to give any reliable statements regarding the potency of the extract used, but 1·0 c.c. was equivalent to 1·0 gm. of fresh anterior lobe. The experimental animals received six subcutaneous injections of 0·5 c.c. each during the ten days prior to the tumour inoculation and fourteen doses in the fifteen days following. In two animals no tumour resulted; in two others the tumour may have taken, but if so, regression occurred very early; in the remaining animals the tumours grew well. Measurements were taken every three days; the animals were killed on the sixteenth day after implantation and the tumours were removed and weighed. The range of variation was 0–23 gm. if the negative cases are considered, and 4–23 gm. if only the positive cases are considered. If the figures obtained are compared with the standard figures observed in twenty-six animals under equivalent normal conditions (range of variation, 6–25 gm.) it is found that the growth-rate of the tumours in the injected animals differs but slightly from the 'standard' growth-rate. If the negative cases of the pituitary experiment are discarded for comparison of actual weights, it is found that the difference between the normal series and the pituitary series is negligible; the actual difference is 1·04 gm. with a probable error of 1·19.

In a second experiment employing twenty-four rats and conducted by exactly the same technique, we used a gonadotropic preparation of pregnancy urine obtained from a batch of the protein residue which is rejected at one stage when highly purified extracts are prepared by the method of Wiesner and Marshall[4]. Notwithstanding claims made in the literature, it is not possible in the present state of our knowledge to make any exact statement regarding the potency of any extract. As an indication, however, it may be mentioned that in a control experiment it was found that about one two-thousandth of the total given to the tumour rats was sufficient to produce œstrus in rats aged 32 days.

After having received six doses of 0·5 c.c. of the extract during the ten days preceding implantation, and fourteen similar doses during the succeeding fifteen days, the animals were killed and the tumours removed and weighed on the sixteenth day. The tumour weights varied from 13 gm. to 33 gm., the average being 22·46 gm. Comparison with the standard series shows (*a*) that there is no difference in the incidence of successful implants, and (*b*) that there is an undoubtedly significant increase in the growth-rate of tumours in the animals treated with gonadotropic hormones from urine. The difference between the respective average weights of treated animals and controls is 8·29 gm. with a standard error of 1·63 gm. The difference of the means is thus 7·54 times the probable error.

This acceleration effect is in accordance with Gross's findings, and one might be inclined to regard the gonadotropic hormones as factors promoting tumour growth. Although their appearance in certain cases of malignancy might be interpreted from this point of view, extreme caution is advisable, and Zondek, Zondek and Hartoch have obtained contradistinct results. It therefore seems advisable to refrain from any definite interpretation, but at present it appears that the views of Zondek, Zondek and Hartoch—implying that gonadotropic hormones are secreted in defence against the tumour—are not supported by any data save those supplied by these authors themselves.

B. P. WIESNER.

Macaulay Laboratory,
Institute of Animal Genetics,
University of Edinburgh.

ALEXANDER HADDOW.

Department of Bacteriology,
University of Edinburgh.
June 10.

[1] H. Zondek, B. Zondek and W. Hartoch, *Klin. Woch.*, **11**, 1785; 1932.
[2] L. Gross, *Z. Krebsforsch.*, **38**, 289; 1933.
[3] B. P. Wiesner and N. M. Sheard, "Maternal Behaviour in the Rat", Edinburgh, 1933.
[4] B. P. Wiesner and P. G. Marshall, *Quart. J. Exp. Physiol.*, **21**, 147; 1932.

Accumulation of Ions by Living Cells

THERE appears to be a growing amount of misunderstanding about the different hypotheses so far offered in the endeavour to account for the accumulation of ions by living cells. As an example I quote from a recent paper by Asprey[1]: "It is noteworthy that Briggs[2] has advanced a theory, thermodynamically sound, showing how the accumulation of solutes in the cells of *Valonia* and *Nitella* can be explained . . ." This not only affirms the adequacy of Briggs's explanation, but also accepts his supposed proof that previously proposed theories are thermodynamically unsound. Neither proposition is correct.

Briggs argues that the ionic exchange hypothesis proposed by me[3] under the title: "The Accumulation of Ions in Living Cells—a Non-Equilibrium Condition", is invalid because *at equilibrium* it would not account for the accumulation of ions. Argument

from equilibrium obviously does not disprove the validity of a theory explicitly restricted to "non-equilibrium" or perhaps better, "dynamic equilibrium" conditions. Similar arguments might equally well have been used to disprove Briggs's own theory, which also implies the absence of true equilibrium. It seems possible that Briggs was misled by my unfortunate use of the word "equilibrium" in the discussion of certain equations where the term "dynamic equilibrium" would have been more exact (*l.c.*, pp. 403–4). These equations not only indicate the upper limits of ion accumulation during dynamic equilibrium, but also predict that if true equilibrium were actually attained, accumulation of ions would stop, just as Briggs showed by more elaborate reasoning. This true equilibrium would be attainable only in the absence of all metabolism, and it is this, rather than the dynamic equilibrium indicated by the title and context of my paper, which is discussed by Briggs. In addition to his theory there is therefore also my own theory which is physically sound and antedates and underlies his.

What is more important is the fact that, while my theory is, with minor modifications, competent to explain the observed conditions in the case of *Valonia*, Briggs's theory is not. According to Briggs's own calculations, his theory falls short of predicting the observed accumulation of potassium by more than one-half (*l.c.* p. 259). To put the matter in another way: his explanation would be adequate if sea-water had a *p*H of 6·3 instead of 8·0, a potassium content of 10^{-5} *N* instead of about 10^{-2} *N*, and a chloride content of 10^{-5} *N* instead of about 0·5 *N*. Since such assumptions would be fantastic, it is clear that Asprey is not justified in stating that the accumulation of solutes in *Valonia* can be explained by Briggs's theory. The same can probably be said in regard to the case of *Nitella*, which is not analysed by Briggs.

I see no good reason for denying the possibility of cyclic changes in permeability such as Briggs assumes. On the contrary, his constructive contribution to current thought in this field seems to me both opportune and valuable. Certainly no theory as yet advanced can be regarded as more than a working hypothesis. But Briggs's is only one of several such hypotheses, and will eventually have to be supplemented if not supplanted by other explanations which are better able to account for what we know to be true about the accumulation of solutes in living cells.

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May 11.

[1] Asprey, G. F., *Proc. Roy. Soc.*, B, **112**, 451–72; 1933.
[2] Briggs, G. E., *ibid.*, **107**, 248–69; 1930.
[3] Brooks, S. C., *Protoplasma*, **8**, 339–412; 1929.

AFTER the remarks of Prof. Brooks in the final paragraph of his letter it would be ungracious as well as only part of the truth if I merely stated that I was not misled about the point of dynamic equilibrium and that I maintain that his theory is thermodynamically unsound. The rest of the truth is that it was a critical consideration of his theory that led me to suggest an alternative.

The theory suggested by Prof. Brooks assumes a membrane consisting of a mosaic of areas, some permeable to anions and some to cations, between the cell-sap and the external solution. An accumulation in the sap of ions, such as K and Cl, is explained by the anions of an electrolyte, such as H_2CO_3, passing through the anionic areas in exchange for Cl ions and the cations through the cationic areas in exchange for K ions.

Let us consider a simple system: in the sap, H and HCO_3 ions are maintained by the production of carbon dioxide at a concentration higher than that outside the enclosing membrane, the concentration of H equals that of HCO_3, the mobility of the two ions is assumed to be equal whether in the liquid or in the membrane; the same applies to K and Cl ions except that their concentration is the same in the sap as outside. If K ions are to be driven into the sap against a concentration gradient then there must be a gradient of electric potential, the sap being negative to the outside: if Cl ions are to be driven in, the gradient must be in the opposite direction. It is obvious that the sap as a whole will be at the same potential as the external solution, since the H ions pass out of the sap as rapidly as the HCO_3 ions. Near to the anionic areas the sap will be positive and the external solution negative to the bulk solutions because the HCO_3 ions have a shorter path to the outside than have the H ions, and hence in the sap there will be a local excess of Cl ions and deficit of K ions, while outside the reverse will hold. Near the cationic areas it will be in the outside solution that there will be a local excess of Cl and deficit of K ions. There will be no accumulation of K and Cl ions in the sap from outside in such a system; the H ions passing out will be balanced electrically by the HCO_3 ions passing out with equal facility. Anions could be accumulated if HCO_3 passed out more readily and the sap was positive to the external solution, or cations if the reverse held, but not both. Such were the objections raised to Brooks's theory.

The theory which I suggested resembled the above only in that it postulated the production of an electrolyte by the cell which was permeable to both ions. For the mosaic it substituted periods of greater permeability to anions alternating with periods of greater permeability to cations. Prof. Brooks says such a theory cannot explain the condition in *Valonia* without fantastic assumptions. The mechanism can account for accumulation to any extent; it is only a question of the ratio, inside to outside, of the concentration of the ions of the produced electrolyte. The numerical example was based on the data of Osterhout and Dorcas[1] for carbon dioxide, which was assumed to be the electrolyte. To account for the known accumulation of potassium chloride, the not unreasonable assumption of a greater concentration of undissociated carbonic acid at an earlier stage in the history of the cell or the production of other electrolytes is required. On the basis of the former assumption the cell in question would be losing ions such as Cl under the conditions given. This would be a necessary consequence of any theory involving permeability of the membrane to anions, for the concentration of HCO_3 ions in the external solution is greater than that in the sap according to the data of Osterhout and Dorcas used in the calculation.

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May 29.

[1] Osterhout and Dorcas, *J. Gen. Physiol.*, **9**, 255; 1925.

Influence of Geophysical Factors on the Frequency of Lightning Strokes on an Area

DURING the past three years we have been exploring by geophysical means regions which are frequently struck by lightning[1]. These experiments were based on the assumption[2] that the lightning, which has all the properties of the spark discharge, must choose the path with the least resistance. When the discharge takes place between the cloud and the earth, this path consists of the thickness of the air and the surface layer of ground. Therefore our aim was to explore the conductivity of the ground and of the air.

The increase in the conductivity of the air may be due to the increase of its ionisation, and as the ionisation factor must be connected with the place of observation, it is natural to assume this factor to be the increased concentration of the radioactive elements in the rocks, which, by means of their radiation, cause the ionisation of the air. The conductivity of the ground depends on its chemical structure.

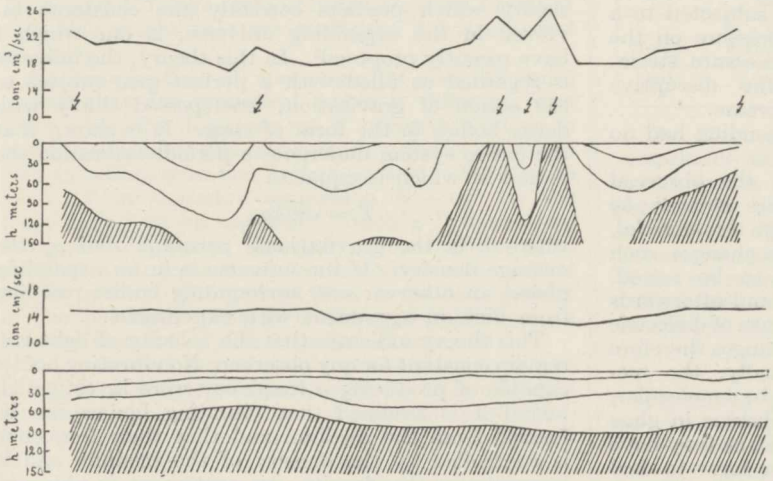

FIG. 1.

We have carried out measurements of radioactivity and made electrical surveys in ten regions well separated (outskirts of Leningrad, Moscow and Cheljabinsk in the Ural), in all, 405 points. In connexion with radioactivity, we have measured the intensity of the penetrating earth radiation by an electrometer of special type. Electrical survey was accomplished at the same places by the method of 'electrical boring' of Schlumberger. In eight out of ten regions the work was carried out on the electric power lines. The results are shown by the curves representing the change of intensity of the penetrating earth radiation and by profiles indicating the layers of rocks with the definite electroconductivity.

The results of the investigation show that the points of the lightning strokes always correspond to the places with increased intensity of the earth radiation, and that the character of the curve of the penetrating earth radiation depends on the layer with the definite conductivity lying sometimes at a considerable depth.

Fig. 1 shows electroprofiles and curves of the intensities of the penetrating earth radiation for two regions, one of which (above) is frequently struck by lightning while the other (below) is not struck. The points of observations were situated at the supports at a distance of 200 metres one from another. The arrows indicate the supports of the electric power line which were damaged by the thunderstorm discharges. The correlation of these figures emphasises the importance of the intensity of the penetrating earth radiation and the character of the underground layers of rocks for the frequency of lightning strokes in the area in question.

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[1] *Electritchestvo*, No. 5, 1931; No. 10, 1932. *J. Phys. et Radium*, April 1931.

[2] Dauzère et Rouget, *C.R.*, June 4; 1928. Dauzère et Rouget, *C.R.*, June 18; 1928. Boutaric, *R.G.E.*, Feb. 21, 1931. Dauzère, *R.G.E* Oct. 21, 1931.

Effect of Mechanical Stress on the Disruptive Strength of Dielectrics

AN interesting problem is involved in the question whether the disruptive strength of a dielectric may be affected by simultaneous mechanical strain or not. Some investigations (Goodlet, Weicker) have led to the conclusion that with porcelain insulators such an influence does exist. We have investigated this problem in the case of well-defined insulating materials and with as high specific stresses as possible. Details will be published in the *Archiv für Elektro-technik*.

The first method used was pressure on a metallic sphere. In this case the points of electrical and mechanical stresses nearly coincide, namely, at the apex of the sphere; moreover, it is possible to apply very high specific stresses, because of the small surface of contact. The mechanical and electrical forces are parallel. With increasing weight the disruptive strength at first increases, reaches a maximum, then decreases again. The most probable explanation for this behaviour is that at first the test-piece becomes compressed: therefore its strength increases. Later on, destructive moments such as dilatation and shearing forces outweigh the compression effect and the disruptive strength decreases. The specific weight at the point of maximum is of some critical value. This critical weight is proportional to the thickness of the test specimen, and to the radius of curvature of the sphere. The first of these results is evident; the second arises from the fact that the contact surface also increases with radius.

An appreciable effect of mechanical stress is only attainable with small spheres. As regards the greatest percentage change in electric strength from zero weight to the maximum point, this value is independent of the thickness of material, but diminishes greatly with increasing radius of the sphere. The same results were obtained with mica, glass, celluloid, and rubber. With rubber it was important to measure not only the voltage, but also the thickness, which varied to a great extent with mechanical load. The changes in thickness with glass and mica can be

neglected, since they are only of the order of 1 per cent.

Another way of applying mechanical stress is by linear tension, which acts perpendicular to the electric force. The steel clamps which fixed the dielectric touched only its inner part, not its edges, in order to avoid any notch effect. By carefully placing the clamps, one can reach mechanical stresses, which are near the theoretical tensile strength (some 10^4 kgm./cm.^{2}). The dilatation of mica perpendicular to the electric force also caused in this case decrease of the electric strength. The decrease of thickness by mechanical stress has also been considered. We succeeded in measuring the thickness by means of a microscopic method.

A third application of strain took place with thin blown glass bulbs. One side of the bulb communicated with the aid of a water-filled copper pipe with a hydraulic pump, the other side was in contact with water at atmospheric pressure. The pump was earthed and the high tension was carried to the outer vessel. In applying pressure on the concave side of the bulb, the wall of this latter was subjected to a stretching strain; in applying the pressure on the convex side, it was subjected to a pressure strain. Dilatation caused diminution of the disruptive strength, and compression caused increase.

Finally, it may be remarked that bending had no effect at all.

It may perhaps be thought that the observed effects, namely, *increase of disruptive strength by compression, decrease by dilatation of the material*, are only due to irreversible microscopic changes, such as capillary crevices in the pieces to be tested. Experiments carried out by stressing and afterwards relieving the specimen showed a fair return of dielectric strength to the original values. The changes therefore appear to be reversible. Theoretically, the mechanical effect on electric strength may be a molecular, as well as a microstructural one. Whereas in glass and rubber the former is more probable, as they have but few microscopic pores, in mica we have to deal partly with thin flat voids between the different layers of the crystal.

We are much indebted to Prof. K. W. Wagner, president of the Heinrich-Hertz-Institut, for his help during the course of this work.

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Constancy of Light Frequencies and the General Relativity Principle

IT is the purpose of this note to direct attention to the importance of a recent experiment[1] on the constancy, with time, of the frequency of light from an emitting atom, from the point of view of the general relativity theory, or any other theory of space-time structure. In the experiment in question, light is sent over two paths of different length and made to interfere at the point of observation. The number of waves retardation was measured as a function of time with the result that a measured retardation of $1{\cdot}4 \pm 1{\cdot}1 \times 10^{-5}$ fringes per day was observed for a path-length of 582,000 wave-lengths. The conclusion is that either a frequency increase of

$$\frac{d\nu}{dt}\Big/\nu = (2{\cdot}8 \pm 2{\cdot}3) \times 10^{-16}$$

occurs per second or else there is a corresponding decrease in the velocity of light.

In spite of the change in the gravitational potential for any observer, due to the expanding universe, no such effect is to be expected for the general relativity theory, as has been shown by McVittie[2]. The reason for this is obvious from general considerations; for since an observer at one place finds the same value for a fundamental quantity such as the velocity of light or the frequency of an emitting atom as an observer at another place, and time and space co-ordinates are members of the same co-ordinate system, an observer at one time should find the same value as another observer at a different time, if the general principle of relativity is to hold.

This effect will exist, however, for any theory which holds that time and space are not members of the same co-ordinate system. An example of such a theory which predicts correctly the constants involved in the expanding universe, is one which I have recently proposed[3]. In this theory, the universe is regarded as filled with a perfect gas, subject to the action of gravitation, interspersed thinly with dense bodies in the form of stars. It is shown that the entire system undergoes a periodic vibration the period of which is equal to

$$T = \sqrt{\pi/k\rho_0}$$

where k is the gravitational constant and ρ_0 the average density. If the universe is in an expanding phase, an observer sees surrounding bodies receding from him, in agreement with experiment.

This theory indicates that the velocity of light will remain constant for any observer. No vibrating bodies capable of producing a frequency were investigated, but if it is assumed that vibrating bodies can be formed from the medium and that their frequency is controlled by the density of the medium and is inversely as the density, an agreement is obtained with the observed red shift in the neighbourhood of a heavy body. This follows because it can be shown that the density of the medium in the neighbourhood of a heavy body will be

$$\rho = \rho'_0 (1 + V/c^2),$$

where V is the gravitational potential and c the velocity of light. Then since the frequency is inversely as the density, a decrease in frequency of the proper value is obtained. Now, since the universe is expanding, the density of the gaseous medium must be decreasing, and hence the frequency of a vibrating body must be increasing according to this theory. Depending on the phase of the motion, the order of magnitude of this change can be shown to be from two to nine times as large as Hubble's constant, which measures the rate of recession of the spiral nebulæ, and hence should be

$$\frac{d\nu}{dt}\Big/\nu = (2 \text{ to } 9) \times 1{\cdot}63 \times 10^{-17} = (3{\cdot}3 \text{ to } 14{\cdot}7) \times 10^{-17}$$

Hence the experimental value found above is of the right sign and the right order of magnitude to agree with this result.

In conclusion, it appears desirable to establish on a better experimental basis the existence or the non-existence of this effect, since it provides a crucial experimental test of the general principle of relativity.

If the effect is definitely established, then the partnership of space and time cannot be upheld in the general relativity theory. If the effect is shown not to exist, it will provide independent evidence of the validity of the general relativity principle.

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[1] Kennedy, "The Velocity of Light", NATURE, **130**, 277, Aug. 20, 1932.
[2] McVittie, "Dirac's Equation in General Relativity", *Mon. Not. Roy. Astro. Soc.*, **92**, 868–877, Oct. 1932.
[3] Mason, "A Newtonian Gravitational System and the Expanding Universe", *Phil. Mag.*, Ser. 7, **14**, 386, Sept., 1932.

Ionisation Density and Critical Frequency

IN some recent papers[1] on ionisation in the upper atmosphere, the theoretical relation between ionisation density N and critical frequency f has been taken to be $N = (3/2)\,(\pi m/e^2)f^2$. On the other hand, J. J. Thomson has, on various occasions, as have L. Tonks and I. Langmuir[2] published formulæ identical with this except that the coefficient 3/2 is replaced by unity.

An examination of the origin of the difference reveals that the numerical factor is different from unity when the displacement of negative relative to positive charges in the medium gives rise to a doublet field in addition to the impressed field. This is the force aP in Lorentz's expression $E + aP$ for the force acting on an electron[3]. Such a 'polarisation' force can only exist, however, when there is some detailed arrangement of the negative with respect to the positive charges, so that a volume element of the polarised medium is distinguishable from a volume element of the unpolarised medium.

In an ionised gas, the only possible arrangement of this type is that associated with the Debye-Hückel ion cloud, but its effect is completely negligible[4]. The 'polarised' gas contains no electric doublets and in an infinite gas only the space charge developed in the volume will contribute to the force acting on any ion. Consequently, the relation of electron concentration to critical frequency is $N = (\pi m/e^2)f^2$ in this case.

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May 24.

[1] Among others, *Proc. Phys. Soc.*, **45**, 389; 1933.
[2] *Phys. Rev.*, **33**, 195; 1929.
[3] "Theory of Electrons", p. 139.
[4] *Phys. Rev.*, **38**, 1219; 1931.

Catalysis of the Hydrogen-Sulphur Reaction by Minute Traces of Oxygen

IT has been pointed out[1] that the curvature found by Norrish and Rideal[2] in the log $\frac{d[H_2S]}{dt} \Big/ \frac{1}{T}$ curve representing the hydrogen-sulphur reaction was only to be observed in the presence of nitrogen. Pending further inquiry, we tentatively ascribed this to a facilitation by the nitrogen molecules of some chain mechanism. The investigation of this point, now complete, indicates that the effect is foreign to the true reaction, and arises from minute traces of oxygen present in the hydrogen-nitrogen mixtures.

Originally these mixtures had been prepared from pure hydrogen and cylinder nitrogen washed with alkaline pyrogallol, and, as a further precaution, treated after mixing with the same reagent. Since certain tests had indicated that minute traces of oxygen in otherwise pure hydrogen considerably accelerated the velocity of hydrogen sulphide formation at the lower temperatures, it seemed worth while to examine the effect of an even more rigorous exclusion of oxygen from the mixed gases. Extensions of the pyrogallol treatment diminished the velocity until it eventually became practically identical with that resulting from the use of pure hydrogen. It was, however, felt that even freshly prepared pyrogallol might possibly lead to a contamination of the gases with traces of carbon compounds, and, therefore, in a parallel series of experiments this reagent was replaced by chromous chloride together with amalgamated zinc. Again, values approximating to those for pure hydrogen were obtained. Specimen results from the homogeneous reaction in bulbs are given below :—

	Rate of formation of H_2S (gm. per sec. $\times 10^{-8}$)			
Temp.	H_2+N_2 normal	H_2+N_2 over pyrogallol	H_2+N_2 over $CrCl_2+Zn$	Pure H_2
291°	2·51	1·28	1·17	1·13

The effect of so minute a quantity of oxygen is remarkable and unexpected, but there seems little doubt that it accounts for the form assumed by the log velocity $1/T$ plots of Norrish and Rideal and thus invalidates deductions made therefrom as to the nature, temperature coefficient or heat of activation of the reactions.

The first stage of the investigation has now been completed and will be published in full shortly.

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June 2.

[1] Aynsley, Pearson and Robinson, NATURE, **131**, 471, April 1, 1933.
[2] *J. Chem. Soc.*, **123**, 696; 1923.

Reducing Bodies, and Fumarase, in Tumours

WITH reference to Dr. L. J. Harris's comments in NATURE of July 1 (p. 27) on the presence of reducing bodies in tumours, perhaps the following observations may be of some interest. In making a systematic investigation of the distribution of fumarase in animal and plant tissues, I have studied the activity of several human tumours. They have all shown very powerful fumarase activity and usually more so than the surrounding host tissue. In performing the test for fumarase activity, I have estimated the *l*-malic acid formed by adding acetic acid and concentrated ammonium molybdate solution, filtering off the proteins, etc., and examining the resulting clear solution by means of the polarimeter. With all tumours so far examined, the solution after adding acetic acid and molybdate became deeply coloured, probably due to the formation of the lower oxides of molybdenum and indicating the presence of reducing bodies in the tumours. The host tissues failed to give such extensive reduction of the molybdic acid reagent.

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July 3.

A New Triol from the Urine of Pregnant Mares

RECENTLY, Dr. André Girard very kindly placed at our disposal a large quantity of an extract of the urine of pregnant mares from which the keto-hydroxyœstrin had been previously removed. Attempts to isolate from the neutral fraction of this extract, the sterol degradation product *pregnandiol*, $C_{21}H_{36}O_2$, which occurs in the neutral ether-soluble fraction of human pregnancy urine, have not been successful. We have, however, isolated from this same fraction a new crystalline substance, m.p. 300° (decomp.); $[\alpha]_{5461}$ (in pyridine) = − 44°, which has given combustion figures agreeing closely with the formula $C_{21}H_{36}O_3$. Acetylation has yielded a triacetate, $C_{27}H_{42}O_6$, m.p. 169°. The compound gives an iodine value of 0 by the Rosenmund-Kuhnhenn method. The colour given by it when treated with hot concentrated sulphuric acid is similar to that given by pregnandiol under the same conditions.

In view of the source from which it was obtained, its solubilities and its empirical formula, we consider that it is probable that it is closely related to pregnandiol. Full experimental details will shortly be published.

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Forest Fires in Relation to Soil Fertility

IN his interesting article in NATURE of June 3, p. 787, Prof. F. P. Worley describes some of the effect of fire upon soils. It is not impossible that his observations may apply to soils in tropical Africa, even in the open woodlands where the humus content is low, and leaves are consumed by fire each year.

Soil burning to obtain fertility has recently come under observation in Nyasaland, where two principles emerge. The first is that burning of timber (on red earth soils) producing a moderate intensity of heat, is a common practice before growing crops of maize. Cultivation continues for some years before moving. The second method is for the purpose of growing finger millets (*Eleusine*). Wood from a considerable area is stacked together three feet deep on the area intended for cultivation, and some months later is burned, causing a very intense heating of the soil. One good crop of *Eleusine* is grown, after which the land must be abandoned for some years. The effect of burning is not only to produce a friable and sterilised seed-bed. The manurial value of the wood ash is regarded as negligible by the natives. Some experiments by Moffat[1] confirm the suggestion that good cultivation and the use of more common manures is no substitute for firing for producing large grains and a heavy yield.

Curiously enough, in Cornwall, at least one golf course maintains the quality of its greens by a compost of decaying vegetable matter and earth which is kiln heated to 212°–220° F. It is then applied as a light dressing. The value of this dressing is attributed mainly to the heated earth itself rather than to the burnt vegetable matter.

The destructiveness of *Eleusine* cultivation must be seen to be believed, in removal of forest and rendering the soil barren and liable to erosion. In 1932 the Conservator of Forests observed *Eleusine* cultivation to be on a very much larger scale than had previously been supposed, being grown also in small patches in maize gardens throughout Nyasaland. The method of heating the small patches is the same as for heating a large area. Fresh patches are sown each year within the garden until the whole garden has been burnt over and left to fallow for a number of years. The growth of the surrounding maize obscures the destructive growing of the *Eleusine*. This observation probably explains much shifting cultivation of maize being brought about more quickly than is otherwise necessary.

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June 17.

[1] *N. Rhodesia Agricultural Bulletin*, 1932.

Origin of the Time Pendulum

THOUGH the promulgators of the C.G.S. system were devout decimalists, they strangely took for time the solar day divided by 86,400, instead of the day divided by 100,000 for the unit. If we take the natural standard of day divided by 10^5, the pendulum would be 29·157 in. at lat. 30°. Now this is exactly the basis of the Egyptian land measures, most precisely known by the diagonal of that squared, being the Egyptian double cubit. This value for the cubit is 20·617 in., while the best examples in stone are 20·620 ± 0·005 in.

This close coincidence raises the question whether the highly mechanical Egyptians of the IVth dynasty had experimented with the pendulum, and adopted the hundred-thousandth of the solar day. No difficulty stood in the way, for they counted cattle up to millions. The most practical course would be to swing a pendulum of 116 in., and tick off on papyrus rows of ten swings, during the 50,000 swings between sunrise and sunrise. All that would be easily within their abilities, and a dozen such experiments would suffice to find the true value. Can we allow that the exact coincidence here will give them the credit of the first time pendulum? This unit length divided by 40 is the basis of the Greek foot of 12·150 in. and the Roman foot of 11·66 in.

FLINDERS PETRIE.

Position of Page Numbers in Books

How many months, weeks, or at the very least, days, are wasted in each year by the habit of publishers and printers of omitting the page number at the beginning of a new chapter or article? When one is making a reference to a paper it is excessively annoying to have almost invariably to turn over the leaf in order to find the number of the page on which the chapter or article begins. Certainly it must occupy several minutes of my time each year, and the total time wasted by scientific writers and others who are careful in giving their references must certainly be considerable. If the printer or publisher objects to putting the page number in its usual place at the top outer corner of the page, he could quite easily centre it or place it at the bottom of the page. This, in fact, is a procedure occasionally adopted, especially of late years, but one would like to see it universal.

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Research Items

Tuareg Origins. A suggestion towards the elucidation of the origin of the Tuareg is made by His Excellency, H. R. Palmer, Governor of Gambia Colony, in *Man* for June. The Tuareg veil is undoubtedly ritual in origin; but the only cult to which it can be referred is that of Mithras. Mithraic ritualistic representations show magi wearing a veil similar to that of the Tuareg; and the illustrations in Woolley and MacIver's "Karanog" suggest that the 'noble Blemyes' may have worn veils. An alternative name for the Tuareg veil is *t'imedr*, which thus may mean the 'property of Mithras' (Midr). This would involve the acceptance of Ibn Khaldun's statement and implication that the Tuareg spread westward from Abyssinia to the Sudan at some date later than the beginning of the Christian era; and moreover, the assumption that the custom of covering the mouth as a sign of high rank—a convention universal from Abyssinia to Senegal—is due to the same ultimate religious influence. It is probable that this convention was brought to Africa from Asia at the opening of the Christian era. In the time of Strabo the dominant caste in much of the eastern Sudan was the Sambritae, Automoloi or Ασμάχ, names which reappear in the fifth century A.D., and are very similar to Tuareg caste names. These references are intermediate in date between the break up of the Meroitic kingdom of the Blemyes or Makkora and the reception of the Makkoritae by Justin II at Constantinople in A.D. 537. The passage of the Blemy tribes from the eastern Sudan to North Africa probably coincides with the coming of the camel to North Africa, while the invaders of the Delta after the Arab conquest, known as 'Lewata', were probably in many cases tribes from the Sudan and not necessarily Libyans. Mithraism was a powerful influence in the Sahara and central Sudan up to at least A.D. 1200 and also probably in Bornu, which culturally is closely akin to the Tuareg, up to A.D. 1500, where indeed it may survive to the present day in the Nâthirîn or 'Stargazers'.

Dolmens of North Caucasia. Prof. A. M. Tallgren, in *Antiquity* for June, analyses the prehistoric culture of the north-western Caucasus, the so-called Kuban culture of the Early Bronze Age. In this part of the Caucasus dolmens occur in considerable numbers, occupying the basin of the western tributaries of the Kuban river between Mt. Elbruz and the Black Sea, the best examples being actually on the Black Sea coast. The dolmens are stone cists built of heavy well-squared stone slabs, fitted together with admirable precision. The side walls and capstone project beyond the front, and in the front slab there is generally a hole, like a window, which is fitted with a stone disc, or mushroom-shaped plug. In a small class a long quadrangular block is hollowed to form a monolithic box, the lid being one of the sides. There is no difference in time between the different types. Of the 1500 dolmens in Caucasia (approximately), only part have yielded finds. From the animal remains it is evident that the people were nomad cattle-keepers. The pottery is decorated with the geometrical designs of the early bronze age and never painted. Bronze tools, daggers and rings are present, but no stone weapons. Flint flakes, scrapers and arrow-heads show that the stone age had not long passed. In the Tsarevskaya dolmens were found ornaments, pins, beads and rings of gold and silver, as well as bronze implements. With the cultural remains from the barrows the dolmenic culture constitutes a cultural group of a very distinct character, which is rich in objects of oriental type, a characteristic to be noted particularly in the Staromyshastovskaya and Maikop treasures. It is an oriental culture, in which, however, the pottery differs from that of Asia and is to be related to Fatyanovo and Thuringian cultures of central Russia and Germany. The dolmens are of eastern type. The culture is probably the origin of one of the cultures known in hither Asia in the 2nd millennium B.C. It is therefore suggested that the people who created the Kuban culture were an Indo-European aristocracy who appear as the Mitanni, the Indian element, among the Hurri in hither Asia about 1600 B.C. at the close of the Early Bronze Age in Kuban.

Digestibility of Raw and of Heated Milk. A series of artificial digestion experiments upon raw certified milk, the same boiled, and pasteurised milk, has been carried out by Miss Mary Andross (Report of Digestion Experiments on Milk. Glasgow and West of Scotland College of Domestic Science: Dietetic Dept.). The digests consisted of 5 c.c. of milk, 5 c.c. of aqueous pepsin or of trypsin (1 per cent of the powder), with 5 c.c. of the activator, 0·4 per cent hydrochloric acid or 4 per cent sodium carbonate, respectively. From weighings of the curd left at the end of each five-minute period up to 40 minutes digestion with pepsin at 35°–40° C., it is concluded that heating lowers the digestibility of milk, boiled milk being more affected in this respect than pasteurised. The curd of the boiled milk is harder and more granular than that of the other two and is much more resistant to digestion. It may be noted, however, that in an experiment of longer duration in which pepsin was followed by trypsin digestion (as occurs in natural digestion) the weight of the curd residue was practically the same for the raw, pasteurised and boiled milks. From experiments on the digestion of cheese with pepsin in the presence of the different milks, it is also concluded that the natural enzymes of fresh milk are a considerable aid to digestion.

Chromosomes and Sex-linked Characters in the Fowl. Silver and gold plumage are known to form a pair of sex-linked characters in fowls, gold being recessive in inheritance. There is also evidence that in fowls the female sex is heterogametic (XY or $X0$) and the males homogametic (XX). The results of matings between a silver female and a gold male are well known as criss-cross inheritance. Thus a Light Sussex hen (silver) × Rhode Island Red (gold) cock generally gives equal numbers of silver male chicks and gold females, because the female chicks all get an X-chromosome carrying gold from their father and the male chicks all get an X with the dominant silver from their mother. Occasional exceptions occur, and Prof. F. A. E. Crew (*Proc. Roy. Soc. Edin.*, vol. 53, p. 90) has investigated the genetics and cytology of a typical gold male from this cross. This bird, mated to Light Sussex hens, produced 117 chicks, 68 silver and 49 gold. The latter were all female but one, and the former were all male except two. Further genetical results strengthened

the hypothesis that the original gold male had the sex chromosome formula *XXY* and had arisen through non-disjunction, his *X*-chromosomes being joined end-to-end as has happened in *Drosophila*. Cytological examination of meiosis in this male and of mitosis and meiosis in many of his offspring seems to confirm this result. Among the progeny were found *XX* males, *XXX* males and *X* females, but the *XXY* male and the *XYY* female type expected could not be identified, because the *Y* is small and generally indistinguishable from numerous other small chromosomes. The chromosomes of the chick are notoriously difficult to count, partly by reason of their great variation in size, and various numbers have been published. Crew finds 32–35, which is in accord with various other workers, but M. J. D. White (*J. Genetics*, vol. 26, No. 3) has recently counted as many as 66 ± 2. The real number in the chick, and whether it remains constant, is therefore still in doubt.

The Yellow Leaf Pigments. The Yearbook of the Carnegie Institution of Washington, No. 31, includes a brief review of the progress made in the investigation of the yellow leaf pigments in the Division of Plant Biology under the general direction of Dr. H. A. Spoehr. These pigments, carotene and xanthophyll, are exceedingly complex molecules, although in the case of carotene only carbon and hydrogen enter into its composition. The carotene molecule exhibits an extraordinary degree of unsaturation. Dr. J. H. C. Smith has investigated the number of double bonds present by determining the number of hydrogen atoms which are taken up by the molecule in the presence of a platinum catalyst. All the leaf carotenes examined proved to have ten double bonds in the molecule ; on the other hand, lycopin, the yellow pigment of the tomato fruit, with the same number of carbon and hydrogen atoms, has thirteen double bonds. Considerable difficulty was met with in determining the optical rotation of these pigments because of their colour, but all the leaf carotenes appear to be optically inactive whilst carrot carotene has a strong dextro-rotation. On ozonisation, Dr. Strain has found that carotene yields geronic acid, whilst amongst the products from lycopin is levulinic acid. These experiments have necessitated large-scale extractions and are very laborious, but they are gradually yielding definite information as to two pigments which may prove to have importance in the photosynthetic process.

Geology of Eua, Tonga. Bulletin 96 of the Bernice P. Bishop Museum (1932, pp. 93) is devoted to the results of recent investigations of this interesting island by J. E. Hoffmeister. The petrography is dealt with by H. L. Alling and the Foraminifera are described by G. L. Whipple. The occurrence of boulders of diabasic norites suggests plutonic conditions in the vicinity in pre-Upper Eocene times. The primary nucleus of the island is built of pre-Upper Eocene volcanic rocks. Foraminiferal limestone was deposited in the Upper Eocene. Elevation, denudation and subsidence followed in the Oligocene, after which another period of volcanic activity set in. During the Pliocene, elevation took place with the formation of terraces capped with coral reefs. Low-level abrasion probably occurred in the Pleistocene. The latest change was a eustatic lowering of the strand line leading to the death of the older fringing reef and the growth of the present one. The petrography, especially the finding of red garnets and blue tourmalines in the pyroclastics and the acidic character of the older volcanics, suggests that Eua is a remnant of a continental volcano situated on the coast or shelf of a former continent.

Himalayan Glaciers. In a paper on the Chong Kumdan glacier, the vagaries of which have caused much interest in recent years, Prof. K. Mason (*Himalayan J.*, vol. 5, 1933) directs attention to the seasonal variations of Karakoram and Himalayan glaciers. He points out that while the actual flow in the glacier is faster in summer than in winter, the summer advance which might result from this is entirely negatived by the intense ablation of the snow at that season. In August and September when the ablation has been operating for some time, the snow is in actual retreat. This is a normal seasonal phenomenon. In winter, in spite of the retarded flow of the glacier, due to the low temperatures, the absence of ablation causes active advance of the snow. This explains why glaciers in the Karakoram have often been described by summer travellers as being in a state of retreat. Actually there is no real evidence of this. Prof. Mason points out that ice blocks form in winter and tend to burst in late summer, healing again in the succeeding winter. If, on the other hand, a burst occurs in July before the period of intensive ablation has set in, it is improbable that the winter will heal the break.

Tropical Cyclones in Mauritius. It is only at long intervals that a tropical cyclone or 'hurricane' passes directly across Mauritius, although that island lies just inside the southern tropic and in a part of the South Indian Ocean where these storms are not infrequent in the early months of the year. An account of one that crossed the island on March 5, 1931, and was in the neighbouring waters for a week, is given in a memoir entitled "The Cyclone Season of 1930–31" by M. Herchenroder, of the Royal Alfred Observatory, Mauritius (Misc. Pub. No. 13 of the Royal Alfred Observatory). It is stated to be the most violent storm that has passed over or near the island since the terrific gale of April 1892, which last is unique in the records of the Observatory for intensity and for speed of progression of the storm centre. The more recent storm 'recurved' near Réunion during March 6 and 7 and was remarkable for its size, for the sharpness of the recurve, and for the heavy rainfalls for which it was responsible. At the Observatory (Pamplemousses) 24·6 in. fell between March 1 and 10, while at La Marie Filter Beds, a rain-gauge at a height of 1,700 ft. above sea level, the yield for the month was raised thereby to the huge total of 130 in., about five times the average annual fall in London. The ring of hurricane winds reached Mauritius in the early hours of the morning of March 5, and was large enough to include the island for three days and three nights. A similarly acute shape for the trajectory of the eye of the storm had been observed, it is stated, in storms occurring in the years 1891, 1893 and 1911. The rate of travel of the centre was about 15 miles an hour except near the 'recurve', when it became very slow. The season as a whole was not characterised by many bad storms. A number of disturbances not unlike feebly developed depressions of higher latitudes were observed as in the previous season. Some of these are described in the memoir.

Photometry of Tungsten Filament Lamps. The manufacture of tungsten filament incandescent lamps has changed very rapidly during recent years and this has made necessary a change in the methods of lamp photometry. Twenty years ago, all lamps had squirrel cage filaments in clear bulbs and were rated by the manufacturers at 'efficiencies' expressed in watts per mean horizontal candle. Inside-frosted diffusing bulbs are used now on all lamps which take 100 watts or less. The ring-wound coiled filament has replaced the squirrel-cage type. In addition, practically all lamps of 40 watts or more are gas-filled. For these reasons spherical candle power, that is, the mean candle power in all directions, has to be measured. The result is given in lumens per watt, a spherical candle being equal to 4π (12·57) lumens. In the *Bureau of Standards Journal of Research*, vol. 9, December 1932, L. E. Barbrow and J. Franklin Meyer publish a paper on the characteristic equations of tungsten filament lamps which show how, when one measurement of the pressure, the current, the lumens and the lumens per watt has been made, then all the corresponding values at other pressures, etc., can be found. They also compare the results obtained by computation with experiment, the agreement being most satisfactory. The Bureau of Standards has used the equations and tables given in this paper for the routine testing of lamps for several years. It appears that the efficiency in lumens per watt is a very definite function of the voltage. For example, if, for a gas-filled lamp taking 60–150 watts, the efficiency is 12·50 lumens per watt at 230 volts, then at 184 volts its efficiency would be 7·55, and at 276 volts its efficiency would be 17·84. The life would be much shorter at the high voltage.

Electron Optics. The May *Journal of the Franklin Institute* contains an interesting article by Zworykin on "Electron Optics". Bundles of electrons in high vacuum can be partially focused by suitable magnetic or electrostatic fields, and images may be formed of the electron-emitting surfaces or of diaphragms placed in the beam. The arrangements described include the long uniform magnetic field used in Busch's determination of e/m, the short magnetic field, and various electrostatic arrangements, mostly employing coaxial cylindrical electrodes. The focusing arrangements show effects comparable with spherical and chromatic aberration in the optical case, but a further limitation arises from the self-repulsion of the electrons in the beam. The electron microscope which has been described in the German literature and is referred to in the present article, consists of electrostatic or electromagnetic 'lenses' which form a magnified image of the emitting surface. The arrangement may be used to study the surface distribution of emission from a thermionic source or from a target bombarded by a primary electron beam.

Astronomical Topics

Meteorites. *Popular Astronomy* for May contains an article on meteorites of which the fall has been observed, by Mr. Willard J. Fisher. He points out that these are more frequently observed by day than by night. They differ from meteors in an important respect. More meteors come from the region of the earth's apex than from the antapex; this is from the same cause that makes us meet more vehicles when walking along a street than those that overtake us. But the speed of meteors from the apex is so great (71 km./sec. for parabolic motion) that they are consumed in the upper air, and cannot fall as meteorites. Hence the latter come by preference from the antapex. The minimum speed at which meteors can enter the atmosphere is given as 11·15 km./sec.; this is the speed that the earth's attraction would produce if the earth and meteor were originally at relative rest. Many hundreds of meteor falls have been recorded; of these, thirty have fallen on roads or buildings; this obviously increases the chance of detection. The earth's antapex rises about noon; this helps to explain the greater number of falls by day. Most of those referred to were of the detonating class, and bright enough to be conspicuous in the sunshine.

The same publication contains an article by C. C. Wylie on a remarkable meteor that was seen about dawn on March 24 over a large area in the south-western United States. The dust-cloud remained visible for a long time. Fragments probably reached the ground, but none has yet been found.

Early History of Solar Spectroscopy. An interesting paper on this subject has recently been published by Prof. Pio Emanuelli (*Memorie della Soc. Astron. Italiana*, vol. 6). The existence of dark lines in the solar spectrum was announced by Fraunhofer in 1817. The explanation of the lines was given by Kirchhoff and Bunsen in 1859. The first observer to make detailed observations of the spectra of different regions of the sun, and especially of sunspots, appears to have been Sir Norman Lockyer. Vol. 15 of the *Proceedings of the Royal Society* contains a paper by him bearing the date October 11, 1866, in which he says: "On March 4 of this year I commenced a spectroscopic study of sunspots; . . . All the absorption bands visible in the spectrum of the photosphere, above and below, were visible in the spectrum of the spot; they, moreover, appeared thicker where they crossed the spot-spectrum." Lockyer gave a more detailed account in vol. 17 of the *Proceedings* (March 1869), in which he mentioned the lines of sodium, magnesium and barium as being widened in the spot-spectrum. Secchi, who apparently had not noticed Lockyer's announcement, made similar observations at the Observatory of the Roman College, beginning in January 1869. He considered that the widening was restricted to lines in the red and orange regions, and noted the further fact that some of the lines appeared double and triple.

The year 1870 brought further knowledge of spot spectra from observations by Young in the United States and Respighi at the Campidoglio, Rome. The principal aim of the latter was the study of prominences by the spectroscopic method which was discovered in 1868. It was perhaps for this reason that he paid special attention to the red hydrogen line in the spot spectra, as that was the line usually employed in the study of the prominences.

Prof. Emanuelli wrote this article in order to vindicate Lockyer's position as a pioneer, which some recent writers have overlooked.

Spirals and Twists of Negro Hair

By DR. J. E. DUERDEN, Wool Industries Research Association, Leeds

THE hair of the Negro, Bantu and related races takes the form of short, curly tufts, with an entanglement of interlacing whorled and looped fibres and loose broken fragments, an absence of any orderly arrangement giving the hair its characteristic frizziness. The fibres are very variable in thickness (40–80μ) and usually show breakage phases towards the free end, frequent fragmentations serving to keep the hair short. In cross section they are highly elliptical (1 : 1·4), finer and thicker intervals, just visible to the naked eye, corresponding with the

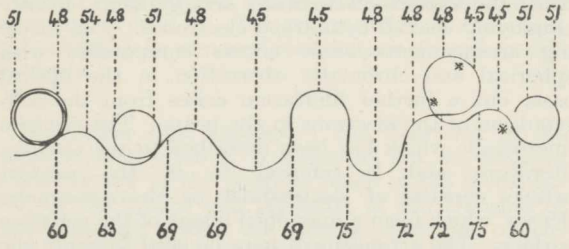

FIG. 1. Photograph of Negro hair, ×3, showing whorls and loops and measurements (μ) of minor and major axes; * are places of breakage.

minor and major axes displayed where the fibre is twisted. Samples taken from the West African Negro, and South African Hottentot, Swazi and Xosa* show no significant differences. On close study, certain structural peculiarities are revealed which serve to interpret the characters mentioned and have a bearing upon the forms assumed by mammalian hair generally.

When single fibres are drawn out of the entanglement and partly straightened, each resolves itself into a grouping of one or more spiral whorls of approximately equal radius (helical, D'Arcy Thompson, 1917), alternating with loops of various sizes, in which any definite spiral arrangement is obscure (Fig. 1). Also when viewed in the plane of the microscope, the major and minor axes are represented as different thicknesses in the fibre, and indicate where the axial twists occur. As seen in the measurements on the figure, the whorls display only the minor axis, as also the crests and troughs of the loops, while the major axis appears at each side of the loops.

The fibre rotator indicates that at any one point an axial turn from the minor to the major axis, or vice versa, represents 90°, while one of 180° represents a complete half turn, that is, from one aspect of the major or minor axis to the opposite. Moreover, a single half turn (180°) brings about a reversal in the direction of a whorl, while two half turns are involved in the production of a complete loop and restoration of the original direction.

Two chief factors evidently contribute to the peculiarities of the Negro hair: a fundamental spiral growth of the fibres, upon which is impressed an axial twist at regular or irregular intervals. The twists produce reversals in the direction of turn of the spiral, sinistral or dextral; a twist of 180° gives a single reversal, one of 360° restores the original direction. An interval of growth between two consecutive twists leaves the fibre in its primary spiral form of one or more whorls, whereas a close succession of twists gives a periodic series of loops or crimps, disposed in no regular plane. It is these variations in the twists of the individual fibre which bring about the frizziness of the Negro hair as a whole. They are structural, not something impressed upon it from the outside, just as is the dark pigment of the hair and the skin. Owing to their diversity of form and position, the spirals and loops of the different fibres cannot dispose themselves in any regular fashion as regards one another, as in the production of curls or locks in the white races, where the fibres arrange themselves with some degree of parallelism. Occasionally in the Negro the tufts display a not very successful attempt to form short helical curls.

The structural characteristics of the hair of the ulotrichous races suggest a comparison with the diverse forms of hair occurring in mammals generally, and particularly with the fleece of the sheep, so much studied at the present time. As before, most of the conditions met with can be interpreted on the basis of a spiral growth of the fibre associated with axial twist. As pointed out by Nichols[1] and others, comparatively few fibres are straight and appear of even thickness throughout their length. In the plane of the microscope most show thickenings and thinnings, usually accompanied by bends and waves; some of these may be due to metabolic differentiation during growth, but most are found to be associated with the twisting of an elliptical structure, and the presentation to view of the axes of different width. Their prevalence may well cause reflection as to the value of the ordinary microscopic measurements of fibres. Variations in form and apparent differences in thickness along the length of the fibres have been found in a wide series of mammals examined and call for fuller treatment. It appears not unlikely that the relationship of spire and twist will be found to be general throughout the hair of mammals.

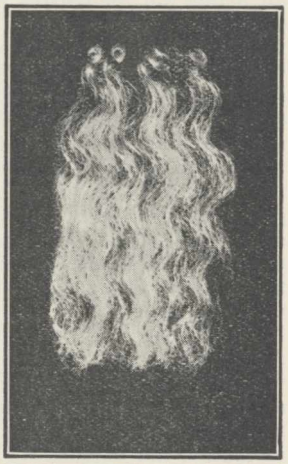

FIG. 2. Wool from Border Leicester lamb, 3 months, showing the helical spirals of the birth-coat above and the stapled, crimped, definitive wool below.

The birth coat in most breeds of sheep consists of spiral tufts of fibres (prototrichs) with free fibres between, somewhat as in Negro hair. The tufts are helical or corkscrew spirals, scarcely increasing in radius from one end to the other, and differ much in the closeness or separation of the whorls, while one or more reversals in the direction of turn usually occur. After birth the fleece changes its character. The spiral tufts are continued into more or less flattened staples, the individual fibres grouped into small strands and assuming an almost uniplanar wavy or crimped form (Fig. 2). Some breeds, like the Wensleydale and Dartmoor, and the Angora, retain to a large

degree the original spiral form of the birth tufts, the adult fleece consisting of long, separate curls or ringlets; others, such as the Cheviot, may lose all the spiral or wavy regularity and take on a loosely matted, frizzy character, as in the Negro.

Fine Merino wool shows the extreme of regularity in crimp formation; the number has been found to vary inversely with the thickness of the fibre and to be a periodic function of time. Among wool problems, probably not one has been more fully discussed than that of the production of crimps, but it is manifest from the above that they are of the same nature as the loops in Negro fibres, and are therefore to be interpreted as a periodic series of twists and reversals impressed on a spiral foundation. Hence the change from the spiral tufts of the birth coat to the crimped definitive coat of the adult, with suppression of the spiral form, is to be associated with the axial twisting of the fibres. The spiral is transformed by a regular succession of mechanical twists and reversals into a periodic series of crimps, which give to wool much of its textile value.

By means of the fibre rotator Rossouw[2] has shown that in each complete wave or crimp there are two twists and two reversals of 180°, the minor axis always showing at the crest and the trough of the wave and the major axis along each side.

The constructive factors involved in the production of the spiral growth of the fibre and its frequent reversals, as well as the regular or irregular incidence of the axial twist, are not yet fully understood. S. G. Barker[3] has shown that they may be interpreted as resulting from two simple harmonic forces acting at right angles, but the biological nature of these forces is not yet clear. That the crimps are to be associated with the primarily spiral, axially twisted condition of the fibres, clarifies the problem. A complete crimp is seen to represent an axial twist of 360°, and in the plane of the microscope exhibits two minor and two major axes. Both vary in number inversely with the thickness of the fibre and are a periodic function of time.

* Dr. S. G. Barker has further obtained from Dr. O. L. Mohr, Oslo, samples of the hair occurring in the Norwegian family recently mentioned in NATURE, **133**, 695, May 13, 1933. Under his direction these have been fully studied by Miss A. L. Walker, by means of the fibre rotator, and the measurements expressed in graphic form. Apart from their reduced pigmentation, they are found to conform in every way with hair from the typical ulotrichous races.

[1] NATURE, **131**, Feb. 11, 1933.
[2] *J. Text. Inst.*, 22, July 1931.
[3] *Trans. Farad. Soc.*, **29**, January 1933.

Cultural History in Middle America*

A NEW series of publications, appearing under the title *Ibero-Americana*, is to be issued by the University of California, which will form a complement to the "Publications in American Archæology and Ethnology" already published by that body. It will consist of studies in Latin-American cultures, native and transplanted, pre-European, colonial and modern. Physical and racial backgrounds are to have a place in the series, but it is anticipated that the studies, in the main, will be contributions to culture history. There will be no regular date for publication, and each issue will be independent and individually paged, its price varying according to size. The editors are Dr. Herbert E. Bolton, Prof. A. L. Kroeber and Dr. C. O. Sauer.

The scope and character of the series may be gauged from the first three numbers which have been published. Broader in scope than the archæological series of publications, this series, if continued on present lines, promises to be of considerable interest to students of American culture.

In "Aztatlán", Dr. Carl Sauer and Mr. Donald Brand describe a previously unrecorded culture in Sinaloa and Nayarit. The culture area is situated in a shallow strip of country on the Pacific coast of Mexico, which stretches from the valley of the Rio Grande de Santiago at the south to Culiacán in the north. This is the Terra Caliente of Guzman's Nueva Galicia, for which the oldest regional term is Aztatlán. In this area, more than thirty mounds were visited, probably only a small fraction of the total number which exists. All are situated either on flood plains or on their margins, the inconveniences of the situation being indicated by the number of artificial mounds on which the habitations once stood. Most of those in the Culiacán valley do not exceed three to four feet in height; but the largest in the Presidio valley is some thirty feet high.

The general character of the culture is purely southern. The district would appear to have acquired its culture well back in the Toltecan period and is pre-Aztecan in character. Culiacán forms a frontier facing north. The whole area is a long north-western tongue of prehistoric Mexican culture. It does not rate high in stone carving; but the stone implements have distinctive qualities. The culture is excellent in pottery making, the ware being thin, tough, of fine paste and highly polished. It has a basic colour decoration in parallel banding but with engraving as its most characteristic feature. This is applied equally to monochrome and polychrome.

The population would appear to have been almost completely destroyed in the early Spanish occupation by Guzman in 1530.

The discovery of the Aztatlán culture was made while the authors were seeking evidence for the existence of a prehistoric corridor between the Mexican highland and the Pueblo country of the south-western States, a problem upon which both the second and the third studies in this series also have a direct bearing. No. 3 "The Road to Cíbola", which here may be dismissed in a few words, traces the course followed by the early Spanish conquerors towards the north-west in their search for a legendary city of fabulous wealth. The interest of the study lies in the fact that their way lay along the main trails beaten by many generations of Indian travel which later became the historic highways, forging a link between the prehistoric past and the modern present.

The third study, "The Comparative Ethnology of Northern Mexico before 1750", bears even more directly on the problem of the relation of the South-Western Pueblos to Middle and South America. Dr. Ralph L. Beals has extracted from early Spanish sources the evidence relating to the culture of the area of northern Mexico which lies between the United States frontier and a line drawn from the mouth of the Rio Panuco to the southern boundary

*Ibero-Americana. 1: Aztatlán, Prehistoric Mexican Frontier on the Pacific Coast. By Carl Sauer and Donald Brand. Pp. 92 (14 plates). 2 dollars. 2: The Comparative Ethnology of Northern Mexico before 1750. By Ralph L. Beals. Pp. vi+93–226. 1.35 dollars. 3: The Road to Cíbola. By Carl Sauer. Pp. iv+58. 75 cents. (Berkeley, Calif.: University of California Press, 1932.)

of Jalisco. This is an area of transition, of which very little is known to the anthropologist.

Dr. Beals has collected a mass of information on elements of culture which can be attributed definitely to tribal units or groups. From this evidence certain tentative inferences are drawn as to the cultural provinces of northern Mexico and an attempt is made to trace the influence of Middle America on the culture of the south-west and south-east of North America.

In the discussion of cultural provinces a large non-agricultural area in northern Mexico with a lack of pottery is defined. Further, it is shown that, at the time of the conquest, sub-Mexican cultures existed in Sinaloa (see above), while a culture of sub-Mexican or sub-Mayan type, utilising truncated stone-faced pyramids and stone or adobe architecture, was to be found about 200 miles from the Rio Grande in Tamaulipas. Continuous distributions for certain traits between Mexican cultures and the south-western States are established, including stone and adobe architecture, the use of turquoise, idols, pottery and architecture. It was also discovered that there are a number of traits of similar distribution in the south-eastern States, northern Mexico and Middle America, such as the religious complex of altars, priests, perpetual fires, temples, temple mounds, and ceremonial trees, which suggests a definite connexion of the south-east with the region of higher culture in the south.

While recognising the influence of one area on another, it must also not be overlooked that very real development was made locally; for example, cultivation, after introduction from the south, was adapted to the local environment and dry-farming methods were developed.

New Science Laboratories in Aligarh

ALTHOUGH Aligarh has been a centre of learning in India during the last sixty years, a new era has started with the erection of the new science laboratories for the Aligarh Muslim University. The laboratories are the fruits of the labours of Nawab Masood Jung Dr. S. R. Massod, the Vice-Chancellor of the University.

The laboratories for physics, chemistry, botany and zoology occupy separate blocks, each fitted with up-to-date appliances for research and advanced studies. To each of these laboratories is attached a library, having all the necessary and important scientific books and periodicals in English and other European languages.

Physical Laboratory: The Department of Physics is installed in a building consisting of about sixty rooms, in two blocks—one for teaching and the other for research and advanced studies. Prof. R. Samuel is the Nizam professor of physics and chairman of the Department; Dr. R. K. Asundi is reader in physics. The Department has been equipped with the following apparatus: Zeiss photometer, Zeiss three-prism glass spectrograph, Zeiss two-prism quartz spectrograph, two vacuum spectrographs, soft X-ray spectrograph, Zeiss comparator, Zeiss grating spectrograph, gratings, quartz spectrographs, quartz and glass monochromators, apparatus for electronic interference, etc.

At present there are some eighteen students working in the Laboratory on problems ranging from the study of absorption and emission spectra in the extreme ultra-violet, ultra-violet, visible and the infra-red region to problems of electronic interference, electronic diffraction, soft X-rays, photochemical problems, etc.

Chemical Laboratory: Prof. R. F. Hunter is Nizam professor of chemistry and chairman of the Department of Chemistry; Dr. R. D. Desai and Lt. M. Haider Khan are readers in chemistry.

Research work on the unsaturation and tautomeric mobility of heterocyclic compounds, the electronic structure of organic perhalides and perhalide ions, and the lability of unshared electrons in organic compounds of different elements, is in progress. Arrangements have been made for the study of absorption spectra and dipole moments and polarisation of organic compounds as well.

Botanical Laboratory: The Department of Botany is under Dr. R. A. Khan, who has recently returned from Cambridge.

Special arrangements have been made for the study of problems in plant physiology. Facilities are given for research in every branch of botany and a botanical garden is attached to the Department. A museum containing tropical plants is attached to the Department.

Zoological Laboratory: Dr. M. B. Mirza, reader in zoology, is the chairman of the Department of Zoology.

A special feature of the Department is the museum attached to it. The museum contains all the necessary specimens for teaching work, and also a large number of rare specimens.

University and Educational Intelligence

BRISTOL.—Dr. H. Jones has been appointed lecturer in theoretical physics.

DUBLIN.—On July 6, the following honorary degrees were conferred, among others: Sc.D. on Prof. W. L. Bragg, Langworthy professor of physics in the University of Manchester, and Prof. J. S. Haldane, honorary professor of mining and director of the Mining Research Laboratory in the University of Birmingham; Litt.D. on Sir Percy Nunn, professor of education in the University of London, and Dr. Douglas Hyde, well known for his work in connexion with Irish university education and folk-lore.

EDINBURGH.—At the graduation ceremony on June 30, the honorary degree of doctor of laws was conferred on the Right Hon. Craigie Aitchison, M.P., Lord Advocate; Sir James Caw, formerly director of the National Galleries of Scotland; Sir Henry Dale; Prof. G. H. Hardy; Sir Alexander Houston; The Right Hon. Baron Meston, Chancellor of the University of Aberdeen; Sir Hugh Arthur Rose; Dr. J. C. Smith, formerly senior chief inspector of schools in Scotland; Dr. W. W. Tarn.

The degree of D.Litt. was conferred on Mr. G. G. Neill Wright for a thesis entitled "The Psychological Analysis of Social Structure"; and the degree of D.Sc. on Mr. J. A. Fraser Roberts for a thesis entitled "Studies on the Biology of the Sheep"; on Dr. B. P. Wiesner for a thesis entitled "Maternal Behaviour in the Rat"; and on Mr. G. B. Brook for a thesis entitled "Experimental and Clinical Studies of the Spine of the Dog".

GLASGOW.—By her will, Miss B. A. Gray has bequeathed a sum of £8,000 to the University to endow a "Matthew Gray Scholarship", as a travelling scholarship for students of engineering.

THE League of Nations publishes half-yearly an "Educational Survey" (L.N. Secretariat, Geneva, price 2*s*.) the latest issue of which is devoted wholly to the question of "Moral Disarmament". Contributions by English, French, German, Hungarian, Polish and Swiss writers exhibit various and conflicting attitudes. Most of them look to moral disarmament for stimulation of the will for material disarmament, and paving the way towards this end, but Prof. Hoelzsch of the University of Berlin shares the view of the Russian representative on the League's moral disarmament sub-committee that material disarmament must first be achieved, and if the national governments fail to carry disarmament to the point which the peoples now almost unanimously desire, the League itself must perish. Included in the survey are various reports of proceedings of the League's International Organisation for Intellectual Co-operation, which was created to serve purposes identical with those now in question. While the survey discloses a consensus of opinion favourable to all proposals calculated to promote knowledge of other lands, foreign languages, the exchange of professors and students and the scientific study of international problems, it was pointed out, in the course of the proceedings referred to, that scientific co-operation was very active before the War but had no real influence on the events of 1914, and that during the War there seemed to be sometimes a better feeling among the 'men in the street' than among intellectuals.

STUDENTS from abroad resort to Great Britain in very considerable numbers. Some indication of the extent to which they take advantage of the policy of the open door traditional with British institutions of learning is afforded by the fact that last year ten per cent of the students of the universities and university colleges of Great Britain were from homes outside the country. A committee has just been appointed by the Board of Trade and the Board of Education "to consider what further steps could usefully be taken to encourage suitable students to come to the United Kingdom for education and training—general, commercial, or technical; and to make recommendations". The committee consists of twelve members and includes representatives of five industrial and commercial undertakings, the heads of the University of Sheffield and the Heriot-Watt College, Edinburgh, the general manager of the *Daily Telegraph*, Mr. Pugh of the Trades Union Congress, and the chairman of the L.C.C. Education Committee. In a statement to the Press on July 5, the chairman of the new committee (Sir Eugene Ramsden, M.P., a member of the Overseas Trade Development Council) directed attention to the wide terms of reference and observed that the object in view was to attract preferentially students well equipped to take advantage of the opportunities available. The committee will examine the feasibility of a system of interchange, not only of students, but also of professors, between universities and technical colleges at home and abroad, and interchange between young people engaged in industrial and commercial undertakings. Evidence will be taken from representatives in Great Britain of the governments of the Empire and of foreign countries, representatives of educational associations and authorities, chambers of commerce, trade associations, professional institutions, etc. Reference will doubtless be made to the masses of evidence on the subject already collected at the Congresses of the Universities of the Empire.

Calendar of Nature Topics

Green-Flies on Potato Crops

With the coming of mid-July, green-fly infestation of potato crops, which shows a beginning in early June, reaches its maximum. Now, at a selected centre of observation, in North Wales, Dr. Maldwyn Davies found every plant attacked and 86 per cent of the leaves carrying aphides, so that the average worked out at 2·81 aphides per leaf, or about 2,000,000 per acre, notwithstanding that it was less severe than in the previous three years (*Bull. Ent. Res.*, **23**, 535; 1932). Economic interest is attached to the observation not so much on account of the direct damage caused by the aphides, but because of the association of aphides with the spread of virus diseases such as leaf-roll. On this account, the movements of the aphides were observed, and weekly records showed that all the individuals moved their site and 84 per cent of each of the three species involved moved from leaf to leaf within the weekly period. Daily records showed further that a large proportion, more than 70 per cent, shifted position within 24 hours, and of these at least half were on other leaves. At beginning of the infestation of a crop in early June, solitary apterous viviparous females make their appearance, and this is explained by the overwintering of aphides on weeds and field plants, by the deposition of solitary nymphs by winged females which at once move elsewhere, and by infection from infested seed.

The Walrus as a Summer Visitor in British Waters

A notable appearance of a walrus in British waters in recent times fell early in July, 1920, when one was seen off the Skerries lighthouse in the Shetland Islands; and the most remarkable feature of the visit was that it lasted from early summer, at any rate until mid-October.

As a rule, the walrus is a wanderer and its stay at any place in the British Isles has been short. In the course of a little more than a century (since 1815) some 26 walruses have been seen in British waters, but the time of appearance of only thirteen is known, and of these, two were spring visitors to the Hebrides, seven appeared in summer from June onwards, the majority in the neighbourhood of the Shetland and Orkney Islands, three were seen in autumn, and one in winter. Summer is predominantly the season of visitation, and it is suggested that the visits are associated with the annual breaking-up of the winter's ice formed along the arctic coasts and in the narrower seas. In 1920 Mr. J. Mathieson met the close pack-ice sixty miles south-west of Spitsbergen in June, and followed the edge of the pack for eighty miles before attempting to force his vessel through. But the southern limit of drift ice lies off the eastern coast of the Faroe Islands, so that even if a walrus drifted part of the way on or with the ice, it must have completed the journey to Britain on its own account.

The appearance of so many individuals on the northern and north-western coasts, 24 in the Shetlands, Orkneys, and Hebrides, out of a total of 26, indicates that their presence there may be connected with an unusual development of the Greenland-Iceland-Faroe oceanic circulation, such as occurs in exceptional years when the cold northern current breaks through the warm North Atlantic drift, and flows by way of the Shetlands into the North Sea.

Tunny in British Waters

The remarkable rise of practical tunny fishing in British waters is of peculiar interest quite apart from that of sport. The first specimen caught on rod and line was taken by Mr. L. Mitchell-Henry off Scarborough in 1930, though he had already caught specimens off Denmark in 1928–29, and Col. E. T. Peel last year took the world's record tunny caught by fair angling with rod and line off Scarborough at 798 lb., 40 lb. more than Zane Grey's 1924 world's record taken off Port Medway, Nova Scotia. Though four species of tunny, the common tunny, *Thynnus Mediterraneus*, the long-finned tunny or albacore, *T. germo albicora*, the short-finned tunny or pelamid, *Pelamys sarda*, and the striped-bellied tunny or bonito, *T. Belamys*, have been known as visitors to British waters for many years, only during recent years have their numbers become sufficiently frequent to make the sport practical.

Apart from the fact that tunny follow the shoals of herring, the cause of this change is little understood. The season of their visits, mainly to the North Sea, where they come closer inshore than anywhere else and have been hooked within two miles of the shore (the 798 lb. record was taken only seven miles out), appears to last from about mid-July until the end of October. However, a common tunny found stranded at Hornsea mere on November 11, 1932 (*Fishing Gazette*, Christmas 1932) and a long-finned tunny taken at Lochgoilhead, Firth of Clyde, in the same month (NATURE, **130**, 889, Dec. 10, 1932) prove that the species does not quit the North Sea so early as was thought. Efforts are being made to try tunny fishing in the Irish Sea, with Liverpool, Fleetwood or Blackpool as a base.

Steady Growth

Looking over a fine crop with its owner, the farmer details the cultivations and manuring that he gave to the field and usually finishes with the remark: "it grew without a check". The credit for this is shared between the cultivator and the weather, but the major part is played by the season. A prolonged check in early summer definitely puts a crop into the second class, for growth is astonishingly rapid at this time of the year. Drought is by far the most potent factor involved, but low night temperatures and certain plant diseases also contribute to the result. There is also the strangely injurious effect of the capping or running together of the surface soil that is liable to occur when a fine-grained soil is lashed down by heavy rain.

One of the reasons of the universal popularity of farmyard and other bulky organic manures is the fact that their presence in the soil tends to mitigate some of the above effects. Better water-holding capacity, warmer soil, better drainage in wet periods, and better tilth all follow the use of these manures and tend to stabilise crop yields. This action is seen in a pronounced degree on the Broadbalk wheat field at Rothamsted, where the annual fluctuations of yield are found to be much less severe on the dunged area than they are on adjoining areas fertilised with inorganic salts. Nutrition is on approximately the same plane in both cases. In horticultural practice the above considerations hold with even greater force owing to the high level of cropping and the necessity of securing a rapid turnover, and here we find the organic manures most securely established.

Societies and Academies

LONDON

Physical Society, June 2. C. F. B. KEMP: Observations on the intensity of low-frequency sounds close to a metal airscrew. A condenser transmitter and continuously recording cathode ray tube have been used to obtain the wave-form of the sound from a metal airscrew operating at zero rate of advance. Fourier analysis has been applied to records taken at various distances up to 300 ft. from the airscrew and the rate of decay of intensity has been determined for the first three harmonics. At distances greater than 100 ft. the inverse-square law of distance has been found to hold, but at nearer points the rate of decay is not constant and varies in a complicated manner. W. M. HAMPTON: The visibility of objects in a searchlight beam. The discussion is divided into three parts dealing separately with the light reflected by the object from the incident beam and with the brightness of the atmosphere background due to scattered light and with the conditions of visibility as functions of the two previous quantities.

Mineralogical Society, June 15. L. J. SPENCER: Minute spheres of nickel-iron in the silica-glass from the meteorite craters at Wabar, Arabia. Microsections of the silica-glass show, in addition to many vesicles, vast numbers of minute black spots. From the crushed material these can be picked out with a magnetic needle in long strings and clusters. They are perfect spheres with a highly polished surface and consist of metallic iron with 8·8 per cent. of nickel. In size they range from 0·14 to 0·003 mm. in diameter, and an estimate of their number gives two million per cubic centimetre. C. E. TILLEY: Portlandite, a new mineral from Scawt Hill, Co. Antrim. A brucite-like mineral occurring in isolated patches in a spurrite-larnite assemblage in the chalk-dolerite contact of Scawt Hill. This proves on analysis to be $Ca(OH)_2$. This is new as a mineral, and the name 'Portlandite' is proposed for it. Optical properties agree with the artificially prepared material studied in connexion with Portland cement. S. I. TOMKEIEFF: Clay minerals and bauxite minerals. A review and classification based on a statistical method. Clay minerals and bauxitic minerals which occur usually in a state of fine-grained aggregates are difficult to classify. The majority of the existing analyses apparently refer to mixtures of minerals and not to pure compounds. The present paper represents an attempt to classify the existing chemical data by plotting on triangular diagrams. The number of analyses used is as follows: for the system H_2O–Al_2O_3–SiO_2, 689, and 320 for the system H_2O–Al_2O_3–Fe_2O_3. This method indicates the definite existence of the following crystalline minerals: pyrophyllite, $H_2O.Al_2O_3.4SiO_2$, kaolinite and its polymers, $2H_2O.Al_2O_3.2SiO_2$, diaspore and boehmite, $H_2O.Al_2O_3$, gibbsite, $3H_2O.Al_2O_3$, goethite, $H_2O.Fe_2O_3$. Newtonite and bauxite ($2H_2O.Al_2O_3$) prove to be non-existing as minerals. A group of minerals including beidellite and montmorillonite, containing a certain amount of basic oxides, are separated from the pure clay minerals under the name of bentonite group. The genetic relation between the various mineral groups studied and certain rock-forming minerals such as the micas and the felspars is briefly outlined. M. H. HEY: Studies on the

zeolites (Part 6). Edingtonite (with X-ray measurements by F. A. BANNISTER). A chemical, optical, and X-ray examination has been made of edingtonite from Böhlet, Sweden. The unit-cell formula is $Ba_2Al_4Si_6O_{20}.8H_2O$, and the mineral is not isostructural with thomsonite or with the mesotype group, a result which is confirmed by base-exchange experiments. The vapour pressure surface of edingtonite has been studied by the methods used for other zeolites; there is no evidence of any other distinct hydrate or modification. M. H. HEY: The accuracy of mineralogical measurements. A review of the probable accuracies to be expected in measurements of a variety of physical constants of minerals by the usual methods. Published results are often calculated to far more places of decimals than the measurements can possibly warrant. S. R. NOCKOLDS and E. G. ZIES: A new barium plagioclase felspar. A barium 'anemousite' felspar has been found to occur in certain aplitic dikes in the Broken Hill district, New South Wales. This felspar shows several kinds of plagioclase twinning with $(-)2V$ varying from 74° to 82° and an average value of 78°. Indices of refraction: $\alpha=1{\cdot}571$, $\beta=1{\cdot}580$, $\gamma=1{\cdot}585$, $\gamma-\alpha=0{\cdot}014$. Dispersion weak. The position of the optic plane and the optic axes correspond quite closely with the position of these elements for plagioclases towards the basic end of the series. The felspar has been analysed and corresponds in composition to $Or_4Ne_4Ab_9Ce_{14}An_{69}$; sp.gr.2·872 at 17° C.

PARIS

Academy of Sciences, May 29 (*C.R.*, 196, 1633–1703). LOUIS DE BROGLIE was elected a member of the Section of Mechanics in succession to the late A. MESNAGER. ALFRED GULDBERG: Bernoulli's law with two variables and the correlation. P. DUBREIL: Some properties of algebraic varieties. JACQUES VALENSI: The study of the field of velocities round a helix. CH. CHARTIER: The hydrodynamic field round a screw with three vanes. An experimental study utilising the chronophotography of aluminium particles. R. RETEL: The influence of the injection pressure on the working of Diesel motors. CLERGET: Tests of various fluids in injection motors. Experiments with mixtures of gas oil and ethyl alcohol. ANDRÉ FOUCHÉ: The secondary vibrations of manographs. JEAN XANTHAKIS: The apparent displacements of the pole star. PIERRE BREMOND: The flow of gas at high temperatures through materials with very close structure. W. UYTERHOEVEN, J. BRUYNES and C. VERBURG: The emission of light by a mixture of gas and vapour in the positive column of a luminous discharge. V. POSEJPAL: New remarks on the atomic radius of carbon in the diamond. RENÉ LUCAS: The thermal variations of abnormal electromagnetic double refractions. Anomalies such as are shown by ethyl phenylsuccinate can be explained by the hypothesis of molecular polymorphism. ALFRED MONNIER and MARCEL MOUTON: The use of glass suitable for reducing dazzle produced by motor-car headlights. The properties of a new cadmium glass are described for use in making electric lamps for headlights. The light emitted contains no blue or violet radiations, reduces dazzle and increases visibility. GUICHARD, CLAUSMANN, BILLON and LANTHONY: The proportion of hydrogen and the hardness of electrolytic chromium. Chromium appears to resemble iron in that the hydrogen which the electrolytically deposited metal contains is not responsible for its hardness. S. ROSENBLUM and MLLE. C. CHAMIÉ: The α-radiation of radiothorium and its derivatives. E. STAHEL and H. KETELAAR: The nuclear diffusion of the γ-rays. A. LALANDE: Temperatures of freezing of ternary mixtures of water, ethyl alcohol and ethyl ether. A. P. ROLLET and PENG-CHUNG-MING: The action of the alkaline borates on lead chloride, bromide and iodide in aqueous solution. The existence of Herepath's lead chloroborate is confirmed and the corresponding bromoborate and iodoborate have been prepared. HENRI LAFUMA: The evolution of the hydrated hexagonal calcium aluminates. PIERRE THOMAS and MLLE. C. KALMAN: The action of various sugars on the reaction of solutions of borax. Studies in the changes in the *p*H of a solution of sodium borate produced by adding solutions of various sugars. M. BACKÈS: The action of phosphorus oxychloride on some aldehydes. An equimolecular mixture of benzaldehyde and acetaldehyde gives cinnamic aldehyde on treatment with phosphorus oxychloride at 30°–35° C. The reaction is shown to be general. ROBERT JARRY: The extraction of pure phenols from tar oils by means of liquid ammonia. CH. DORIER: The action of β-chlorallyl chloride on the primary aromatic amines. HENRI WUYTS: New reactions of the reducing sugars. MARCEL GODCHOT and MAX MOUSSERON: The preparation of aminocycloheptanols and their resolution into active compounds. MME. N. DEMASSIEUX: The reproduction of laurionite and the preparation of lead oxybromide. MME. O. THELLIER: The measurement of the electrical conductivity of the air by a null method. G. PONTIER and R. ANTHONY: The presence of a premolar in *Elephas imperator*. PHILIPPE HAGENE: The humus of pollarded ash. J. RIBÉREAU-GAYON: The rôle of protective colloids in the stability of wines. JULES AMAR: Normal diuresis. RAOUL LECOQ and JEAN SAVARE: The influence of the constitution of the lipides on the evolution of total B avitaminosis and the generality of the want of B vitamins in the utilisation of the lipides in the organism of the pigeon. RENÉ HAZARD: The action of sparteine on the vasoconstrictor effects of some adrenaline compounds. A. MAGNAN and CL. MAGNAN: The structure of the wings of insects and its rôle in flight by beating. HENRI NOUVEL: Observations on the infusoriform of the Dicyemidæ.

GENEVA

Society of Physics and Natural History, March 16. JEAN LOMBARD: The geological structure of Mont Bamba in the southern Mayombe (French Equatorial Africa). The author has made a detailed stratigraphic and tectonic study of this region. W. SCHOPFER: (1) Researches on the heredity of a physiological character in a fungus. The author has studied five generations of Phycomyces developed genetically and interbred, and shows that by the asexual process the character of a well-developed aerial mycelium accompanies a sex. Through the zygote, on the other hand, a partial separation may occur; in spite of this, this character affects the (−) sex with a frequency double that of the (+) sex. (2) Researches on the action of thallium on a fungus. Thallium is supposed to be an accelerating factor in the development of the yeasts. The author shows that so far as the development and sexuality of Phycomyces are concerned, thallium possesses only a toxic action which appears even at a concentration of 10^{-6}. It

has nothing in common with the growth factor of organic nature demonstrated by the author. H. LAGOTALA: Concerning the metalliferous deposits of the French Congo. The author emphasises the frequency of mineralisation in the grits, which show the same characters as the limestones; on the other hand, chalcopyrite is the source of the copper deposits of this region. G. TIERCY: The variation of density in the external layer of a cepheid. The course of the curve of radial velocities and the range of the K coefficient of absorption in the reversing layer show that the density of the external layer does not remain proportional to the mean density of the whole star during the variation of the latter. G. TIERCY and A. GROSREY: The width of a photographic star spectrum for stars of the $B5$ type. The authors make a study, for the spectral type $B5$, analogous with that which they have made for the type $A5$. They establish a function of the magnitude and of the time of exposure representing in each case the width of the stellar spectrum. G. TIERCY and P. ROSSIER: The curve of sensibility of 'Cappelli-blu' plates. In a collection of 'Cappelli-blu' plates a certain number of negatives have given a secondary maximum, very weak but quite clear, for a wave-length of 5400 A. M. GYSIN: Petrographical researches in the Haut-Katanga (4). The formations of the Roan series. Second series. The author has subdivided the rocks met with in the Roan series into sixteen distinct petrographical types. He describes each type; the most important are the arkosic conglomerate, the felspathic quartzites, the clayey felspathic grits, the sericitic quartzites and grits, the dolomitic quartzites and grits and the limestones and dolomites.

Forthcoming Events

ROYAL HORTICULTURAL SOCIETY, at 3.30.—(in the New Hall, Greycoat Street, Westminster, S.W.1). Prof. V. H. Blackman: "Plants in Relation to Light and Temperature" (Masters' Memorial Lectures. Succeeding lecture on July 19.)

INSTITUT INTERNATIONAL DE DOCUMENTATION, July 18–21. Twelfth Annual Conference to be held at Brussels.

ROYAL CORNWALL POLYTECHNIC SOCIETY, July 18-21.—Centenary Celebrations at Falmouth and Penzance. President: The Right Hon. Viscount Clifden. Papers by Sir John Cadman, Sir Richard Gregory, Sir W. Napier Shaw, Dr. G. C. Simpson, and Prof. S. J. Truscott.

WORLD PETROLEUM CONGRESS, July 20–25.—(at the Imperial College of Science).

INTERNATIONAL GEOLOGICAL CONGRESS, July 22–29.—Sixteenth session to be held in Washington, D.C. (Preliminary session at New York on July 21.)

Official Publications Received

GREAT BRITAIN AND IRELAND

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 37: Award of the Boyle Medal to Prof. Paul A. Murphy. Pp. 547–549. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

The Welsh Journal of Agriculture: the Journal of the Welsh Agricultural Education Conference. Vol. 9. Pp. 292. (Cardiff: University of Wales Press Board.) 2*s*. 6*d*.

Rapports 1° du Directeur de la Ferme d'Expériences, "Glenham", Trinité; 2° de l'Expert ayant trait aux maladies affectant les pommes de terre et les tomates; et 3° de l'Expert pour la culture et le soin des arbres à fruit; avec tableaux y annexés pour l'année 1932. Présentés par M. la Juré Justicier Giffard. Pp. 74. (Jersey: J. T. Bigwood, Ltd.)

Leighton Park School: Natural History Memoirs. Memoir 1: Birds of the School Grounds and Neighbourhood. By J. D. Wood and F. R. Barlow. Pp. 29. Memoir 2: Insects (mainly Lepidoptera) of the School Grounds and Reading Neighbourhood. By C. Runge, H. C. Robinson and F. W. Flatterly. Pp. 39. (Reading.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 3, No. 25: The Early Stages in the Development of Cavia. By Dr. Norman H. W. Maclaren and Prof. Thomas H. Bryce. Pp. 647–664+5 plates. 4*s*. 3*d*. Proceedings of the Royal Society of Edinburgh. Vol. 53, Part 2, No. 12: Matrices and Continued Fractions. By Prof. H. W. Turnbull. Pp. 151–163. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1933. Pp. xii+62. (Aberdeen.)

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 44, Part 2, June 27th. Pp. 121–226+plates 11–28. (London: Edward Stanford, Ltd.) 5*s*.

Planetary Co-ordinates for the Years 1800–1940 referred to the Equinox of 1950·0. Prepared by H.M. Nautical Almanac Office. Pp. xviii+156. (London: H.M. Stationery Office.) 12*s*. 6*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol 20 (N.S.), No. 39: A New Silver Filter for Ultra-Violet Light. By G. C. Brock. Pp. 563–566. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

OTHER COUNTRIES

Proceedings of the American Academy of Arts and Sciences. Vol. 68, No. 6, May: A Suggestion concerning Platos Atlantis. By W. A. Heidel. Pp. 189–228. (Boston.) 85 cents.

The Science Reports of National Tsing Hua University. Series A: Mathematical and Physical Sciences. Vol. 2, No. 1. Pp. 73. (Peiping: National Tsing Hua University.) 1 Mex. dollar.

Transactions of the Astronomical Observatory of Yale University. Vol. 6, Part 5: Tables for the Development of the Disturbing Function with Schedules for Harmonic Analysis. By Ernest W. Brown and Dirk Brouwer. Pp. iv+73–158. Vol. 6, Part 6: The General Orbit of Hector. By Wallace J. Eckert. Pp. ii+159–172. Vol. 6, Part 7: Theory and Tables of the Motion of (588) Achilles. By Dirk Brouwer. Pp. iii+173–188. Vol. 9: Catalogue of the Positions and Proper Motions of 10358 Stars; Re-observation by Photography of the Astronomische Gesellschaft Zone between Declinations + 25° and + 30°, reduced to 1875·0 without applying Proper Motions. By Frank Schlesinger and Ida Barney. Together with Photographic Magnitudes determined by means of the Thermoelectric Photometer, by Jan Schilt. Pp. iii+35+208. (New Haven, Conn.: Yale University.)

Straits Settlements. Annual Report of the Director of Gardens for the Year 1932. By R. E. Holttum. Pp. 9. (Singapore: Government Printing Office.)

Department of Public Instruction: Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December, 1932. Pp. 7. (Sydney, N.S.W.: Government Printer.)

Proceedings of the Sugar Cane Investigation Committee, formerly Froghopper Investigation Committee. Vol. 4, Part 2, December 1932. Pp. 63–144. (Trinidad: Imperial College of Tropical Agriculture.)

Indian Journal of Physics, Vol. 7, Part 6, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 16, Part 6. Conducted by Sir C. V. Raman. Pp. 491–621+xi. (Calcutta.) 3 rupees; 4*s*.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 12, No. 2B. Pp. 195–252+plates 30–39. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 8: Monthly and Annual Deviations of Meteorological Elements in Japan. By K. Takeda, K. Terada, T. Hagiwara, K. Atumi, T. Ehiro and T. Tudikawa. Pp. 211–364+21 plates. 2.80 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 7: Faunal Study of the Wanwanian (Basal Ordovician) Series with Special Notes on the Ribeiridæ and the Ellesmereoceroids. By Teiichi Kobayashi. Pp. 249–328+10 plates. 1.70 yen. Section 4: Zoology. Vol. 3, Part 2. Pp. 91–254+plates 4–20. 3.00 yen. (Tokyo: Maruzen Co., Ltd.)

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