NATURE

SATURDAY, NOVEMBER 7, 1931.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3236, Vol. 128]

Industrial and Social Economics.

THE proceedings of the recent World Social and Economic Congress at Amsterdam, organised by the International Industrial Relations Association, are of the greater interest in view of the political and financial crisis which has since developed. An important paper on the principles and practice of scientific management, by Dr. H. S. Person, throws a searching light on the rationalisation movement and its applications, and discloses reasons for the apparent failure of rationalisation to effect industrial stabilisation and avert the present world-wide trade depression and unemployment. While this failure or partial failure is due in part to the misuse of rationalisation, to failure to pass on its benefits, and disregard of the principle of service, a major factor has been the limited scale on which rationalisation has been attempted. Stabilisation of a restricted area may increase the instability of the surrounding area, and complete stabilisation may be impossible owing to the impact of disturbing external forces which are outside the control of the management.

Scientific management has thus been forced continuously to extend its area of operations, and from the application of scientific principles to individual workshops has been compelled to extend them successively to the supply as well as to the production departments, to relations between workers and management, then to relations between production and markets and general administration. It is now considered necessary to apply the same principles to whole industries collectively, not merely on national but also on international lines, and it is the backward condition of many individual industrial and national units which has largely restricted the benefit to the world of the application of scientific management and rationalisation methods elsewhere.

It has already been admitted by authorities in widely differing walks of life that lack of economic statesmanship in general and of national planning in particular are the causes of depression, and the Macmillan Report asserted that an era of conscious and deliberate management must succeed the era of undirected natural evolution and haphazard development which has characterised the past. The recognition that economics acknowledges no frontiers prepares the way for an era of co-operation in which the disturbing intensive competition in basic necessities on a world scale is eliminated.

The keynote of the new era, as suggested by Dr. Lewis Lorwin, is to be economic planning, and this

should be distinguished from both rationalisation and scientific management, of which it is a development. Although rationalisation implies a wide application of scientific methods and increased productivity, and has sometimes made for low prices, high wages, and mass prosperity, it has more often been used to maintain levels of prices out of proportion to decreasing costs of production. Experience shows, further, that combination for business purposes alone tends to restrict production and to maintain profitable price levels. What is now contemplated goes far beyond such conceptions and involves planning national and world development to give maximum satisfaction of the economic and the social needs of a people within a definite period. Essentially it attempts to correlate production and distribution on a world scale. It is offering new conceptions of economic life and methods of promoting a steady growth in standards of living.

Various attempts at social-economic planning have already been made. The voluntary business type is familiar and its limitations have led to the emergence of a social-progressive type of planning, which is that apparently contemplated by the Macmillan Committee. Such planning implies that economic leadership is not a monopoly of the business man, and involves a measure of governmental authority. It is a further break from the policy of *laissez faire*, and is in line neither with the traditions of free trade nor of nationalistic economic policies which since the War have developed protective tariffs to a height entirely disproportionate with economic need and rational development of industry and trade.

Scientific workers will welcome this movement as promising to relate administration and policy to the basic facts of the industrial, economic, and social system, and to liberate them from their bondage to political prejudices. Fundamentally, economic and social planning of national or industrial life involves research on the various factors involved before the successive stages of standardisation, control, stabilisation, co-operation, and planned development, can be realised, leading us to scientific management on a world scale. It involves the balancing of opposing group interests on the basis of ascertained facts and not on the self-valuation of the groups concerned.

Dr. Lorwin considers that there is nothing in the present situation to justify the easy belief that the depression will right itself without conscious effort, that the world need not be troubled with the spectre of its recurrence, or that the rapid economic changes which have persisted since the War will come to an abrupt end. On the contrary, as emphasised by Mary van Kleeck, vice-president of the International Industrial Relations Association, in summarising the discussions at the final session, the security of civilisation demands the exercise of the most expert intelligence which the world's intellectual and technical resources can bring to bear on the common world task of maintaining and raising the standards of living of all people. This involves not merely the handling of the immediate critical problems but also the direction of the resources of intelligence towards the constructive upbuilding of social economic life. Statistical research must indicate the ways in which the world's productive capacity, so greatly increased by technical developments in the last twenty years, can be utilised to raise the standards of living.

Social-economic planning is thus no simple conception. Mary van Kleeck suggested that a world research centre is needed to co-ordinate technical effort, to secure uniformity in statistics bearing upon economic planning, develop greater precision in the methods of economic and social research, and to focus investigations upon practice, in the same way that scientific discoveries are applied in engineering and other industries.

Such planning postulates an adventurous spirit, a greater faith in the possibilities of life, a sense of social and ethical values; and holds out to man, through the synthesis of science and vision, a prospect of ordered evolution. As Dr. Lorwin points out, it is based on a philosophical faith in the power of man to promote orderly economic and social change through scientific research and constructive imagination.

History of Alchemy.

Entstehung und Ausbreitung der Alchemie. Von Prof. Dr. Edmund O. von Lippmann. Band 2: *Ein Lese- und Nachschlage-Buch.* Pp. vii + 257. (Berlin: Julius Springer, 1931.) 26·60 gold marks.

OF all works on the history of alchemy and early chemistry, that to which reference is made most frequently and with most confidence is Prof. E. O. von Lippmann's "Entstehung und Ausbreitung der Alchemie". Published in 1919, it immediately became indispensable to every student of the subject, and in the twelve years that have elapsed since its first appearance, its reputation as a masterpiece of wide learning and careful scholarship has become thoroughly established. Those

twelve years have, however, seen the publication of much research upon the history of chemistry and alchemy—an amount probably greater than in any previous period of the same length—so that we must count ourselves fortunate in the fact that Prof. von Lippmann's seventy odd years have apparently in no degree diminished his prodigious activity.

This second volume is supplementary to the first. The articles in it are arranged alphabetically, as in an encyclopædia, and since the book is provided with three excellent indexes, reference to any particular topic can be made quickly and exhaustively. Some idea of the mass of new information that the author has collected may be gained from the fact that this supplementary volume is more than one-third of the size of the first, running to 257 pages. The sources of this abundant new matter are fully indicated, and Prof. von Lippmann has enriched the whole with that careful criticism and sound judgment so characteristic of all his historical writings.

To do justice to the book, a detailed review of considerable length would be necessary, but some of the most interesting features may be considered here. The problem of alchemy in China has attracted a good deal of attention lately, some authorities having suggested that alchemy was practised in that country centuries before the Christian era. If this suggestion were to be confirmed, it would be necessary fundamentally to revise our present views on the origin of alchemy, though on other grounds these would seem to be well established in broad outline, if not in detail. Prof. von Lippmann mentions the work of O. S. Johnson, who regards Chinese alchemy as an indigenous growth arising from the system of Taoism, and the more recent article of Davis and Lu-Ch'iang Wu, who suggest that alchemy may have flourished in China so early as the second century B.C. He himself agrees with Laufer that alchemy is an entirely foreign element in Chinese thought; but while Laufer believes that alchemy appeared in China in the second century B.C., "when China was actually flooded by an invasion of influences rushing on from the West", von Lippmann, on the contrary, is of the opinion that the introduction was made by the Arabs towards the beginning of the ninth century A.D. This appears to be the more likely, inasmuch as Chinese alchemical writings are said to be clearly affiliated to the early form of Arabic alchemy, in which the Greek influence was more fully apparent than it became later. Prof. von Lippmann would regard alchemical passages in Chinese works definitely earlier than the ninth century A.D. as skilful interpolations of a considerably more recent date.

On the discovery of alcohol, the author finds no reason to alter his previous conclusion: that is, that alcohol was first obtained by distillation in southern Italy in the twelfth century. He regards as erroneous the old tradition that alcohol was first prepared by the Arabs—a tradition that certainly finds no support from any Arabic alchemical treatises hitherto studied.

The perplexing problem of Jabir or Geber has undergone yet a further transformation through the work of Kraus, Schaeder, and Husain Hamdani. From a study of certain Arabic works of Jabir published by the reviewer, these scholars conclude that while the books in question were undoubtedly written by a single author, they must be assigned to the end of the ninth century or the beginning of the tenth. An earlier date is impossible, since the books are steeped in the doctrines of the Isma'ilite sect, which arose in the latter half of the ninth century. The conclusion is supported by the fact that the author uses terms of ophthalmic medicine which did not appear in Arabic literature before A.D. 860. The provisional identification of Jabir's father with the Abbasid agent Hayyan, who lived at the beginning of the eighth century, must consequently be regarded as untenable, and we are still left in ignorance of the life of the greatest chemist of Islam.

Prof. von Lippmann would make the discovery of the mineral acids contemporaneous with the improvements in distillation that led to the discovery of alcohol in the twelfth century. On general grounds, however, this late date seems improbable, since alum and blue and green vitriols were well known in earlier times and must have been heated occasionally in such a way that Nordhausen acid was obtained. There is, moreover, an Arabic work ascribed to Jabir ("The Chest of Wisdom") in which the preparation of nitric acid is clearly described, though—as is so often the case—the work may not be authentic. Later Arab chemists were certainly well acquainted with nitric acid, which they called "parting-water" on account of its use in separating gold from silver.

Among the etymologies mentioned by von Lippmann are several of interest. Thus 'sory', a mineral name of frequent occurrence, is derived from the Egyptian 'se-ur', the great salt; 'kassíteron', the Greek name for tin, probably comes from 'kassitira', meaning 'from the land of the Kassi' or Kassites, a people first mentioned about 2100 B.C.;

while the suggested derivation of indigo from the Egyptian 'n-tinkon' or 'dinkon' has not been confirmed.

The extraction of zinc probably arose in Persia, where it was certainly practised towards the end of the sixth century A.D. There was, however, confusion of this metal with tin for nearly another thousand years, though Boyle always clearly distinguished between spelter (zinc) and pewter (here tin or an alloy of tin and lead). The extraction of zinc was introduced into England by Lawson, about 1700, who had learnt the process in China, and the chief centre of production was Bristol. Zinc oxide was used in the treatment of disease so early as 1150.

Antimonium, as the name of antimony sulphide, is derived from the Greek ἀνθεμώνιον, and may be explained by the characteristic appearance of the naturally occurring crystalline mineral. The element itself has been known for at least 4500 years, since a large antimony bowl of the time of King Gudea (about 2600 B.C.) has recently been discovered.

Such are a few samples of the interesting fare that Prof. von Lippmann sets before us. So far as we have been able to ascertain, very little has escaped him, however obscure the source, and his book is bound to prove of the utmost possible value to historians of chemistry. We feel that perhaps he has not made as much use as he might have done of Dr. Campbell Thompson's investigations into the chemistry of the ancient Assyrians, and that more attention might have been paid to alchemical theories as distinct from facts; but these are minor points that in no way detract from the excellence of a wholly admirable book.

E. J. HOLMYARD.

The Prehistoric Colonists of Yorkshire and their Economics.

Early Man in North-East Yorkshire. By Frank Elgee. Pp. xvi + 259 + 30 plates. (York: The Author, Shirley House, Commondale, 1930.) 25*s*. 9*d*.

A MINUTE field study of a quite small area often paves the way not only to a vivid realisation of the life of our forerunners in the region studied, but also to the solution of problems of much wider scope. Mr. Elgee has not only tramped the moorlands and vales of north-eastern Yorkshire, closely scrutinising the humblest traces left there by prehistoric man, but he has also ransacked the obscure records left by early antiquarians. The results of this labour of love, embodied in the eminently readable and richly illustrated volume before us, will be welcomed both by the specialist, as a solid contribution to prehistory, and by the layman, as a fascinating picture of early life in a delightfully scenic background.

The first inhabitants of the region would be the makers of the mysterious pygmy flints, many of which the author has himself detected. They would have been followed by wielders of stone axes, but it may be doubted whether these can, as here suggested, be separated from the builders of long-barrows and Beaker folk, who certainly used such tools. A rectangular cross-section in celts of stones other than flint does not necessarily betoken Scandinavian influence, since fine-grained rocks are often shaped by sawing. The long-barrow builders in any event represent an influx from the west; for Mr. Elgee successfully defends the connexion of the Yorkshire monuments with those of western England against Kendrick's attacks, though he is not attracted by my suggestion of a wooden chamber under such barrows, and is convinced of the deliberate intention of the incinerations noted by Greenwell. The arrival of these colonists from the west did not long anticipate the advent of invaders from the east, here divided into two groups—Beaker folk and battle-axe folk of more northern affinities. In this connexion a remarkable (?) copper double-axe of pure Cretan type from Whitby is here described, though its ancestry must lie in the south, and it is the prototype rather than the descendant of the Danish stone axes with which it is justly compared. Both groups settled in north-eastern Yorkshire, in only small numbers in comparison with the intensive occupation of the Wolds, and avoided the bleak moorlands altogether, as had the long-barrow builders, with whom the easterners eventually amalgamated.

In the later Bronze Age, on the other hand, cinerary urns are more abundant in the north-east than in the south, and spread right into the moorland wastes. Mr. Elgee argues that the vessels were made by descendants of the earlier Bronze Age population, and that the cinerary urn was developed out of the food vessel in Yorkshire itself. The spread of the autochthonous population on to the inhospitable moors would result from the pressure of fresh invaders, characterised by new types of bronzes, who by virtue of their superior weapons would have been able to occupy the more fertile wolds and vales. These intruders would be Peake's sword-bearers and the 'Hallstadt' folk

(Hallstatt is thus misspelt throughout the book) whose settlement at Scarborough has recently been discovered. To the same people are attributed the lake-dwellings in Holderness and near Pickering, two of which have yielded bronzes of the foreign types, though most of the pottery has been called Romano-British.

In any event, our author establishes a sufficient discrepancy between the distribution of the 'native' cinerary urns and that of the 'foreign' bronzes to confirm Crawford's view that the latter were introduced by Continental invaders. The last wave of intruders before the Romans was the people of La Tène, a culture responsible for the famous chariot burials. This people can be with some confidence identified with the Parisii of Ptolemy. Their neighbours, the Brigantes, must then have been descended from the sword-bearers, and Mr. Elgee advances an ingenious argument to prove that these spoke a Goidelic language.

Thus Mr. Elgee's researches seem to have cleared up the ethnological history of his district in a manner calculated to throw light on the general problems of British archæology. But even more interesting is the fresh evidence on primitive economics here collected. The use of Whitby jet in prehistoric times is critically and cautiously studied. It does not afford any support for the thesis that 'megalith-builders' came to Yorkshire to exploit the deposits of this commodity. The distribution of the monuments seems to be bound up with that of suitable pasture-land.

Then our author has identified on the moors the settlements of the late Bronze Age people, their fields and their routes. The major barrows covering cinerary urns are found to be strung out along natural ways exactly as Sophus Müller found in Denmark. The lines of large howes link up regular cemeteries of smaller barrows which, though they seldom yield datable objects, must be regarded as the graves of commoners of the same culture. In the immediate vicinity of the cemeteries Mr. Elgee finds stony areas, sometimes defended by banks and ditches, which he plausibly interprets as the settlements of the barrow-builders; and near by are irregular enclosures comparable to the cultivation plots found near hut-circles on Dartmoor. Such big stones have been left in the plots that they must have been tilled with the hoe rather than the plough. Thus a peculiar system of rural economy which can be paralleled on other moorlands in the British Isles is logically attached to a specific phase of the Bronze Age culture, and its cultural age, recently called in question, is convincingly established. We say 'cultural age' advisedly, since it is here very properly admitted that many barrows with cinerary urns are posterior to the advent of the Hallstatt and even of the La Tène invaders.

Less convincing is the theory borrowed from Mortimer, that the barrows are laid out to represent constellations, thus indicating star worship. Prehistoric man did not view the cemeteries from an aeroplane, and from the ground can scarcely have seen the similarity of a barrow-cluster to the Plough that we can observe on a drawn plan.

V. GORDON CHILDE.

The Behaviour of Young Children.

Intellectual Growth in Young Children. By Susan Isaacs. With an Appendix on Children's "Why" Questions, by Nathan Isaacs. Pp. xi+370. (London: George Routledge and Sons, Ltd., 1930.) 12*s*. 6*d*. net.

THIS book, the first instalment of a three-volume work on the behaviour of young children, is a valuable contribution to a vitally important subject. The last few decades have seen the emancipation of psychology from the dead hand of traditional philosophical thinking: the last few years, the partial emancipation of child study from the tyranny of outworn ideas. Dr. Susan Isaacs has based this volume on the records of work carried on under her direction at the Malting House School for young children at Cambridge in the years 1924–27. The school consisted of a group of intelligent children ranging at the outset from 2½ to 5 years of age. Its aim (so far as intellectual development is concerned) was to stimulate the active inquiry of the children themselves by bringing within their immediate experience every range of fact to which their interests reached out. This was indeed a formidable undertaking, but one of real importance and profound interest.

Indications are not lacking that the intelligent child is capable of taking a scientific interest in the external world, even in the so-called pre-school period. It becomes, then, a matter of great urgency to obtain accurate and full records: these records must represent first-hand observations by skilled and unprejudiced inquirers. How else can a start be made on solving the problem of successfully fostering the scientific interests of the young child?

The intensive study of the behaviour of young children is also of significance from the point of view of pure science. The disastrous effects of allowing untested *a priori* ideas to dominate

psychology can only be counteracted by the careful study of human beings from the cradle to the grave, in which facts are the basis for cautious inductions and tentatively constructed concepts. It may also well be the case that full and deep knowledge of the mental functioning of human beings depends fundamentally on knowledge of this functioning in the young.

The importance of the problem of behaviour to be attacked in this trilogy needs no stressing, but it may be useful to point out that the method of the inquiry will repay the attention of the methodologist. Here we have a domain where even careful observations and simple experiments are comparatively few in number. In this book the records are presented dispassionately, with a detailed account of the conditions under which they were made. One of the difficulties has evidently been how to select from so great a wealth of material, without falling into the errors of those older psychologists who made their particular psychological generalisations first and selected their instances after. Particularly interesting in this connexion is the inclusion of the full records for four distinct weeks in the life of the school. Here there is no selection of data : a fair sample of the available data is recorded impartially for the use of the students of the subject, in accordance with the best canons of scientific method.

Side by side with the collection of scrupulously careful first-hand observations are certain sections in which the author gives an account of the theoretical views to which she has thereby been led. As a specially interesting example of this, we may cite the work on the biological interests of the young child. Some of this work was originally published in the *Forum of Education* and so is known to those who are interested in suggestions which scientific theorising has to offer as to the optimal education of the young child. In its more complete form, it should attract the attention of the professional educationist and also of the parent who seeks to assist his child to a fundamentally sound conception of living things. The records deal with a period of three years and range from the growing of mustard seed to the care of tortoises, worms, tadpoles, salamanders, and lizards, from the observation by the children of pregnant and suckling mice to the dissection of a crab, a toad, and a mouse.

Just how important in the emotional and intellectual development of the individual this early acquaintance with the essential facts of life, death, and reproduction may prove is still, I take it, an open question. However, according to current psychological theories, the probability is that it has considerable value. In the further development in the future of this problem of educational technique, this clear-cut contribution must prove of value. The actual records are here for all to use who care to do so. There are, besides, inductions from these records as to the conditions which should be satisfied if we are to make (p. 164) " a positive educational use of the child's impulses, so that they shall be fertile in skill and imaginative understanding and lead out of themselves to the world of objective knowledge and common human purpose ".

Mention should also be made of appendices from the pen of Mr. N. Isaacs on children's 'why' questions, an essay of great interest and high epistemological worth, and his short article on " Education and Science ", originally published in NATURE for July 23, 1927, p. 105, which is here reprinted.

Dr. Isaacs' book is destined to take its place among the classics on the behaviour of young children. Educationists, psychologists, and intelligent parents will await with lively interest and considerable impatience the second volume, which will deal with the social development of young children, and the third, which will contain individual histories of some of the child collaborators, to whom the author has dedicated the work.

JEAN AYLING.

Short Reviews.

Fifth International Botanical Congress, Cambridge, 16–23 August, 1930. Report of Proceedings. Edited for the Executive Committee by F. T. Brooks and T. F. Chipp. Pp. xiv + 680. (Cambridge : At the University Press, 1931.) 21*s*. net.

THE publication of the Report of the Fifth International Botanical Congress within little more than a year after the close of the meeting reflects credit on all concerned. In the preface to the volume, the president, Prof. A. C. Seward, pays a tribute to the efficiency of the two honorary secretaries and editors and to the memory of one, Dr. T. F. Chipp, who died while the book was passing through the press.

The Report records the history of the Congress from its inception in 1926, the personnel of the officers and of the executive and sectional committees, and also the names of delegates, representatives, and members. The detailed programme of the meetings, excursions, and social activities will recall to those who participated the interests and experiences of a crowded but enjoyable week in Cambridge in August 1930. A volume of abstracts of communications provided by authors was prepared for use during the Congress ; these have been incorporated, with some additions, in the present report, and the recorders of sections have also supplied a précis of the various discussions. A very full report of the work of the Congress thus becomes available, and will be valued not only by

members, but also by botanists generally as providing expression of opinion by experts on subjects of current interest. An index of authors of papers and speakers in discussions facilitates reference. The *compte rendu* of the discussions in the subsection appointed to revise the rules of botanical nomenclature, prepared by the *rapporteur général*, Dr. John Briquet, will be of special interest to many botanists.

A photograph of the president forms a frontispiece to the volume, and one of the executive committee and officers is placed at the end. The book is clearly printed and of attractive appearance; a word of thanks is due to the Cambridge University Press for its share in this production.

Acoustics: a Text on Theory and Applications. By Prof. G. W. Stewart and Prof. R. B. Lindsay. Pp. ix+358. (London: Chapman and Hall, Ltd., 1931.) 25*s*. net.

THE revitalisation of the subject of acoustics brought about by applications of the thermionic valve is reflected in all the newer books on the subject. The present volume, based upon lectures in a graduate course in electrical communications given at Yale University by Prof. Stewart, who is known for his pioneer work on acoustical filters, is no exception. So good is the book that one can merely note two minor defects, the omission of authors' names from the index and the rather too comprehensive title.

Since the plan followed is to give only as much of general acoustical theory as is necessary for the treatment of the topics selected, omitting such subjects as vibrating strings and bars, the title "Theory of Applied Acoustics" would perhaps have expressed better the scope of the book. Needless overlapping with standard general works on sound is avoided and the space so saved is used to give remarkably lucid expositions of modern developments. Of necessity a good deal of difficult mathematics has to be used, but one feels that the mathematics has been written in a physical laboratory, as, for example, on p. 22, where in the midst of a derivation of the general wave equation a pause is made to examine the actual numerical values of the quantities represented by the symbols.

The book is so written that the treatment of many particular subjects can be read without further reference to other pages. Many readers will be thankful for such foresight as that shown on pp. 55-56, where the authors take care to explain not only their own use of the term 'acoustic impedance' but also the three other different uses in the literature. The book can be heartily recommended to all interested in modern acoustics.

W. H. G.

Handbook of Cornish Geology. By E. H. Davison. Second edition. Pp. 114+4 plates. (Truro: Oscar Blackford, 1930.) 6*s*.

SINCE the first edition of this excellent little book was issued, in 1926, many investigations of the mineral veins and igneous rocks of Cornwall have been made, largely as a result of the work and influence of the author and of Dr. A. Brammall. Mr. Davison is well known as an authority on the Cornish lodes, and Dr. Brammall's unsurpassed petrological work on Dartmoor has stimulated his colleagues and students to apply his methods to the Cornish granites. In consequence, though only five years have elapsed, the second edition marks a very considerable advance on the first. Many parts of the chapters on contact metamorphism, volatile constituents, and lodes have been rewritten, and a new chapter has been added on china clay.

As an outline of the geology and mineralisation of one of the most interesting of English counties the book should be widely welcomed by teachers and students of petrology and of mining and general geology. It is simple and lucid in style, and clearly and effectively illustrated with maps, sections, and photographs. There is certainly no better guide to the visitor who takes an amateur interest in his geological surroundings. Brief descriptions of localities of geological interest are given, and of the chief mines and their minerals. It is recorded that, although most of the mines are at present perforce closed down, specimens worth collecting can usually be found on the waste heaps. A bibliography is added of the Survey maps and memoirs and of the chief papers published since 1906 relating to the district.

The book can be warmly recommended to all who are interested in the geology and economics of Cornwall.

Physical Metallurgy Laboratory Manual. By Dr. Norman E. Woldman. Pp. v+259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s*. 6d. net.

THIS manual is intended to give the student of metallography a series of exercises with the object of familiarising him with the structure of the most usual metals and alloys. The theory of the subject must be studied elsewhere, and stress is here laid on the practical methods of metallographic examination. The book contains a very large number of illustrations, mostly photomicrographs, and detailed directions for the development of each structure are given. The taking of heating and cooling curves and the determination of the effects of heat treatment on the structure of steel are also described. A short section on the subject of X-rays is useful so far as the detection of blowholes and cracks by that means is concerned, but the pictures of crystal structure obtained by the passage of X-rays through metals would be unintelligible without further explanation than is given here. The use of high magnifications is illustrated by some of the well-known photographs of Lucas, but a warning that only investigators of quite exceptional experimental skill can obtain such results at a magnification of several thousand diameters would not have been out of place. Most of the photographs are of very satisfactory quality, and the book will be found useful for reference, even by those who do not wish to work through its exercises.

The Advancement of Botany.*

By Prof. T. G. HILL.

DOUBTLESS it is a coincidence that the year 1831 marks not only the founding of the British Association but also, so far as a date can mark, the beginning of a threefold epoch in botany: the search for a natural system of classification; the emergence of morphology as a study separate from taxonomy; and the development of physiology.

In the first, Britain gave a full share; but in morphology and physiology, on the other hand, the tale of British activity is dismal indeed: against a battalion of Continental workers we could barely range a section, and British work caused only a ripple on the botanical surface. But there is one exception: the brilliant generalisations of Charles Darwin.

MORPHOLOGY.

In 1831, morphology for the most part had relation to the phanerogams only; the structure and life history of no plant was completely known; the fields of the vascular cryptogams, the bryophytes, and the thallophytes were almost untrodden. It is not surprising, therefore, that when ontogeny came into being the trickle of investigations fast developed into a flood, and for this the greatest honour is due to Schleiden, Nägeli, von Mohl, and Hofmeister, for they showed the way and contributed the most.

A welter of facts was discovered, many of which, especially those relating to the Thallophyta, had to await the arrival of a new technique, that of cytology, before co-ordination was possible; but for the Muscineæ, the vascular cryptogams and the angiosperms, the times produced the man whose patient and detailed work, directed by a keen intellect, gave cosmos to morphological inquiry. I refer to Hofmeister, one of the greatest botanists of all time. He first traced the development of the sexual organs and of the embryo. He was the first correctly to interpret heterospory: he discovered the alternation of generations. Nowadays, alternation of generations is accepted as a matter of course, but when it is realised that Hofmeister was working it out, almost cell for cell, more than eighty years ago without the aid of the microtome and of cytological technique, as we know it, it will be appreciated how great was his work.

Although many contributed to anatomical knowledge, the great advances were associated with the names of relatively few men. Of these, Schleiden and Schwann, the zoologist, are the first to be commemorated since they laid the foundation of the scientific study of anatomy in their theory of the cell, which enabled others, especially von Mohl and Nägeli, to build a knowledge of the anatomy of plants on a sound basis. Von Mohl discriminated the tissue elements and traced the course of the vascular system. He was the first accurately to trace the development of vessels and gave the first correct account of stomates. His observations on periderm and cambial activity are of first-rate importance.

Nägeli made several well-known anatomical investigations. His investigations on the cell wall and on the starch grain are classical: the recognition of the cell wall as a product of protoplasmic activity, growth by intussusception and the occurrence of granulose and amylose in the starch grain, need only be mentioned. The results he obtained by the use of polarised light were as important as those of Sponsler and others by the use of X-rays in our own times.

In the earlier study of cytology, von Mohl and Nägeli were the pioneers. Von Mohl was the first to see cell division. Later, he studied the 'mucilage' described by Schleiden in 1838; he recognised it as a distinct component of the cell and gave it its present name, protoplasm. He described the primordial utricle and realised that the streaming movements of the cytoplasm were independent of the cell sap. Further, von Mohl perceived that the matrix of the chloroplast was protoplasmic.

Nägeli more carefully observed the nucleus and appreciated the facts of cell division more truly; and in this he was the first to recognise that the nucleus is the starting-point. With the passing of time it was recognised that the protoplasm of the plant and of the animal is identical and that it is the basis of life, a conclusion to which Payen, Cohn, and Max Schulze contributed much.

The improvement of microscopical technique led to great discoveries in the details of nuclear division. In this the work of Strasburger is outstanding, and to him is due the main credit of firmly establishing that aspect of botany now called cytology. The contributions of Fleming and of Schmitz must, however, not be overlooked, nor those of Guignard, who, unfortunately, prejudiced his own work by his description of structures which had no existence.

PHYSIOLOGY.

Our knowledge of osmotic phenomena is founded on Dutrochet's studies (1827) on differential diffusion through a colloidal membrane. Graham showed (1854) that the rate of this diffusion depends, *inter alia*, on the nature of the membrane. This led to Traube's discovery of the so-called artificial cell produced by dropping a crystal of copper acetate into a solution of potassium ferrocyanide. This observation was used by Pfeffer (1877), who supported the membrane of copper ferrocyanide in the wall of a porous pot and with it made many highly important observations. Thus was born a branch of physical chemistry, and one of the first results was van't Hoff's theory of solutions. At this time de Vries also was busy on the problem and contributed a great deal to it.

* From the presidential address to Section K (Botany) of the British Association in London on Sept. 28.

Hales, Priestley, Senebier, Ingen Housz, and de Saussure were the pioneers in the study of carbon assimilation, with the result that the more obvious facts were known before 1831. Of these men, de Saussure was the greatest: he was the first to strike a balance which indicated the unity of the photosynthetic quotient, and to show that water and salts, as well as carbon dioxide, are essential for the nutrition of the green plant. His work, however, naturally did not convince the upholders of the humus theory; the problem was settled beyond dispute by Boussingault, who, in 1851, introduced the method of water culture.

Dutrochet (1837) correlated carbon assimilation with chlorophyll and was the first to use the 'bubbling method', a method adopted and improved by Sachs and used by him in quantitative experiments.

Von Mohl (1851) considered that a carbohydrate was formed from the carbon dioxide, but it was Sachs who proved that the starch grains in the leaf were produced from carbon dioxide. Sachs considered that starch was the first product of carbon assimilation; it was not until some years later (1885) that Meyer showed that there were sugar leaves as well as starch leaves and thus indicated that sugar preceded starch in the process.

Turning to the pigments associated with photosynthesis, Grew was the first to suggest that chlorophyll, using the word in its loose sense, was made up of more than one pigment, but to Stokes (1864) is due the credit of making the first real advance; he demonstrated the presence of two green and two yellow pigments. The methods of separation of the mixed pigments were in time refined and culminated in the work of Tswett (1906), who, by his chromatographic method, separated two chlorophylls and five carotinoids, of which one was carotin and the others xanthophyll.

Many years were to elapse before the chemical constitution of chlorophyll was to be elucidated, but Hoppe-Seyler was the first to make the significant discovery, in 1879, that there is a chemical relationship between the green pigment of the plant and the hæmoglobin of blood. The formaldehyde hypothesis was originated by Butlerow (1861) and developed by Baeyer (1870).

Before 1831 certain fundamental facts of respiration were known: Ingen Housz had shown that the plant absorbed oxygen and evolved carbon dioxide, and de Saussure had discovered that a continuous supply of oxygen was necessary for the life of the ordinary plant, that the more vigorous the organ the greater was the amount of oxygen consumed. Dutrochet (1837) confirmed the work of de Saussure and showed that responses to stimulation are not made in the absence of oxygen. He distinguished between the evolution of oxygen in carbon assimilation and the evolution of carbon dioxide in respiration, which facts were confused by many subsequent workers.

The reasons for our deficiencies during this epoch are patent. In the first place, the classical traditions of our old universities dominated teaching, with the result that the approach to biology was, in the main, through medicine. Other reasons lie in the facts that the period was one of exploration, expansion, and development of the Empire, which meant an inflow of great numbers of plants for identification, and the labourers were few. Finally, the systematists did not entirely favour the new movement and, if not actively antagonistic, they looked upon it with amused tolerance.

The Renaissance of Botany in Britain.

The botanical renaissance in Great Britain began about 1875 and it happened in the Royal College of Science. The credit for it is due to Thiselton-Dyer, who, as Huxley's demonstrator, instituted and conducted the first laboratory classes in botany. University College, London, immediately followed. At Cambridge was Sydney Howard Vines.

In 1882 in all branches of botany there were masses of well-ascertained facts; the principles appeared to be settled and the problems formulated. Some aspects, such as anatomy, were in an advanced stage and were developing in various directions; other aspects, physiology, for example, were relatively backward.

In Germany especially, causal morphology was more dominant, in which development von Goebel played a pre-eminent part. His work and his teaching on the influence of the environment on the configuration of plants cannot be too highly appraised; he with Wiesner, Haberlandt, Stahl, Bonnier, and other pioneers stripped morphology of its formalism and revealed the plasticity of the plant.

Of the lower groups I shall say but little; one name, however, leaps to mind, that of Klebs, whose work on the conditions governing the reproduction of the green Algæ is classical. In mycology, Marshall Ward laid the foundation of the modern British school. Of a later date, Blakeslee's discovery of heterothallism was of the greatest importance and led to far-reaching results.

A great contribution to our knowledge during this period was given by the palæontologists. Stur and Williamson recognised the occurrence of fern and gymnosperm characters in certain fossil plants, and with the increase of evidence a separate phylum was recognised and named Cycadofilices by Potonié in 1899. Later, in 1906, Oliver and Scott made known their observations on the seed-like structures attached to the fronds of *Lyginodendron*. Passing on to the gymnosperms, the work of Strasburger and others was continued and many gaps in our knowledge were filled; but of all these investigations the most sensational was the discovery in 1896 of the motile sperms in *Ginkgo* and *Cycas revoluta* by Hirasé and Ikeno respectively. Mention also must be made of Wieland's important work on Cycadeoidea and other fossil cycads.

This progress was accompanied by that of detailed cytology, which immediately reacted to the conception of Strasburger and Weismann that the

nucleus is the bearer of heredital qualities (1884). The reduction in the number of chromosomes was discovered in the parasitic worm *Ascaris* by van Beneden in 1883; the next year Strasburger observed it in the Angiosperms, and this was followed by similar observations by Overton and by Farmer in other groups. Thus was initiated a period of intense cytological study.

The condition of anatomy in 1882 is shown by De Bary's "Comparative Anatomy of the Phanerogams and Ferns": the fundamental facts were well ascertained and the application of those facts determined the direction of increasing knowledge. In Germany the trend, initiated by Radlkofer, was taxonomic, and Solereder took the leading part; in Austria, Haberlandt developed physiological anatomy, whilst in France the drifts were various. The study of purely descriptive anatomy was continued by Hovelacque, for example; Sauvageau, Costantin, and others studied structure in relation to environment, and van Tieghem was the father of stelar theories. In Britain the main morphological interest was phylogeny and this gave the bias to anatomical study. Its principles were first applied by Williamson and Scott in their studies of the fossil plants of the coal measures.

In 1883 van Tieghem and Duliot published their theory of the stele. Their deductive conclusions were not checked by ontogenetic studies, with the result that their theories were discredited soon after the intensive investigations on vascular anatomy were begun in Great Britain. In remembering those who contributed most to this aspect of vascular anatomy, Gwynne-Vaughan comes first, not only on account of his sustained work, but also for the fact that he recognised and demonstrated the importance of the leaf trace.

In the year 1900 came the independent discovery of Mendel and the confirmation of his work by de Vries, Correns, and Tschermak. The effect was immediate; for the first time genetics had definite laws which clarified many problems and disclosed others. It is doubtful if any other botanical work caused such an outburst of activity over so wide a field: a period of intense plant breeding set in; the transmission of colour factors stimulated the investigation of the flavones and other petal pigments and also the distribution of oxidases; and a new field of vast area was opened to the cytologist.

This period is remarkable also in that it saw the growth of ecology. The first ecologist was Humboldt, who was the first to realise the units of vegetation and to essay their ordering (1805). His system, however, was unsound. Interest in the subject was resuscitated by Grisebach in 1872.

Ecological study now became very active: in France, Bonnier was at work on the influence of edaphic factors on plant form and Flahault on vegetation surveys. In Belgium, Massart was studying littoral vegetation (1893), and in Switzerland there was Schröter. A few years later saw the entry of the American vanguard—Clements, Cowles, Harshberger, Livingstone, and Pound, and in New Zealand Cockayne followed his lonely bent (1901). Robert Smith was the pioneer in Great Britain: in 1898 he published his observations on the plant associations of the Tay Basin, and this was succeeded by various other communications. He was followed by his brother, W. G. Smith, Moss, Rankin, Lewis, Tansley, Yapp, Oliver, and others.

Another noteworthy series of observations of this period was those on the ascent of sap. Strasburger's experiments pushed home the idea that the phenomenon was entirely physical, a view which was adopted by Askenasy, and Dixon and Joly (1895), who realised the significance of the tensile strength of water and on it founded their well-known explanation. Concurrently, the splendid lead given by Pfeffer and de Vries was vigorously followed, and the problems of permeability, osmotic pressure, and, in general, the water relations of the cell, were the subject of hundreds of papers.

Mention also must be made of the progress of knowledge of the gaseous diffusion into and out from the ordinary leaf. F. F. Blackman showed that the evolution of carbon dioxide during respiration and its intake during carbon assimilation was, in general, proportional to the number of stomates on the leaf surfaces. These results were confirmed by Brown and Escombe (1905). Their classic work on the static diffusion of gases was published in 1900, the kernel of which is that the rate of diffusion through the pore of a stomate is governed by the law of diameters.

Turning to metabolism, this third period is remarkable for the clearer focusing of the circumstances attending metabolic activity, and especially of the action and interaction of those factors which influence the rate of particular activities. Before 1905 these factors were considered separately and various optima were given for various functions. The insufficiency of this was soon appreciated by F. F. Blackman, and his application of Liebig's law of the minimum to physiological processes led to his conception of limiting factors. The truth of the doctrine is generally admitted, but the observations of Boysen-Jensen, Harder, Lundegardt, Warburg, and others indicate that a particular factor is only strictly limiting when it is very much weaker than the others.

It has been mentioned that Hoppe-Seyler established a chemical relationship between chlorophyll and hæmoglobin. His work was carried much further by Marchlewski, Nencki, Schunck, and Zaleski. Their work paved the way for Willstätter, who with his fellow-workers, by improved methods of experiment, obtained a number of products—the phytochlorins and the phytorhodins. The fact was established that magnesium is an essential constituent of chlorophyll and that the pigment is an ester of the alcohol phytol. These facts led to the chemical characterisation of two chlorophylls, and, later, of carotin and xanthophyll. A few years after, Willstätter and his collaborators elucidated the composition of many anthocyanins.

Of the sequence of events in the elaboration of

food stuffs, but little real progress was made. The work of Brown and Morris (1893) on the chemistry and physiology of foliage leaves, in which they recognised sucrose as the sugar first formed in carbon assimilation, is outstanding and was the first of many investigations amongst which the work of Parkin, Davis, Daish and Sawyer, Gast, Kylin and Weevers may be mentioned.

The work of the Darwins, Sachs and Pfeffer on irritability was continued throughout this period, and, indeed, to the present day.

The natural sequence of this tropistic work was an inquiry into the mechanisms of the sense organs. The statolith theory of graviperception, due to Haberlandt and Němec, was, in general, accepted. In addition to those mentioned, Noll, Czapek, Jost, Vöchting, Oltmanns, de Vries, and Rothert contributed much to the elucidation of the problems. There remained the question of the transmission of the stimulus from the perceptive organ to the motive region. Boysen-Jensen (1910) showed that a stimulus could pass through a water-gap but not through a thin plate of mica. Thus arose the idea that definite bodies, hormones, were generated in the perceptive region by the action of the external agents and travelled to the motive organs to activate the visible reaction. These observations were continued, and amongst those who contributed were Nielson, Paàl, Purdie, Rothert, Stark, Dreschel, Snow, and especially Went.

PRESENT-DAY BOTANY.

The present period is chiefly remarkable for the great output of work in those branches of botany which have an applied aspect. Thus mycology, plant pathology, genetics and cytology occupy a prominent position. In physiology, but little progress has been made in the elucidation of the serial events of the various metabolic changes. But the closer examination of the governing factors, the conditions of growth and the more detailed analyses of these activities, have secured our knowledge, inadequate though it be, more firmly, and also have disclosed certain relationships of first-rate importance, hitherto unsuspected —photo-periodism, in which Garner and Allard were the pioneers; the carbohydrate-nitrogen ratio, to our knowledge of which Kraus and Kraybill have contributed much; and the principle of predetermination so clearly demonstrated by Balls. The application of the principle of the hydrogen ion concentration has given an instrument of great precision capable of use in the investigation of a wide range of problems. The cell wall constituents have been the subject of intensive investigations, some dictated by the requirements of industry, and important discoveries and elucidations have been made.

A survey of this period shows two well-defined tendencies: specialisation and the obliteration of the artificial margins between botany and cognate studies.

The study of physiology in particular and of many aspects of ecology require the application of the technique and conceptions of physics and especially of chemistry: this will increase in the future; if the approach to such problems be made from the biological point of view, progress will be more assured.

The stress of the War soon forced lessons home, and amongst other things learnt was the dependence of man on the plant. The experience of the War was, curiously enough, not forgotten when peace came, with the result that the training of young botanists for economic work and for the investigation of definite problems became with time a settled policy. But other nations also have learnt the lesson—low living ever has been an incentive to high thinking—with the result of gross over-production—some prefer to call it under-consumption—of essential commodities such as wheat, sugar, and rubber. This is mostly due to the unconsidered use of the great advances of applied botanical knowledge and of agricultural engineering without regard to economic consequences. The present tendency in States and industries to curtail expenditure on research and expert knowledge is a wrong policy: "They that be whole need not a physician, but they that are sick".

The successful conduct of these and many like activities is impossible without expert advice. In Great Britain this is provided by many research stations, and their development is all to the good. But there are a few dangers. The founders of new research institutions may be unmindful of the fact that results cannot be commanded. This may react on the investigators, who may be tempted to justify themselves by the dissemination of unripe fruit. Again, the promotion of applied research may tend to obscure the value of pure research. Lastly, there is the comparative isolation of the workers from their academic brothers so that both lose a source of stimulation and ideas. These possible dangers will be eliminated if there be some connexion, the closer the better, between the botanical departments of universities and the research institutions, accompanied by an occasional interchange of the workers in both.

The British Commonwealth of Nations is, in the main, an agricultural Empire: the great need for trained botanists for its administrative and technical service is patent; the problem is their supply and their training. The increased demand is slowly having its effect in the universities, and more students are taking botany for their finals, but their numbers are too few. In the university the training of young botanists for the first three years must be in pure science; this is absolutely essential, and should be followed by a period of appropriate specialised training.

This raises the problem of the manning of our botanical departments: universities cannot compete with industry in matters of salary, and this in the past has resulted in good men being lost to academic work, especially in plant physiology. If good material for the service of the State and of industry is to be provided and pure research maintained, an adequate flow of recruits of the highest quality into academic life is essential.

Forms of the Solar Corona and their Origin.

By Dr. WILLIAM J. S. LOCKYER, Norman Lockyer Observatory, Sidmouth.

IT has long been known that the solar corona undergoes cyclical changes of form synchronising approximately with the eleven-year period of solar activity as determined by the variation of the spotted area on the solar surface from year to year.

These forms are so pronounced and distinctive that they can be classified into three main types, known as 'Polar', 'Intermediate', and 'Equatorial'. The characteristics of the types are as follows:

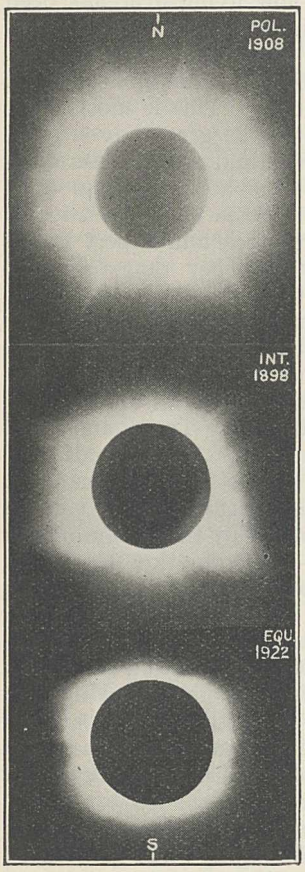

FIG. 1.—Types of solar corona.

(1) The 'polar' type includes those irregular forms in which the streamers are situated all round the solar disc; the polar 'rifts' or 'plumes' in this type are conspicuous by their absence. This type is usually termed the 'maximum' or 'maximum sunspot' type.

(2) The 'equatorial' type is exhibited when the streamers are restricted to comparatively low solar latitudes, and the poles display the 'polar rifts' to the best advantage and have a large spread in latitude. This type is sometimes termed the 'minimum' or 'minimum sunspot' type, and also the 'wind-vane' or 'fish-tail' form.

(3) The 'intermediate' type displays the streamers in mid-solar latitudes. The 'polar rifts' are present, but not so extensive in latitude as in the 'equatorial' type. The streamers also approach nearer the polar regions than in the 'equatorial' type, while the equatorial extensions are not in such great evidence. This type is sometimes referred to as the 'square corona', and 'intermediate' between sunspot maximum and minimum type.

Illustrations of these types are shown in Fig. 1, and the coronas are so oriented that their north poles are situated at the top of each, and can therefore be compared directly with one another as regards the positions of the polar 'rifts' and 'steamers'. The corona at the top represents the 'polar' type (1908), and it will be seen that long streamers are situated in nearly all solar latitudes and the polar rifts are absent. The corona is very extensive all around the dark moon, owing to the sun being at its maximum state of activity.

The next lower figure represents the 'intermediate' stage (1898), the polar rifts becoming apparent. The corona takes a square form, the main streamers radiating more in mid latitudes. In the last form, that of the 'equatorial' type (1922), the polar rifts are well pronounced and the whole corona is not so extensive all round the disc. It is difficult, however, to show the extent of the equatorial streamers, as they are much fainter than usual and to some degree become lost in the reproductions.

Owing to these changes of form varying with the sunspot curve—that is, the 'polar' forms synchronising approximately with the maxima of spotted area, the 'equatorial' with the minima of spotted area, and the 'intermediate' with the intervals between these maxima and minima—all investigators who have studied this subject have concluded that these changes of form were due to the sunspots themselves.

When we come to examine the positions of spots on the solar surface, it is found first of all that they are never near the poles at all. The highest latitude they ever attain is somewhere about 45° north or south, and this occurs only at about the time when the spots are very small and the sun at a low state of activity. When, however, the sun is most active and the spotted area at a maximum, their mean latitude is only about 15° north and south.

It will thus be seen that the presence of the spots themselves cannot possibly be the origin of the coronal streams at the poles of the sun, because at the epochs of the occurrence of the latter phenomena the spotted activity is at a maximum in latitude 15°, a very long way away from the poles. If, therefore, the spots do not cause the polar streamers, then there is no reason why they should account also for the streamers which occur in the spot zones. There must, therefore, be some other form of solar activity which gives rise to these brilliant streamers which can radiate from any latitude.

When the frequency of occurrence of solar prominences is studied closely it is found that, from year to year, they wax and wane, synchronising approximately with the variation of the sunspot areas. Thus it may be said that the curves representing prominence frequency and spotted area are very closely allied or similar, and if the changes in the coronal forms follow closely those of spotted area, they may equally be stated to follow also those of the prominence frequency.

Prof. Ludendorff, in 1929, made a very detailed study of this subject of the cause of the changes of coronal form, and concluded that this change varies with the sunspot period. He did not add

that it corresponds with the frequency of prominences as well, but if he had, his deduction would have been correct. The great advantage of accepting prominence action rather than spot action as the cause of the coronal streams is that prominences *can occur in any latitude*, even at the solar poles.

To illustrate the distribution in latitude of the prominences on the solar disc year by year, reference may be made to Fig. 2, where the latitudes

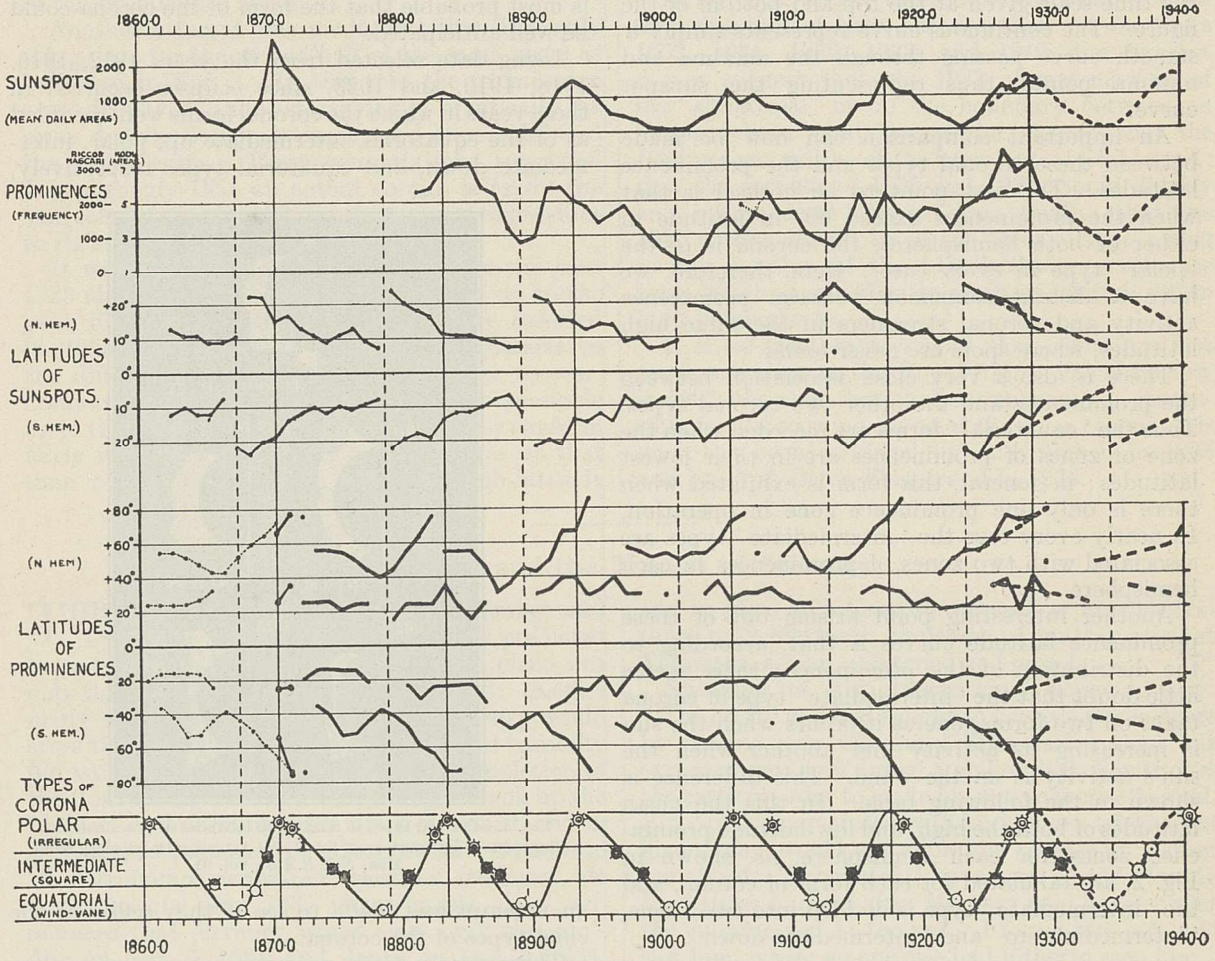

FIG. 2.—Periodicity of solar phenomena. Reproduced by courtesy of the Royal Astronomical Society from *Mon. Not. R.A.S.*, vol. 91.

are given for each year from 1870 to 1929 for both hemispheres of the sun. In this figure the other solar changes already mentioned are also inserted, so that they can all be compared with one another on the same time scale. Thus, the first two curves show the strong similarity between the variations of the spotted areas and the prominence frequencies, and the approximate similarity of epochs of their maxima and minima. The third curve displays the change of latitude of the mean spotted area for each year for both hemispheres, demonstrating the movements towards the equator of the spot zones from a sunspot minimum to the following minimum. The vertical continuous lines show the epochs of sunspot maximum, and the vertical broken lines those of sunspot minimum.

Coming now to the fourth series of curves, namely, those showing the latitudes of the prominence zones from year to year, it will be seen that in both hemispheres there are nearly always two zones of prominences in action simultaneously.

That which may be termed the 'low-latitude zone' commences two to three years after sunspot minimum, tends to move (like the spot zone) to lower latitudes, and disappears generally about two years before the next sunspot minimum. The other zone, which may be called the 'high-latitude zone', commences about three years after sunspot maximum, and moves towards the poles in each hemisphere, terminating generally very abruptly close to the poles about a year after sunspot maximum. At about the sunspot minimum there is usually a period of about two or three years when only one prominence zone is in operation, and that is the 'high-latitude zone', which is then situated in about latitude 45° in each hemisphere.

When the sun is most active, as exhibited by either spots or prominences, the latitudes of the prominences exceed 60° in both hemispheres *in every case*, except in the year 1928, when it was at 60° in the southern hemisphere only. Attention should specially be directed to the fact that the *highest* prominence latitudes do not necessarily occur *at* the sunspot maxima, but more generally about a year later, and in one instance, namely, in 1908,

the highest latitude was attained in the southern hemisphere *three years* after the sunspot maximum.

Below these prominence latitude curves are shown the forms of the corona as observed at each eclipse. These are arranged in three horizontal strips, the uppermost one containing all the ' polar ' forms, the middle the ' intermediate ', and the lowest the ' equatorial ' forms. Each eclipse is placed in the year of its occurrence, according to the time scale given at the top and bottom of the figure. The continuous curve represents simply a smooth curve passing through the maxima and minima points, thus representing the sunspot curve.

An important comparison can now be made between these coronal types and the prominence latitudes. The first point to be noticed is that when the prominences exceed 60° in latitude in either or both hemispheres, the corona is of the ' polar ' type in every case. Here, therefore, we have a distant connexion between prominence activity and coronal streamers in the same high latitudes, where spots are never found.

There is also a very close association between the prominences and the other two coronal types. Thus the ' equatorial ' forms are recorded when the zone or zones of prominences are in their lowest latitudes; in general, this form is exhibited when there is only one prominence zone in operation. In nearly every case the ' intermediate ' types are associated with two zones of prominences in each hemisphere.

Another interesting point arising out of these prominence latitude curves is that, according to the distribution of the prominences, there seems little doubt that the ' intermediate ' type of corona takes on two forms, one as it occurs when the sun is increasing its activity and another when the sun's activity is on the wane. This difference is shown in the following table. In this the mean latitudes of both the high- and low-latitude prominence zones for each hemisphere, as shown in Fig. 2, are tabulated for each form of corona, and the ' intermediate ' type is divided into two forms, ' intermediate up ' and ' intermediate down '.

Corona Type.	Prominence Zones. High Latitude. S.H.	N.H.	Mean.	Low Latitude. S.H.	N.H.	Mean.	No. of Eclipses.
	°	°	°	°	°	°	
Equatorial . .	45·5	44·4	44·9	20·0	22·5	21·2	9
Intermediate up .	51·5	58·5	55·0	30·6	30·6	30·6	4
Polar . . .	71·6	70·5	71·0	26·5	29·5	28·0	10
Intermediate down .	46·8	51·7	49·2	20·7	25·0	22·8	9

While there are only four eclipses of the ' up ' type, but nine of the ' down ', the latitudes of both the high- and low-latitude zones are greater in the former than in the latter.

Thus for the high-latitude zone the mean latitude for the ' up ' is nearly six degrees higher than that for the ' down ', and for the low-latitude zone the ' up ' exceeds the ' down ' by nearly eight degrees. This difference, which is in the same direction for both zones, seems to be sufficiently large to suggest that there may be a small change of type at the times of the rise and fall of solar activity.

It seems most probable that the form of the corona seen at any eclipse is not the immediate result of the presence of prominences at that particular moment. It seems more likely that the form is the result of long-continued action of the prominence zones, for weeks or maybe months, previous to the eclipse. If, for example, the prominences recorded on the sun for two or three months previous to an eclipse occurring were examined, it is most probable that the form of the corona could be well anticipated.

Using data selected from the years 1912, 1916, 1918, 1919, and 1923, since eclipses occurred in these years in which the coronal forms were recorded as of the equatorial, intermediate up, polar, intermediate down, and equatorial types respectively,

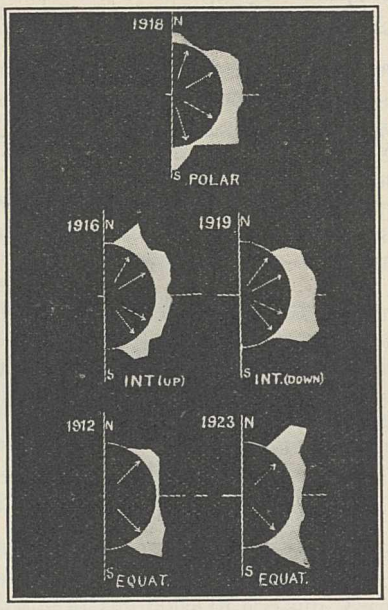

FIG. 3.—Coronal types in relation to latitudes of prominences. Reproduced by courtesy of the Royal Astronomical Society from *Mon. Not. R.A.S.*, vol. 91.

an attempt was made to see if they reflected the chief types of the corona.

These yearly mean prominence areas were then plotted for each ten degrees of latitude, as shown in Fig. 3, for each of the five years, the same scale being used throughout; this scale has, however, no special relation to the areas of the dark half suns, which are all of the same size. The sequence to be followed is from bottom left-hand side up to top right-hand side down.

It will be seen that the main features of the coronal types are all reflected in the prominence distribution in latitude, the high-latitude zones moving towards the poles simultaneously with the greater area of prominence activity, and reaching the poles at the epoch of the ' polar ' type of corona. The ' equatorial ' type is conspicuous by having only one prominence zone in each hemisphere.

There is here a decided difference between the prominence distribution in the ' intermediate up ' and the ' intermediate down ', the latter, in this instance, conforming more to the equatorial type,

disregarding the greater area of prominence activity there displayed.

The white arrows in each of the five half suns are the plotted positions of the latitudes of the high and low prominence zones extracted from the table previously given, and show the *mean* positions of these zones from all the eclipses of each type. It will be seen that, for this single series of years, the arrows conform very well to the actual positions of the prominence zones.

Another attempt was made, but this time only using data for the second half of the same years as indicated in Fig. 3. In this case the prominence areas displayed, quite astonishingly, practically the same distribution in latitude, and thus exhibited the same forms. These computations suggested very strongly that an actual corona is really the sum total of a prolonged prominence action previous to its appearance at an eclipse.

It will be noticed in Fig. 2 that from the year 1925 all the curves have been continued up to the year 1940 by broken lines. These were inserted in 1925 to attempt to forecast the changes in the different solar phenomena from year to year. Comparing those curves with those now available up to the year 1929, it will be seen that they conform fairly well with the actual facts. It was at that time considered probable that the high-latitude prominence zone would be still in evidence in both hemispheres in the year 1929 in about latitude 80°, and would therefore give rise to a ' polar ' type of corona for that year. The latitude of this zone was, however, not so accommodating, but only actually reached 52° in the southern hemisphere and 44° in the northern hemisphere, so that an ' intermediate ' type of corona should have been expected and was actually recorded.

In the case of the next few total solar eclipses following that of 1930, namely, those for the years 1932, 1934, 1936, 1937, and 1940, the forecast curves suggest that the 1932 corona may be of the ' equatorial ' or on the boundary between an ' intermediate ' and ' equatorial ' type ; that the 1934 corona will be of the pure ' equatorial ' type ; that the coronas of 1936 and 1937 should display an ' intermediate ' type ; and, finally, that the 1940 corona should be of the ' polar ' type, owing to the position of the high-latitude prominence zone, which should then be in about latitude 70° in both hemispheres.

It is satisfactory to record that, since my first communication to the Royal Astronomical Society in 1903, showing that the prominences are responsible for the varying shape of the solar corona, this view has been endorsed by J. Evershed in 1908 and by Prof. Osten Bergstrand in 1930.

Gassendi and the Transit of Mercury.

THREE hundred years ago, in November and December 1631, the first accurately predicted transits of both Mercury and Venus took place, but only the transit of Mercury was observed. Kepler many years before had stated that Mercury would cross the sun's disc on May 20, 1607, and carefully but vainly watched for it. With the completion of the Rudolphine Tables in 1627, he again took up the problem of determining the times of transit, and in a small tract published in 1629, entitled "Admonitio ad Astronomos rerumque celestium studiosos, de miris rarisque anni 1631 phaenomenis . . .", announced that Mercury would pass over the sun's disc on Nov. 7, 1631, and Venus on Dec. 6, 1631. He announced at the same time that there would not be another transit of Venus before 1761, but in this he was in error.

Only one person was fortunate enough to observe the transit of Mercury predicted by Kepler, and this was Gassendi, who then, at the age of thirty-nine years, was already recognised as one of the foremost French philosophers. Some years afterwards, Gassendi became professor of mathematics at the Collège Royale in Paris and by his lectures and writings did much to stimulate an interest in science, but in 1631 he was provost of the Cathedral at Digne, near which he was born. He had been a precocious youth, lecturing at the age of sixteen and at the age of twenty-one becoming a professor of theology and philosophy at Aix. Among his contemporaries he counted Mydorge, Mersenne, and Descartes, while among his correspondents was Galileo. He was in Paris at the time of the transit and he gave an interesting account of his observations to Schickhard, professor of mathematics at Tübingen, a man as learned as himself.

Speaking of his observations, Gassendi said: "The crafty god had sought to deceive astronomers by passing over the sun a little earlier than was expected, and had drawn a veil of dark clouds over the earth in order to make his escape more effectual. But Apollo, acquainted with his knavish tricks from his infancy, would not allow him to pass altogether unnoticed. To be brief, I have been more fortunate than those hunters after Mercury who have sought the cunning god in the sun. I found him out, and saw him, where no one else had hitherto seen him."

Gassendi had arranged to see the transit by admitting solar light into a dark room through a small hole and receiving the image of the sun upon a white screen marked with a circle divided into sixty parts. He placed an assistant in a room above, to observe the altitude of the sun with a 2 ft. quadrant, and to signal. Nov. 5 and Nov. 6 were both rainy and overcast and the morning of Nov. 7 broke with the weather still changeable. But fortune favoured him in the end and he was able to observe the planet some time before it passed off the disc about 10.30 A.M. He calculated that the transit had taken five hours and had occurred about four and three-quarter hours before the predicted time.

The second predicted transit of Mercury occurred on Nov. 3, 1651, and was observed at Surat in India by the young English astronomer, Jeremy Shakerley, who had gone to that country for the purpose; while the third transit recorded by astronomers was

on May 3, 1661. This was observed by Hevelius at Dantzig and by Huygens, Street, and Mercator in London.

Immediately after his observation of the transit of Mercury, Gassendi prepared to observe, if possible, the passing of Venus across the sun; for although this had been predicted to take place about sunset on Dec. 6, he considered that a possible error in the calculations might afford him the opportunity of seeing it. Dec. 4 and Dec. 5 were both stormy; Dec. 6 gave him glimpses of the sun, and the sun was visible all the forenoon of Dec. 7. He saw nothing, however, and it was afterwards shown that the transit took place during the night between Dec. 6 and Dec. 7. Eight years later, the first recorded transit of Venus was observed, on Nov. 24, 1639, at Hoole, eight miles from Preston, Lancashire, by the young clergyman, Jeremiah Horrocks, and his companion, William Crabtree.

Gassendi died in 1655 at the age of sixty-three years and was buried in the Church of St. Nicolas-des-Champs, Paris; while Horrocks died in 1641 at twenty-three years of age and was buried in the ancient chapel of Toxteth Park, a monument being erected to him in Hoole Church in 1826 and another in Westminster Abbey in 1874.

Obituary.

Dr. David Starr Jordan.

DR. DAVID STARR JORDAN, who died in California on Sept. 20, was for many years a prominent leader in the promotion of biological science and higher education in the United States. He was born at Gainsville, in New York State, on Jan. 19, 1851, and after attending a local school gained a scholarship at the newly founded Cornell University in 1869. There he graduated and began his active career as instructor in botany.

Jordan's first original papers, published in the *American Naturalist*, were on botanical subjects, but in 1873 he had the opportunity of attending the summer school of Louis Agassiz at Penikese, and henceforth his chief interest was in fishes. During the next few years he worked most industriously at systematic ichthyology, publishing several noteworthy papers, and in 1879 he was appointed professor of zoology in Indiana University. He was not only keen in research but also endowed with administrative ability, and in 1885 he became president of the University. There he remained until 1891, when he was elected first president of the Leland Stanford University in California, and rendered distinguished service to this new foundation until his retirement in 1916. As an acknowledgment of his work, he was eventually made chancellor emeritus of Leland Stanford University.

While occupied with academic duties, Jordan found time to take part in many other scientific and educational activities, and even in political discussions. From 1879 until 1890 he was closely associated with the United States Fish Commission, and in 1880 he was in charge of fishery investigations on the Pacific coast. In 1896–97 he was the American representative on the commission for studying the fur seals in the Bering Sea, and in 1898 he published (with the aid of George A. Clark) an official "Report of Fur Seal Investigations". He was always active in organisations for the abolition of war. His varied reminiscences were published in 1922 in two volumes entitled "The Days of a Man".

Jordan's researches on fishes were chiefly concerned with the naming of genera and species and their systematic arrangement. He made a special effort to examine personally the older collections, to determine precisely the meaning of many of the earlier names which had been given without adequate definition. Helped by his pupils, who were usually joint-authors of his papers, he then proceeded to describe and name some hundreds of new forms, not only from North America, but also from Japan, the Philippines, and Hawaii. In 1883, with C. H. Gilbert, he published a "Synopsis of the Fishes of North America", and in 1896–1900, with B. W. Evermann, he prepared and published in four volumes a still more elaborate work on "The Fishes of North and Middle America". In 1905 he issued a more general "Guide to the Study of Fishes", in two volumes. Between 1917 and 1920 he aided systematic ichthyology by preparing a list of all the genera of fishes named between 1758 and 1920, with an indication of the type species of each—a work published in four parts by Leland Stanford University. In 1923 he supplemented this by "A Classification of Fishes" in the same University's publications. In his later years, Jordan was stimulated, by the discovery of numerous fishes in the Tertiary diatomaceous earth of California, to describe and name fossil fishes both from North America and from Brazil, but the results were not very satisfactory.

Throughout his career Jordan's influence on the systematic study of fishes in North America was indeed great, and he has left several devoted pupils to continue and extend his work. A. S. W.

We regret to announce the following deaths:

Prof. James S. C. Douglas, Joseph Hunter professor of pathology in the University of Sheffield, on Oct. 30, aged fifty-two years.

The Rev. Dr. T. C. Fitzpatrick, president of Queens' College, Cambridge, and formerly a demonstrator in the Cavendish Laboratory, on Oct. 28, aged seventy years.

Dr. James W. Gidley, assistant curator of fossil mammals in the United States National Museum, on Sept. 26, aged sixty-five years.

Mr. Alfred J. Henry, senior meteorologist in the United States Weather Bureau, on Oct. 5, aged seventy-three years.

Prof. Guido Holzknecht, professor of medical radiology in the University of Vienna, and honorary member of the British Institute of Radiology, who was one of the pioneer workers in the application of X-rays to medicine, aged fifty-eight years.

News and Views.

IT is announced in the *Times* of Oct. 30 that the Nobel Prize for Medicine for 1931 has been awarded to Prof. Otto Warburg, of the Kaiser Wilhelm Institute for Biology, Berlin-Dahlem. Prof. Warburg is known for his work on the metabolism of tumour tissues, which is a development of his researches, commenced about twenty-five years ago, on the respiratory processes of cells and tissues. The earlier work was concerned mainly with the utilisation of oxygen by sea-urchin eggs and red blood cells; his later investigations have shown that tumour cells have a characteristic type of metabolism. In the presence of oxygen, lactic acid is produced, whereas the majority of normal tissues only produce the acid in the absence of oxygen; in its presence they oxidise it or resynthesise it to some more complex substance, such as glycogen. In other words, tumour cells appear to obtain the energy they require, or at any rate part of it, from the simple breakdown of sugar to lactic acid, whereas in normal tissues the further oxidation of the acid to carbon dioxide and water is required to supply the energy for their metabolic processes. The distinction between the two types of respiration, however, is not absolute: thus, tumour tissues also consume oxygen, whilst normal cells can be made to develop the abnormal type of metabolism by interfering with their respiration. Warburg's view of the origin of cancer is that it depends upon this abnormal development of aerobic glycolysis: in most cases this change in the type of metabolism leads to death of the cell; if the cell lives, however, a tumour results.

FURTHER information is now to hand regarding the discovery of element No. 87, to which reference was made in NATURE of Oct. 24, p. 696. Papish and Wainer, in the October number of the *Journal of the American Chemical Society*, describe some preliminary experiments in which samarskite was treated for the removal of elements before the alkali metal group, and the alkali metal fraction, in the form of the least soluble alum fraction, was examined in the X-ray spectograph. Five lines corresponding with the element 87 were obtained by excitation in a Siegbahn vacuum apparatus of high dispersion, the absence of tungsten, gold, and tin, which would have caused interference, being established by special experiments. Previous experiments by an optico-magnetic method made by Allison and Murphy in 1930 had led to the conclusion that element 87, which belongs to the alkali-metal group, was present in minerals rich in the rarer alkalis. Preparations from lepidolite and pollucite, which gave indications of the presence of comparatively large amounts of element 87 by the optico-magnetic method, were found, however, not to contain it by chemical and optical tests. The element 87 is regarded as non-radioactive or very feebly so, but it may be an inactive residue from the disintegration of radioactive elements of existing series or of a series long extinct. The samarskite used was rich in uranium and also contained rubidium and cæsium.

SIR CYRIL KIRKPATRICK'S presidential address to the Institution of Civil Engineers, delivered at the opening meeting of the session on Nov. 3, was on "The Tidal Thames"—a subject full of historical and engineering interest. By a charter of Richard I. in 1197, the citizens of London became conservators of the river Thames from London Bridge to Colnie Ditch, now the river Colne, near Staines, where the boundary stone, dated 1280, is still in existence. By an Act of 1489 the river came under the direction of the Mayor and Corporation of London. In 1771 a Committee of the Corporation took over the duties. In 1857 a new Board, the Conservators of the River Thames, was created, and this Board was succeeded, on March 31, 1909, by the Port of London Authority; the upper section of the river above the landward limit (about 265 yards below Teddington Lock) remained under the Conservators, and the lower section under the Authority. The dredging of the river was taken over by the Port Authority in 1909, and the total quantity of material removed to the end of the year 1930 was 41,768,747 cubic yards, as measured in the hoppers. Reference was also made to dredging for ballast, which in the sixteenth century was a privilege of the Lord High Admiral of England and later of Trinity House. In 1861 there was shipped in the Port of London as ballast 202,915 tons of chalk and 565,700 tons of shingle. Owing to the introduction of water ballast during the nineteenth century, the dredging of ballast from the Thames for the use of vessels became no longer necessary.

DEALING next with the constructional works carried out in connexion with the Thames, Sir Cyril Kirkpatrick stated that in 1909 the area of dock water was about 641½ acres and the length of quays about 27½ miles. Since that date, the most noteworthy additions have been King George V. Dock and a new entrance lock and passenger landing-stage at Tilbury. The area of dock water is now about 723 acres, and the length of quays about 33 miles. The total capital expenditure incurred by the Authority on new works was over 14 million pounds. The total net register tonnage of vessels entering and leaving the port had increased from 38½ millions in 1909 to 57½ millions for the year 1930. Referring to the principal industries associated with banks of the Thames, Sir Cyril stated that shipbuilding practically disappeared with the substitution of iron for wood in shipbuilding and the introduction of steam propulsion. About 4½ million tons of coal are carbonised annually at the riverside gasworks for the production of gas, which is distributed by upwards of 7000 miles of mains. The coal is brought up the river by the companies' own steamers to their wharves, and the by-products amount to more than one million tons a year. Another very important industry is the generation of electricity for lighting and power. It is estimated that more than 650 million tons of water

are borrowed from the river annually by electric power-stations for circulating water. It is expected that by 1935 the number of units will have increased to 3500 million, the consumption of coal to 2,200,000 tons, and the water required to more than 1000 million tons. A very important commercial undertaking is that of the Ford Motor Company at Dagenham, equipped with the first blast-furnace built on the Thames. Extensive depots for crude petroleum, motor-spirit, and lamp-oil have been established at Thames Haven in Sea Reach; more than three million tons were imported during 1930.

LIEUT.-COL. E. KITSON CLARK in his presidential address to the Institution of Mechanical Engineers, delivered on Oct. 23, forsook the usual path of a president who feels it his duty to deal with the particular branch of engineering he has been engaged on and thus give the members the benefit of his experience, and devoted his remarks entirely to hammers, hammering, and humanity. His title, indeed, was "Humanity under the Hammer". Claiming that mechanical history began with the hammer, he traced the evolution of hammers from palæolithic and neolithic man down to the present time, exhibiting and illustrating many types of both hand and power hammers, and we should not be surprised if his address comes to be regarded as a classic on the subject. Engineering knowledge, a love of antiquarian lore, a philosophic outlook, and a sense of humour were all brought to bear on the matter in hand. Whether it was the hammer of the flint knapper, the hammer of the coppersmith, the stone-mason, the gold-beater, each and every kind brought out some interesting and often unexpected point, and history, mythology, poetry, and religion were all called upon to contribute to the discussion. The plain story of the hammer, indeed, became a philosophy; and in the romance of the story there were to be found some essences of principles which are by no means settled, and even some reflections of the greatest issues of existence. Lieut.-Col. Clark said: "Let us reverence the unknown, determined, wherever we may find ourselves, to be ready to strike a blow *mente et malleo*, outside the routine of our allotted task, and try to carry even more than our part of that divine burden placed upon every nation, every family, on every kind and true heart, on every engineer, to leave the world a better place than we found it".

To the great suspension bridges of the United States has recently been added another of much greater span than has hitherto been attempted. The Manhattan Bridge has a span of 1470 ft., the span of the Brooklyn Bridge is 1595 ft., of the Williamsburg Bridge 1600 ft., of the Bear Mountain Bridge 1632 ft., and of the Delaware River Bridge 1750 ft. The George Washington Bridge over the Hudson River, between Upper Manhattan and Fort Lee, opened on Oct. 24, however, has a span of no less than 3500 ft. The main features of the bridge include the two supporting towers, 635 ft. high, in the construction of which about 40,000 tons of steel have been used, and the two pairs of supporting cables, 106 ft. apart. Each of these four cables is 36 in. in diameter and contains 26,474 parallel steel wires, each 0·196 in. in diameter. The wires are divided into sixty-one groups of 434 wires each, special spinning and compacting methods being employed. More than 28,370 tons of cable have been used. The roadway is 256 ft. above the river and has a designed capacity of 30,000,000 vehicles annually, while the addition of a second floor to the bridge will double this capacity. As the outcome of experience with this and other bridges, it is now proposed to construct a suspension bridge at Golden Gate, California, of 4200 ft. span, and another across New York Bay of 4500-5000 ft. span.

THE high cost of patent litigation was among the topics discussed in Section F (Economic Science and Statistics) of the British Association on Sept. 28. Two well-known authorities, Mr. W. H. Ballantyne and Mr. H. A. Gill, reiterated the complaint that has so often been voiced in NATURE—that the expense of patent actions precludes all but the wealthiest corporations from defending their patent rights, and largely defeats the aims of the patent system. The Departmental Committee under Sir Charles Sargant having failed to suggest any effective way of dealing with the difficulty, Mr. Ballantyne proposes a method analogous to that prescribed by the London Building Acts of 1894 and 1930 for the settlement of party-wall disputes. In the case of patents, the parties' patent agents having failed to reach agreement, would agree upon an arbitrator selected from the 'patent bar' or from among experienced expert witnesses, and would submit their cases in writing, with oral amplification if necessary. The parties would be bound by the arbitrator's decision. Mr. Gill referred to the British Science Guild's proposal to utilise the Comptroller of Patents for the settlement of small disputes, a proposal favoured by a minority of the Sargant Committee. He suggested that, failing adoption of that plan, an official referee of the High Court might be appointed for dealing with infringement and validity by a simplified procedure. The matter certainly cannot remain where the Sargant Committee left it.

MR. MAURICE DOBB, in a paper on "Current Economic Theory in Relation to the Five-Year Plan", read before Section F (Economic Science and Statistics) of the British Association on Sept. 29, said that Russia to-day presents to the economist a unique and important type of economic system in three ways. First, it presents a planned economy in which the conscious control of key factors which characterises the operations of a business trust in an individualist system is extended to the economic life of half a continent. Secondly, it presents an example of a socialist economy in the more fundamental social and institutional sense that the former propertied class has been expropriated and the receipt of personal income on property rights has ceased to be the controlling motive over the major part of the economic system. Thirdly, the aim of the Five-Year Plan is to effect an epoch-making industrial revolution of the whole country so that a backward agrarian economy

may be transformed to one based on the most up-to-date American technique. Under the Five-Year Plan about thirty per cent of the national income is to be devoted to capital investment (or a proportion double that in pre-War Great Britain). Giant schemes are being undertaken, such as the half-million kilowatt Dnieper Dam scheme, the Stalingrad tractor plant (the largest of its kind in the world), the Nijni-Novgorod automobile plant with a capacity of 150,000 machines a year, and the State Farm, 70 miles by 30 miles in extent.

MR. J. F. SCHOFIELD, of Durban, writes to suggest that Great Zimbabwe may have been occupied at a much later date than is generally thought, and, in fact, may have been abandoned so recently as 1825, at the time of the Swazi invasion. The evidence upon which this conclusion is based is threefold. Wooden lintels would appear to have been used generally for the door openings in the girdle-wall of the 'Temple' and the west wall of the 'Acropolis'; but no one who has a practical acquaintance with the use of timber, especially in the form of logs retaining the outer sap-wood, in sub-tropical countries, would estimate its life at the five hundred years required by Miss Caton-Thompson's dating, still less the twelve centuries demanded by Frobenius. The date of the girdle wall and the wall of the Acropolis must be compatible with timber construction. In the second place, where the upper courses of the walls have been damaged by the branches of trees, the existing trees are the cause; but none of these is a hundred years old. Consequently the buildings must have been kept clear of vegetation up to a hundred years ago. In the third place, in view of the rapid change of ground level owing to the torrential rains of Rhodesia, it is improbable that the drain-hole through the wall noted by Bent would have been still overground in 1892 if it had been constructed more than a short time before Zimbabwe was abandoned. Mr. Schofield therefore concludes that, taking Miss Caton-Thompson's date of A.D. 800 as the earliest date of occupation, the latest and finest work was not completed until about A.D. 1775.

DECREASES in the number of samples examined during the year ended March 31, 1931, at the Government Laboratory and its branches reflect the present depressed state of industry. During the year the total number of samples was 517,462, compared with 545,422 in the preceding year. The report of the Government Chemist, Sir Robert Robertson, surveys the activities of the laboratories at Clement's Inn Passage, London, at the Custom House, London, at certain of the more important seaports, at the Geological Survey Museum, and at the War Office Supply Reserve Depot, Deptford. While most of the work is of a routine character, concerned with the protection of public health or State revenues, much investigation has to be continuously undertaken both to keep abreast of advances in manufacture and industry and to improve the processes of analysis. Moreover, the Government Chemist is frequently consulted by Crown Departments on such chemical problems as from time to time arise, and representation of the Laboratory on committees frequently necessitates experimental investigations. Among the subjects on which advice was sought was the protection, particularly from insects and the effects of moisture, of water-colour drawings in West Africa; the use, in frames, of hermetically sealed, glass-fronted metal cases was recommended. A sample of soot from burners using oil as fuel was found to contain free sulphuric acid; this explained its irritant action on a worker's mouth and throat. The causes of the deterioration of cinematograph films of national importance, and means for restoration and preservation, have been studied. The damage was traced to inefficient washing or to the use of weak or exhausted 'hypo'; improved methods of washing, together with final treatment with fresh 'hypo' and subsequent washing, were advocated.

AMONG the foodstuffs examined at the Government Laboratory was brown sugar which contained a considerable proportion of formic acid, either produced during the process of refining or added as a preservative. Three samples of tinned vegetables contained copper colouring matter. Although the abolition of the duty on tea has removed the necessity for the examination of tea denaturants or tea for export, all consignments are examined on importation to ensure that no tea other than that which is pure and fit for human food shall pass into the country. Sea-water samples are examined in connexion with a scheme of oceanic research carried out by the Fisheries Department of the Ministry of Agriculture and Fisheries and by the Fishery Board for Scotland, acting in concert with the International Council for the Exploration of the Sea. The objects of the investigations are "to determine the influence upon fish life of the salt concentration or salinity, and to trace the movements of the water, apart from tidal ebb and flow, from one part to another in the sea. The sea-water in the Atlantic is more salt than in the North Sea, and the drift of the water from place to place can be traced by making periodical measurements of the salinity at definite positions and charting the results." Imported cheese was found to vary considerably in water and fat content; less than half of the samples had been prepared from whole milk. Yet no exception could be taken, since there are no regulations relating to the marking of skimmed or partially skimmed milk cheese. Likewise, since there is no standard for cream in Great Britain, no action could be based on the fact that only seven per cent of the samples of cream contained 45-55 per cent of fat, the remainder containing only 19-35 per cent. Other important work has been concerned with the administration of the hydrocarbon oils duty, and with the accuracy of hydrometers.

IT has again proved worth while to provide a class at the Dairy Show at Islington for Muscovy ducks only—this species, after being neglected in England for a generation or so, and ignored or disparaged by most writers on poultry, having again come into prominence. Descended from the *Cairina moschata*

of the warm regions of America, this duck is one of the few domestic-animal contributions of aboriginal American culture, the others being the llama, guinea-pig, and turkey; and, although less generally known, it has become more widely distributed than any of these, being kept even by savages in Africa and Polynesia. This is not surprising, as it is far more tolerant of unnatural conditions than the domestic ducks of mallard descent, and will rear its young with as much devotion as any hen. Curiously enough, though more sluggish than any other kind of poultry, it has not lost the power of flight, although its domestication, for all we know, may have been more ancient than that of the mallard. Another curious fact about it is that, although naturally black, it but rarely produces a slate-coloured or 'blue' variety, whereas 'blue' ducks of mallard descent are frequently to be seen; as blue-grey is supposed to be a dilute form of black, this is exactly the opposite of what might have been expected, the mallard having little black in its coloration.

THE Mongolian wild horses at the London Zoological Gardens are now assuming their thick winter coat, which, curiously enough, is bay, not dun, like the short summer pelage. The beasts are thus darker and brighter in colour in winter than in summer, showing the exact reverse of the change undergone by the northern race of the tiger. A more marked change in seasonal colour in the same direction is to be found in the chamois, which is brown in summer and becomes black in winter; but this is more easily understood as, in a winter world of snow, ice, and rock, black is obviously a colour better adapted to protective concealment than brown. The wild-horse foal born in mid-August this year is, however, growing a winter coat of dun, and as this was the case also with the last foal exhibited, it would appear that the dark rich winter coat is only worn by the older animals, which would be better able to look after themselves. The legs of the foal are beginning to blacken from the hoofs up, the wild-horse foal not being black-stockinged like its parents, and hence falling into line with other wild equines in leg-tint, which in these is either light or only barred with black.

NEARLY a hundred papers, contributed by scientific workers of fifteen nations, are listed in the preliminary programme of the Third International Conference on Bituminous Coal, to be held on Nov. 16-21 in Pittsburgh. The papers cover almost every phase of coal preparation and utilisation. The 'coal' man, it is hoped, will be furnished with an accurate picture of the coal industry throughout the world, and the mine-owner should be helped to predict the future demands for his product by major consumers. A section on the economics of the coal industry has been included because of the desperate condition of the industry throughout the world. The organisers felt that it would be impossible to hold any discussion on coal without considering this problem. Pulverised coal will come in for major discussion. Other sections of the conference will be concerned with gasification, hydrogenation and liquefaction, low and high temperature distillation, coal cleaning and preparation, smoke and dust, by-products, origin and classification, domestic heating, metallurgy, and competition of coal with other fuels.

DURING the last five years, the *Chemiker-Zeitung* has published from time to time reports upon developments of various branches of applied chemistry in the form of special supplements. In the issue of Oct. 14 will be found a twenty-five-page condensed summary by Prof. F. Mayer, of Frankfurt, of advances made throughout the world during the year 1930 in the dyestuff industry. An introductory section outlines the more important experimental lines of progress. This is followed by sections dealing with problems of theoretical interest, particularly those relating to colour and chemical constitution, new methods of obtaining intermediate products, and with the various types of artificial and natural dyestuffs and colours. The report presents, in a form useful for reference, a list of the principal publications and patent specifications relating to the subject, which should be helpful to those who are engaged upon dyestuffs research. The supplement also contains a brief report by Dr. Walter Herzog upon saccharin and its derivatives and on other synthetic sweetening compounds.

THE Report for 1930 of the Strangeways Research Laboratory, Cambridge, has been issued by the Trustees. The Laboratory has continued to make satisfactory progress under the direction of Miss H. B. Fell. The Medical Research Council has continued its financial support, but further endowment is required to extend the work. Experimental embryology and histology have been pursued by means of tissue cultures, and an extensive scheme for research into the effects of radiation upon normal and malignant cells has been organised and is in progress in association with various University departments and with the Addenbrooke's Hospital, Cambridge.

REFERENCE was made recently to an apparently new feature in the floor of the North Sea in the form of a deep trench about 100 miles east of Montrose. It was described by Prof. J. W. Gregory in the *Geographical Journal* for June. A note on the subject is published in the October issue, and it now appears that the Devil's Hole, as it was named, is not a new feature and so has no relation to recent earthquake activity. The feature appears in old fishermen's charts, with a depth of 142 fathoms, but was apparently not recorded on the Admiralty charts, since its exact position was not known. This has now been determined to be some ten miles north and twenty miles east of the position given on unofficial charts. The 'discovery' was thus due to a misunderstanding, and recent survey has not recorded any changes on the floor of the North Sea.

THE Rockefeller Institute for Medical Research, New York, has issued a brief account of its foundation and organisation, with a description of the buildings and equipment and present scope of the scientific work. The Institute was founded in 1901 by Mr. John D. Rockefeller with a gift of 200,000 dollars to

be expended on grants and fellowships for investigations into the nature and causes of disease and methods of prevention and treatment. With the aid of further gifts, a small laboratory building was rented in 1902, in 1906 a large modern laboratory was erected on a site in New York overlooking the East River, and to this a hospital of 60 beds was added in 1908. A department of animal pathology was created in 1914, located near Princeton University, and it was extended this year to include a division of plant pathology. The Institute is administered by a Board of Trustees and a Board of Scientific Directors, which together constitute the Corporation.

THE latest arrangements for the polar year 1932–1933 were outlined in a paper communicated to Section A of the British Association by Dr. G. C. Simpson on Sept. 30. Thirty-five States have agreed to participate in the work, and of these the following are to establish new stations in high latitudes, chiefly within their own territory: Austria, Canada, Denmark, Finland, France, Germany, Great Britain, Holland, Iceland, Japan, Norway, Russia, Sweden, and the United States. The preliminary arrangements have been made to house the British party, which will leave England in May 1932, at Fort Rae, on the Great Slave Lake, where a party was stationed during the original polar year fifty years ago. The party will consist of five. The Government grant will cover the expenses of this station, but further funds will be required if a second station is to be established in Canada and the further project of reopening the Ben Nevis Observatory is to be undertaken. The programme of work arranged by the International Meteorological Committee was referred to in NATURE for Oct. 31, p. 754.

DR. MICHAEL C. GRABHAM writes from Madeira recalling an incident in 1901 when Lord Kelvin gave him an advance copy of the paper "On the Clustering of Gravitational Matter in any Part of the Universe", which Kelvin read on Sept. 17 of that year at the meeting of the British Association at Glasgow. The incident to which Dr. Grabham refers took place on the eve of his departure for Madeira, and on the same day Crookes had given him a very active speck of radium bromide mounted in the spinthariscope which Crookes had recently invented. This inspired Kelvin to remark on the 'whimsical' objection of those who denied a rigid stellar ethereal medium, and on his own reluctance to accept radium as an element. In view of the theories at present being propounded on "a mathematical reconstruction of a Universe where planets are rare, while here and there in insignificant corners and at infrequent intervals a strange accident results in life stumbling into being", Dr. Grabham expresses a hope that Kelvin's "gravitational paper" may be still surviving. The paper in its entirety appears in NATURE for Oct. 24, 1901, p. 626, and in the Report of the British Association, 1901. Lord Kelvin states his arguments still more fully in the *Philosophical Magazine* for August 1901, p. 169.

AT the special general meeting of the Linnean Society of London held on Oct. 22, His Majesty the Emperor of Japan was elected an honorary member of the Society.

THE seventh annual Norman Lockyer Lecture of the British Science Guild will be given by Dr. H. H. Dale, in the Goldsmiths' Hall, Foster Lane, London, E.C.2, on Tuesday, Nov. 24, at 4·30 P.M. The subject of the lecture will be "Biology and Civilisation".

AT the annual statutory meeting of the Royal Society of Edinburgh held on Oct. 26, the following Council was elected: *President:* Sir E. A. Sharpey-Schafer; *Vice-Presidents:* Prof. F. G. Baily, Prof. T. J. Jehu, Prof. J. H. Ashworth, Dr. A. Logan Turner, Dr. J. B. Clark, Prof. James Ritchie; *General Secretary:* Prof. R. A. Sampson; *Secretaries to Ordinary Meetings:* Prof. C. G. Darwin and Prof. F. A. E. Crew; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Prof. D'Arcy W. Thompson; *Councillors:* Prof. James Drever, Mr. A. H. R. Goldie, Dr. R. A. Houston, the Hon. Lord Sands, Dr. Murray Macgregor, Dr. A. Crichton Mitchell, Prof. P. T. Herring, Sir Thomas H. Holland, Prof. James Kendall, Prof. T. M. MacRobert, Prof. Godfrey H. Thomson, Dr. Malcolm Wilson.

A NEW part (pt. II.) of Sotheran's "Catalogue of Exact and Applied Science" (No. 828 of Sotheran's "Price Current of Literature") has just appeared. It deals with works on astronomy, dialling and horology, and physics, and contains, as is usual with the catalogues of Messrs. Sotheran, numerous valuable and interesting bibliographic comments upon the books listed.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued two new catalogues of second-hand books of science obtainable from them. No. 191 gives the titles of nearly a thousand works on botany, gardening, herbals, and allied subjects. No. 192 is devoted to books dealing with conchology, entomology, geology, ornithology, and zoology. Some 300 works are listed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A graduate assistant at the Plymouth Day Junior Technical School for Boys, in physics and mechanics—The Secretary for Education, Rowe Street, Plymouth (Nov. 11). A chief handicraft instructor at the Bath Technical College, etc.—The Director of Education, Education Office, Sawsclose, Bath (Nov. 14). A professor of medicine at St. Thomas's Hospital Medical School—The Academic Registrar, University of London, S.W.7 (Nov. 26). A full-time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Nov. 28). A professor of anatomy in the University of Lucknow—The Registrar, Lucknow University, Lucknow, India (Dec. 7). A Stevenson professor of international history at the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 8). A bacteriologist at the Wellcome Tropical Research Laboratories, Khartoum—The Director, Wellcome Tropical Research Laboratories, Khartoum, Sudan.

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.*]

Branching of Lightning.

IT has long been known that the ordinary spark discharge between spherical electrodes exhibits numerous side-branches which are forked away from the positive pole. Similar branching, almost always directed downwards, is shown by lightning discharges between a thundercloud and the ground. For this reason it has been concluded that the direction of branching in a lightning flash is a criterion of the polarity of the discharge (Walter and Simpson). Simpson has examined some five hundred photographs of lightning and has concluded that at least 80 per cent of these pass from a positively charged cloud-base.

This conclusion can be tested from observations of the electric field change at the ground caused by the disappearance of the elevated charge. If the field change is negative, the cloud-pole must have been positive, and vice versa. The method is free from any ambiguity, provided care is taken to exclude multiple flashes which involve more than one charged region; such flashes can be distinguished both by

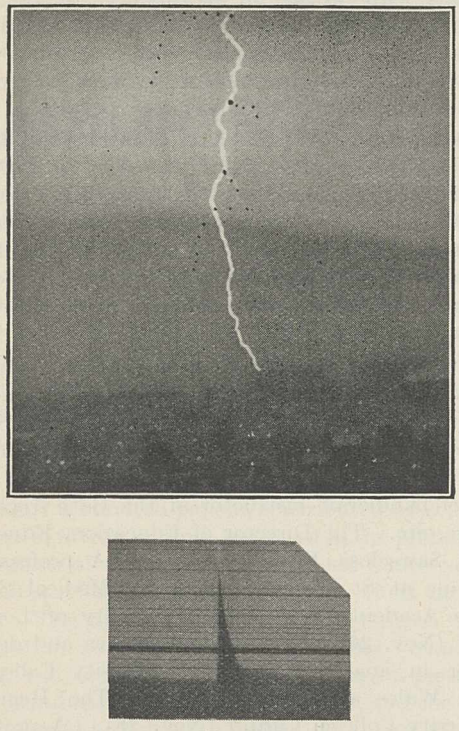

FIG. 1.

the multiple nature of the field change recorded and by direct observations of the appearance of the lightning.

Observations of this kind have now been made on more than fifty South African thunderstorms, and indicate that in at least 95 per cent of the 404 flashes examined the cloud-pole was negative. The appearance of these flashes was observed by eye, and the field changes recorded by the capillary electrometer method of C. T. R. Wilson. Photographs of South African flashes to ground show a high preponderance of downward branching (21/24), and suggest, therefore, that in these flashes the branching was the reverse of that observed in laboratories.

Final evidence was obtained by correlating photographic records of the field changes with photographs and sketches of the flashes producing them. Ten such correlations have been made; eight showed that the

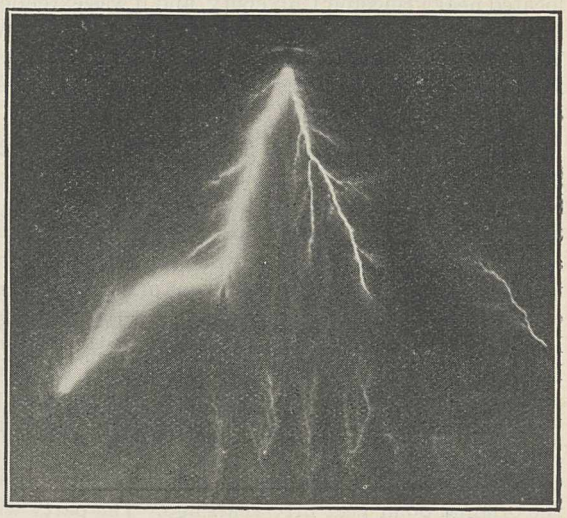

FIG. 2.

branching was directed away from the negative pole, and the other two showed no branching and were possibly partly obscured by rain. One such correlation is shown in Fig. 1—this was a single flash to ground; the branches have been emphasised by dots placed above them.

The conclusion that the branching criterion for cloud polarity is invalid seems unavoidable and is supported by the recent results of Lewis and Foust,[1] who have examined 100 cases in which lightning actually struck exposed conductors, and found that a negative charge was conveyed from cloud to ground in every case.

It is difficult to reconcile this negative branching with the common observations of positive and negative discharges. In addition to the observations on spark discharges mentioned above, the Lichtenberg figures taken between point and point or point and plane show that around the negative pole there extend straight radial streamers showing no branching, whereas around the positive pole the streamers are forked, and when a certain critical voltage is exceeded it is from the positive pole that heavy tree-like discharges extend far beyond the confined circle of brush discharge. What, then, are the conditions under which a positive discharge is suppressed and the negative enhanced so that in the macroscopic example of the lightning discharge the branching occurs from the negative pole?

One obvious difference between experiments in the laboratory and in the field is that in one case we are dealing with a symmetrical gap and in the other with an unsymmetrical gap. It is well known that the sparkover voltage of a point-plane gap is considerably less when the point is the positive pole than when it is the negative pole, whereas a sphere-sphere or point-point gap can show no such difference. But more important than this difference is the part played by the projections from the earth's surface—trees, buildings, etc.—which contribute their quota of space

charge in the electric field between earth and cloud; these projections have not featured in experiments hitherto.

Some time ago, one of us had occasion to study the discharge of an impulse generator delivering 1,000,000 volts to a point-plane gap; it was noticed then that all positive impulses applied to the point—the plane being connected to earth—showed branching from the point; all negative impulses showed branching from the plane. Clearly asymmetry of the gap was insufficient to produce branching from the negative point. On raising a short projection out of the earthed plane, branching occurred from the high voltage point when positive, but in addition there was marked branching from the projection, that is, from the negative point. We have recently had further opportunity of continuing experiments on these lines; confining our attention to the case when the high voltage point was negative, we created a positive space charge above the plane by erecting from it a comb of short nails. From most of these proceeded short streamers branching upwards, whilst from the negative point the main discharge to ground was accompanied by many side branches forking downwards, as illustrated in Fig. 2. Negative corona is

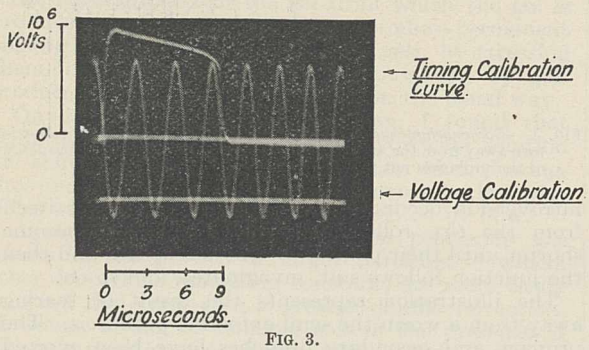

FIG. 3.

seen extending for a short distance from the electrode above the discharge, and positive branching is seen above the nails—St. Elmo's Fire. Thus, provided the conditions are correct, negative branching of a magnitude comparable with positive branching can be produced, and we have a ready explanation of the branched discharges from negative clouds. This throws fresh light on the mechanism of the discharge, and further investigations are proceeding.

Fig. 3 is an oscillogram of the impulse applied to the point; the voltage applied reaches a maximum of 10^6 volts in $\frac{1}{4}$ microsec., remains at that figure without oscillations for 9 microsec., and decays as the discharge passes to ground in $\frac{1}{4}$ microsec. The polarity of the discharge is given by the oscillograms and also by a polarity indicator on the impulse generator. The current in the discharge is about 1000 amperes.

Some of the thunderstorm observations referred to are due to Mr. E. L. Halliday, of the University of the Witwatersrand, Johannesburg, whom we have to thank for permission to use them; our thanks are due to Mr. F. R. Perry and Mr. W. G. Hawley for assistance with the impulse generator, and to Mr. A. P. M. Fleming, for permission to publish.

B. F. J. SCHONLAND.
University of Cape Town.
T. E. ALLIBONE.
High Voltage Research Laboratory,
Metropolitan-Vickers Electrical Co., Ltd.,
Manchester, Oct. 10.

[1] *Gen. Elect. Rev.*, vol. 34, 8.

Atoms and Molecules as Fitzgerald Oscillators.

IN his studies on the polarisation of scattered radiations, Bhagavantam,[1] besides recording numerous cases in which the displaced lines in the spectrum of the light transversely scattered by liquids exhibit complete depolarisation, also discovered in the case of sulphur trioxide liquid an anomalously polarised line. The depolarisation of this line exceeded unity; in other words, the horizontal component, instead of being weaker, as in normally polarised lines, was actually stronger than the vertical component. Critical and systematic investigations undertaken by S. Venkateswaran definitely confirm the existence of such anomalous polarisation in the spectra of light-scattering by various organic liquids, and indicate that it is by no means an unusual phenomenon.

The maximum depolarisation which a rotating electric dipole or Hertzian doublet can yield is 6/7 or 3/4 according as the incident light is common or plane polarised. It would seem, therefore, that we have to seek in some new direction for an explanation of the large depolarisations and anomalous polarisations so frequently encountered in light-scattering. It is proposed in this note to put forward, with all reserve, the suggestion that an atom or molecule scattering light may, in certain cases, function as a Fitzgerald oscillator or magnetic doublet. As electrons and nuclei in atoms and molecules are known to possess magnetic moments, there is nothing inherently improbable in this idea, and it offers an immediate explanation of 'anomalous polarisation' in light-scattering. For what is 'normal' polarisation for an electric oscillator is 'anomalous' for a magnetic oscillator, and vice versa.

A test of this idea is furnished by working with *polarised* incident light, and finding how a variation of its plane of polarisation affects the intensity of the given line in the spectrum. The conditions for maximum and minimum intensity for a Fitzgerald oscillator are the reverse of what they would be for a Hertzian doublet, the intensity of the line being a maximum when the magnetic force instead of the electric vector in the incident light is perpendicular to the direction of observation, and a minimum in the converse case. Venkateswaran has found liquid thiophene to be an excellent example of a substance which simultaneously gives 'normally polarised', 'unpolarised', and 'anomalously polarised' lines, and is, therefore, very suitable for the experiments. Polarising the incident light, and varying its plane of polarisation, he has discovered that 'normally' polarised lines show maximum intensity, while 'anomalously' polarised lines give minimum intensity, and vice versa.

The hypothesis that atoms and molecules may function as magnetic oscillators appears, therefore, to receive support from experiment. It should be remarked, however, that anomalous polarisation may also be explained as due to radiation from electric quadrupoles.

C. V. RAMAN.
210 Bowbazar Street, Calcutta,
Sept. 28.

[1] *Ind. Jour. Phys.*, 5, 59 and 603; 1930.

The Jumping Negative Glow.

I FIRST observed the jumping negative glow in December 1929, in 'I' type Osglim tubes of special design supplied by the Research Department of the General Electric Company; the effect was demonstrated to the Physical Society on Dec. 13, 1929, and at the Royal Institution soirée on Jan. 24 of this year. Afterwards it was found that Taylor had observed

a similar effect in a Beehive Osglim lamp filled with air.[1]

Investigations designed to throw some light on the cause of the phenomenon have been carried on at intervals during the past two years. In the course of these, it was observed some time ago that the jumping effect was produced in an experimental tube with sealing-wax joints when the wax was heated. This suggested that the phenomenon might be caused by impurities in the filling gas. A further series of experiments led to the conclusion that the introduction of minute quantities of the vapours of certain hydrocarbons (toluene and hexane were both found effective) would produce jumps in neon-filled tubes in which the negative glow was previously quite steady.

I hope that a full account of the experiments (which showed other interesting effects of the introduction of traces of hydrocarbon vapour into neon discharge tubes) will be published in due course.

The jumping negative glow is probably related to the wavering positive column in discharge tubes containing hydrocarbons, as demonstrated recently by the General Electric Company. W. A. LEYSHON.

Physics Department,
London School of Medicine for Women,
Oct. 16.

[1] NATURE, Sept. 13, 1924.

Raman Spectra of Benzene and Toluene.

I HAVE during the last summer, at Macdonald Physical Laboratory, McGill University, examined the Raman spectra of benzene and toluene under the fairly high dispersion of 4-5 A. per mm. This work has revealed that the line in the neighbourhood of 1000 cm.$^{-1}$, always characteristic of the benzene ring, is complex.

In benzene there are five components :

1005·3 cm.$^{-1}$
998·8
992·2
983·9
980·3

In toluene there are four frequencies in this region :

1027·7 cm.$^{-1}$
1001·9
992·2
968·3

Several other lines are observed to be complex. In addition, a number of entirely new lines are observed in toluene. A complete account of the work will appear shortly in the *Canadian Journal of Research*.

LESLIE E. HOWLETT.

National Research Laboratories,
Ottawa, Sept. 28.

A New and Peculiar Marine Nemertean from the Australian Coast.

THIS note is to record the discovery of a rather anomalous nemertean worm from the coastal waters of New South Wales. The creature is of outstanding interest because its proboscis, that organ highly characteristic of the phylum, is apparently different altogether from any previously described for this group. In fact, we are not aware of any approximately similar protrusible organ having been recorded in any animal class.

The proboscis of the nemerteans usually consists of an introverted tube in a proboscis sheath, and it is everted like a finger of a glove that has been pulled 'outside in'. This new nemertean has also a proboscis which is retractile within a proboscis sheath, but the proboscis is branched. The branching is of the dichotomous type. By the help of the illustration (Fig. 1) the extraordinary nature of this organ will be realised. During eversion, which takes place almost explosively, the short main trunk first appears, then this divides and the finer and finer branches appear, but since each one of these is the result of an evagination the effect is almost indescribable. It is as if a large number of lively, wriggling, minute worms had been shot out. The tip of the animal is like a gorgon's head. The final branches, all tubular but quite thread-like, are constantly in motion, becoming now longer, now shorter.

If the stimulus has been great, there is, apparently, no possibility of the retraction of the mass and it is thrown off. But it is most interesting to watch the slow retraction which takes place when complete

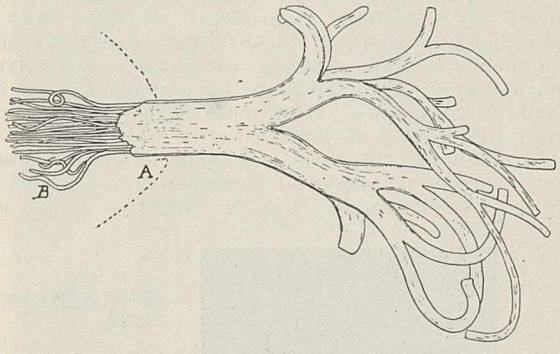

FIG. 1.—*Gorgonorhynchus repens* n.g. n.sp. Semi-extended proboscis torn away from the worm at A. At B can be seen the final branches of the proboscis not yet everted.

introversion occurs. Each fine branch inverts itself from the tip—rolls inwards—the branches become shorter until their point of origin is reached, and then the junction follows suit, invaginates, and so on.

The illustration represents the result of tearing away from a worm the semi-extended proboscis. The primary and secondary branches have been everted but not the final ones, twenty or thereabouts in number, which lie within the former and still extend backwards. They have actually been exposed by the tearing away of the proboscis from the worm where its wall passes into that of the sheath.

A complete description of the anatomy of this interesting creature is being prepared. Many specimens have been found. The surprising thing is that such an anomalous form should fit in with one of the already known nemertean groups. From a study of its body wall it belongs to the *Heteronemertini*. We have created a new genus and species for it, *Gorgonorhynchus repens*, and the description here provided will serve to distinguish it from all other members of the group so far described.

WILLIAM JOHN DAKIN.

Zoology Dept.,
University of Sydney, Australia.

MAHALAH G. C. FORDHAM.

Zoology Dept.,
University of Liverpool, England.

Anisotropy Due to Flow in Cellulose Sols.

IT has been known for some years that certain liquids, and sols containing anisotropic colloidal particles, which in the normal state appear isotropic, will under the influence of external forces show some of the properties of anisotropic substances. The fact that an anisotropic state can be produced in certain fluids by means of the shearing forces caused by hydrodynamic flow, is due, at least in the case of sols, to the non-spherical particles contained in them.[1]

Cellulose gels have been shown to contain non-spherical colloidal particles or micelles,[2] and it is *a priori* almost certain that cellulose sols contain similar particles, which should be oriented by flow in just the same way as, for example, vanadium pentoxide sols are oriented. Further, since cellulose micelles show intrinsic optical anisotropy in the gel state, it should be possible to observe optical anisotropy in flowing cellulose sols.

In the case of cellulose nitrate sols in ether-alcohol, Kundt [3] has reported the generation of double refraction by shearing stresses, though he tried unsuccessfully to explain his observations as due to strains set up in the fluid. But since then an adequate explanation has been advanced, which ascribes the anisotropy to deformation and orientation of the particles.[4, 5] However, Faust [6] was not able to observe any anisotropy in flowing cellulose sols produced by the viscose process, and advanced the improbable theory that the anisotropy present in the fibres of artificial silk (generally regenerated cellulose gel) is due entirely to internal strains. Against this there is a large body of experimental evidence which indicates that this anisotropy is due to an oriented structure of the artificial silk fibres.[7, 8] Such an oriented structure must be originated in the sol from which the gel is produced, since it is not possible to produce permanent anisotropy in unoriented cellulose gels, by stressing them, of the same kind as that possessed by gels produced from rapidly flowing sols in the usual way.

On carrying out an investigation, I found that cellulose sols in cuprammonium hydroxide solution did show appreciable double refraction when flowing, thus indicating that they contain non-spherical particles which are capable of being oriented by flow.

Ageing in the case of vanadium pentoxide sols results in the growth of larger particles,[1, 5] which, other conditions remaining constant, are more easily oriented and thus give a greater double refraction. However, ageing of cellulose sols in the presence of air gave rise to lower double refraction, indicating a diminished particle size. This is to be expected, since the viscosity of such sols falls on exposure to air,[9] and this fall of viscosity is considered to be due to a decrease in micelle size.[10]

A fuller account of the anisotropy of cellulose sols when flowing, with particular reference to their behaviour during the spinning process in the manufacture of rayon, is to appear in the *Journal of the Society of Chemical Industry*.

J. M. PRESTON.
College of Technology,
Manchester,
Oct. 5.

[1] Zocher, *Koll. Zeit.*, **37**, 347; 1925.
[2] Frey-Wyssling, *Zeit. für. wiss. Mik.*, **47**, 1; 1930.
[3] Kundt, *Ann. der Physik und Chem.*, Neue Folge **13**, 110; 1881.
[4] Schwedoff, *Jour. de Physique* (3), **1**, 49; 1892.
[5] Freundlich, Stapelfeldt, and Zocher, *Zeit. Phys. Chem.*, **114**, 161, 190; 1925.
[6] Faust, *Ber.*, **59**, 2919; 1926: and *Cellulosechem.*, **8**, 40; 1927.
[7] Preston, *Jour. Soc. Chem. Ind.*, **50**, 199 T; 1931.
[8] Preston, *Jour. Soc. Dyers Col.*, in the press.
[9] Gibson, Spencer, and McCall, *Jour. Chem. Soc.*, **117**, 486; 1920.
[10] Stamm, *Jour. Amer. Chem. Soc.*, **52**, 3047; 1930.

The Oldoway Human Skeleton.

THE announcement by Mr. Leakey and his colleagues [1] that, in their considered opinion, the Oldoway human skeleton found by Prof. Hans Reck in Tanganyika Territory, in 1913, appears to be of late Kenya Chellean or Kenya Acheulean age, is of outstanding interest. The Oldoway remains represent, unquestionably, an individual of the type of *Homo sapiens* who was buried in the ultra-contracted posture. Moreover, while there may be some doubt whether it is yet possible exactly to correlate the Chellean and Acheulean periods of Kenya with the corresponding prehistoric phases of Europe and of Great Britain, it does not seem probable that there is any great difference in antiquity between them.

It is therefore apparent that, if Mr. Leakey and his colleagues are correct in their opinion, there is now to hand evidence that in Chellean or Acheulean times in Africa there was in existence a race of people who were of 'modern' type and buried their dead in the contracted posture. Though this may seem incredible to some, it is not so to those who, in view of the evidence furnished by certain skeletons of *Homo sapiens* type found in various parts of the Continent and in England in pre-Mousterian deposits, and judging by the excellence and skill with which flint implements of the Acheulean period were made, have concluded that human beings of a high type were living at that epoch.

Further, if Mr. Leakey and his colleagues are right in their estimate of the age of the Oldoway skeleton, it is necessary to conclude that the origin of man must date back to a time much more remote than has been generally imagined, and this will also confirm the opinion of those who believe, from a study of his flint and bone implements and other cultural relics, that man was already well advanced in the Pliocene period. In view of these considerations, all those interested in man's antiquity will look forward to the publication of the detailed evidence upon which Mr. Leakey and his colleagues have based their momentous conclusion.

J. REID MOIR.
One House, Henley Road,
Ipswich.

[1] NATURE, **128**, 724, Oct. 24, 1931.

Priestley and Lavoisier.

I SHOULD like to make one correction (due to my friend Dr. Meldrum) of a statement in my discourse on Priestley before the Royal Institution. On p. 25 of the discourse, I say that "In his memoir of 1775 Lavoisier does not refer to Priestley". I ought to have said that Lavoisier "does not refer to his meeting with Priestley in October 1774". This was the meeting following Priestley's famous experiment of Aug. 1, 1774, generally described as the 'discovery of oxygen'. Lavoisier does, as a matter of fact, refer at the end of his paper to Priestley's views on fixed air as a compound of ordinary air and phlogiston, which he says, though not without plausibility (*non sans vraisemblance*) are contradicted by the facts. The correction does not affect my general argument.

P. J. HARTOG.
Oct. 20.

A New Locality for *Gammarus chevreuxi* Sexton.

IN the autumn of 1929 the dominant animal in the fauna of Wyken Slough, near Coventry, was a *Gammarus*, the species of which was uncertain, but which I then recorded as *G. pulex* Linn. I have since sent specimens to Mrs. Sexton, who has identified them as *G. chevreuxi* Sexton. This organism has previously been found only in Chelston meadows, near Plymouth, and in view of its value in the study of genetics a new locality is worth recording.

Wyken Slough is a pond of about five acres in area, of brackish water (salinity 8·3 parts per thousand), at Alderman's Green, Foleshill, about three miles north-north-east of Coventry, Warwickshire.

F. T. K. PENTELOW.
Ministry of Agriculture and Fisheries,
The Tees Laboratory,
Barnard Castle, Co. Durham, Oct. 12.

Research Items.

Human Remains from Kish.—Dr. L. H. Dudley Buxton and Mr. D. Talbot Rice have published in the *Journal of the Royal Anthropological Institute*, vol. 61, Jan.-June 1931, a report on human crania and skeletal remains from Kish collected by the Field Museum and Oxford University Expedition in the three seasons 1923–26. The material was excavated in the old Sumerian palace at Ingharra (Eastern Kish) and Mound *W*, and belongs to the period immediately preceding the age of Sargon of Agade. It is contemporary with the fourth and last dynasty of Kish (2900–2800 B.C.), of which the names indicate the Semitic character. Owing to the defective condition of the material the number of specimens available for study is relatively small. In the majority of cases the height of the head cannot be measured, and the series comprises twenty-five specimens only. Examination of the crania suggests a dichotomous classification, corresponding to the linguistic and cultural division into 'Semitic' and 'Sumerian'. The majority of the skulls are distinctly long-headed and usually high, the extra height being due to a well-marked scaphocephaly. Yet the jaws are small instead of large and powerful as among most scaphocephalous races. This type of skull from Kish is strongly reminiscent of the Combe Capelle skull. The forehead is retreating and the eyebrow ridges prominent, cheek-bones and nose broad. It belongs to the type which has been described as Eurafrican, and is of considerable antiquity, lingering on in remote parts from western Europe to North Africa, and it may be very early in Egypt. The second type is also dolichocephalic. The main distinction is in the contour, which is rounded, not angular. The eyebrow ridges are mainly absent, and the occiput specially prominent. There is no scaphocephaly and the skull is well filled. It is assigned to Elliot Smith's 'brown race'. The third type is only sparingly represented. It is brachycephalic, with a well-marked eyebrow ridge and a stronger jaw. There is little doubt that it is 'Armenoid'. It did not penetrate to Ur. In a similar series from Ur the first two races from Kish are present, but not the 'Armenoid'.

Migrations of the Greenland Whale and Narwhal.—In the *Geographical Journal* for September is a paper by Dr. R. W. Gray on the colour of the Greenland Sea and the migrations of the Greenland whale and narwhal, founded mainly on log-books of the whaling vessels *Eclipse* and *Hope*, belonging to his father and uncle, in the former of which he himself has sailed. Both species of cetaceans, it appears, avoid the clear blue water and congregate in that which is turbid and olive-green in colour owing to the presence of diatoms, which supply food to the copepod *Calanus finmarchicus*, on which the whale feeds. The cuttle-fish (which feed the narwhal) also, it is suggested, ultimately depend on these. The 'banks', or areas of green water, appear to drift, like the ice, south-west, and are accompanied by the cetaceans for a varying distance according to circumstances, when they turn and migrate north-east, as they had done originally to meet the 'banks' early in the year. Whales are much dependent on ice for shelter, and the introduction of steam has increased this tendency. In summer there seems to have been some separation of the tribes in both cetaceans, the males of the whale following the food-banks south-west, while the females and young went north: while some of the narwhals also take a northerly route, independently of sex. Narwhals have been practically untouched by whalers, but it is suggested that whole tribes of the whales, with resorts and routes of their own, have been killed off, or nearly so.

Disappearance of Insect-borne Diseases from Britain.—Dr. Ll. Lloyd contributed a paper on this subject before Section D (Zoology) of the British Association on Sept. 20. In commenting upon the fact that Britain has suffered in the past from such insect-borne diseases as bubonic plague, typhus, relapsing fever, and malaria, Dr. Lloyd discussed the possible causes responsible for their more recent absence. There appears to be no evidence of any graded climatic change to account for the improved state of affairs. In so far as plague is concerned, this disease was dependent on insanitary habits in towns and fragile houses, which, respectively, afforded food and shelter to the black rat and allowed it to multiply greatly. With changes in these conditions, enforced by legislation, the black rats were reduced in numbers and plague ceased. Rapid reduction in numbers of the human flea is still in progress. Typhus and relapsing fevers, which are louse-borne diseases, had their foci especially in gaols and insanitary camps, and, when these were reformed, continuance of these diseases was due to the vagabond class. Outbreaks followed especially after famines, and the ability of the British people, in recent times, to make up any deficiency of food by importation has been an important cause of their cessation. Social measures which have tended to reduce the condition of utter vagabondage also contributed. Malaria was widespread in England and Scotland up to 1800, and since then, in several outbreaks, a tendency to restriction of its northerly range is noted. It is suggested that an old strain of malaria, capable of transmission at a somewhat lower temperature than present-day strains, has died out, probably owing to very cold years. Other factors which have, or may have, played a part in the reduction of malaria are—better treatment of the disease; increased drainage through improved farming; possibly also a change in the feeding habits of *Anopheles*, such as Hackett and Missiroli believe has abolished malaria from parts of Italy.

Atlantic Foraminifera.—In the eighth and concluding part of J. A. Cushman's "Foraminifera of the Atlantic Ocean", the author describes the species which have occurred in the waters adjacent to the United States, including the Caribbean Sea (*Bull.* 104, Smithsonian Inst., 1931). Nine families are included in this account. From the Rotaliidæ, a large family, the geological history of which begins with the genus *Spirillina*, recorded as early as the Cambrian, developed the Amphisteginidæ, the palæozic records of which are stated to be erroneous. The pelagic habit of many species of the Globorotaliidæ and their association with the Globigerinidæ in both recent and fossil marls and oozes are held to indicate the close relationship of the two families—the Globigerinidæ have developed from the Rotaliidæ as a specialised group adapted to pelagic conditions. The Anomalinidæ, another family derived from the Rotaliidæ, gave rise to the attached forms placed in the Homotremidæ, and to the Planorbulinidæ, the species of which are mostly in the Indo-Pacific at the present time, but were more widely distributed in the tertiary period. The paper is illustrated by twenty-six plates.

Leaf Fall in the Tropics.—Mr. R. E. Holtum has recently put on record (*The Gardens' Bulletin*, Straits Settlements, vol. 5, Nos. 7 and 8, June 1931) the behaviour as regards leaf-fall and flowering of a number of trees in Singapore, thus rendering com-

parison possible with the behaviour of similar trees in the more seasonal tropical climates of Java and Ceylon, on which Coster and Wright have previously made similar observations. The climate of Singapore is very uniform throughout the year, but there is usually a definite change to drier conditions after the north-east monsoon in February, and also some tendency for July and August to be comparatively dry. It is therefore interesting to note that trees of a number of deciduous species change their leaves annually about February, whilst a few species change their leaves in August, and four species were observed to change their leaves twice a year, usually in February and August. A number of other species change their leaves at approximately constant intervals, which, however, have no reference to the faint seasonal cycle, so that, though the intervals are equal in time, they have no reference to the annual cycle and fall upon different months in successive years. These trees, especially, show variation from tree to tree within the same species, and Holtum's observations, since 1927, have been based upon weekly observations upon the same individuals. Detailed notes are given upon the different species, and interesting comparisons with Wright's and Coster's observations are made.

Liquid Drops in Electric Fields.—The October number of the *Proceedings of the Royal Society* contains a paper by Dr. W. A. Macky on the behaviour of water drops in electric fields which clears up several points in connexion with the mechanism of thunderstorms. It appears that the first effect of an increasing field is simply to elongate a drop. Then, at a field strength which varies inversely as the square root of the initial radius, instability sets in and filaments of liquid are drawn out from both ends, accompanied by characteristic electric discharges from the points so formed. The fields necessary to produce instability are independent of the air pressure, unless this is so small that the field is only a little greater than is required for a discharge in absence of the drops. Applied to storms, these results afford strong support for the view that the discharge current is carried by ordinary gaseous ions and not by charged droplets. They show also that the field will rise to some ten kilovolts per cm. immediately before a discharge passes, and that when this occurs the largest drops present are unlikely to be greater than about 0·15 cm. in radius, larger ones being automatically reduced by the formation of filaments. Dr. Macky's paper is illustrated by some interesting photographs of distorted drops and discharges.

Diffraction of Electrons.—Two papers on the diffraction of electrons in gases, which cover a large range of experimental conditions and serve as a check on the approximations which have to be made in the theoretical treatment of the phenomenon, are described by F. L. Arnot and by E. C. Bullard and H. S. W. Massey in the October number of the *Proceedings of the Royal Society*. The results provide, qualitatively at least, further convincing evidence that the interactions of electrons and atoms which have been studied are capable of description as a wave effect, but it is apparent that much still remains to be done in the necessarily complicated theoretical treatment of what occurs. The main features—the effect of the atomic fields, polarisation of the atoms in the interaction, and the exchange of electrons between the beam and the atoms—are probably recognised, but in the treatment of all three, difficult calculations and approximations are involved, the validity of which must be tested by reference to an extensive set of experiments such as the present ones, and even these are still evidently not completely adequate. At the moment, it looks rather as if the value of the diffraction patterns in the investigation of molecular structure consists chiefly in the comparison of the interaction of electrons with systems of known and of unknown internal arrangement respectively, and in the investigation of progressively deeper parts of a system by the use of electrons of increasing energy. There is, however, a natural tendency to look for unique analysis of structure from a theoretical treatment of the diffraction due to any particular substance, without reference to other substances, and future work is likely to be directed both on such lines and towards the accumulation of more complete experimental data.

Lightning Phenomena.—In a communication to Section A of the British Association on Sept. 25, Dr. B. F. J. Schonland gave an interesting account of observations he has made during more than eighty thunder-storms. It is well known that an electric spark branches away from the positive pole of the discharger. It has also been observed that lightning discharges between the base of a cloud and the ground generally fork downwards, away from the cloud base. It is therefore sometimes concluded that the base of the thunder-cloud involved in such a flash is positively charged. Dr. Schonland described experiments made on South African thunder-clouds, which make it very difficult to accept this argument from analogy with the ordinary spark discharge. An examination of the results obtained from some 500 flashes showed that the base of the cloud was negatively charged in 98 per cent of the cases, although the branching was generally downwards. He exhibited records which show downward branches proceeding from the negative pole of the cloud. He gave evidence to show that the conditions preceding the ordinary spark gap discharge require modification before they can be compared with those prevailing below a thunder-cloud. When these modifications are made, the branching is no longer from the positive but from the negative side. The chief modification lies in earthing the positive side of the spark gap (see also p. 795 of this issue of NATURE).

The Dissociation of Water.—An investigation of the dissociation of water in the glow discharge, described by E. G. Linder in the *Physical Review* of Aug. 15. breaks new ground in the application of electrical methods to chemical problems. A tube was set up through which a continuous stream of vapour could be pumped whilst a discharge at a few hundred volts passed through it. The products of dissociation were collected and analysed, and at the same time the potential throughout the discharge and the concentration and energy of the electrons were found, wherever possible, by the use of probe wires. Further information about the electrons near the cathode was obtained by calculations based upon the recent satisfactory theories of the cathode dark space due to K. T. Compton and P. M. Morse. From the collected chemical and electrical data it was then possible to show that about 11 electron-volts were expended for each water molecule which was split into hydrogen and oxygen in the discharge, although the minimum energy needed is only 2·5 electron-volts, and that each electron in the negative end of the tube dissociated about five molecules. Further, the probability of dissociation by an electron near the anode was shown to be of a reasonable order of magnitude. Little information is given about intermediate products in the dissociation, but it is of interest in this connexion that Prof. Bonhoeffer, who has recently discussed a similar problem with T. G. Pearson in the *Zeitschrift für physikalische Chemie*, has shown that it is unlikely

that the hydroxyl radicle can ever be isolated from the discharge, in spite of the intensity of its band-spectrum.

Microscopic Examination of Metals by Polarised Light.—In *Metallurgia*, Oct. 1931, p. 180, is given an account of work by Dr. M. v. Schwarz on the application of polarised light to metallographic investigations. Although suffering in parts from the translation, the paper will be of great interest, particularly perhaps to those concerned with non-ferrous alloys. As an example of the utility of the method may be mentioned the clear differentiation between cuprous oxide and sulphide in copper. The former under crossed nicols appears deep red; the latter, as well as the corresponding selenide and telluride, blue. Crystalline orientation is also very clearly differentiated, to such an extent that etching may in some cases be dispensed with altogether. In the examination of worked materials this is a matter of considerable importance, and the existence of 'preferred orientations' may readily be observed. Structures are in some cases—such, for example, as the ternary eutectic which occurs in certain high phosphorus-bearing bronzes—much more clearly revealed than by ordinary etching methods; and for the determination of the existence of small amounts of insoluble impurities the method may be of great scientific and industrial importance. Stannic oxide, for example, in bronze or in the corrosion product of the alloy, is very clearly revealed, and the characteristic, needle-like, idiomorphic crystals are very evident. Although an account of the necessary technique is given, it will probably be better to refer to the original account given by Reichert (*Zeit. für Metallkunde*, **17**, 299; 1925).

Origins of Power Engineering.—In a short paper contributed to Section H (Anthropology) of the British Association on Sept. 29, Mr. H. P. Vowles gave a sketch of the origins of power engineering. For half a million years or more, man has sought to augment his own bodily power, first with sticks and stones which gave him the mechanical advantage of the lever and the wedge; then after a vast lapse of time, by means of simple mechanisms operated by man and animal power; and, finally, by an ever-increasing control over the forces of Nature. It is only during the past 7000 years we find any evidence of man's attempt to harness external power. One very early invention was the wheel and axle, which is found depicted on a Sumerian plaque of 5000 or 6000 years ago. The wheel and axle led to the use of the wheel for irrigation and flour milling. Water-raising wheels are of great antiquity, but before water-wheels could be adapted for driving mill-stones the toothed wheel had to be invented. Toothed wheels are referred to by Heron, Papus, and Vitruvius. Three primitive types of water-mill exist to-day. One of these, seen in China, consists of a pivoted beam, one end holding a pestle, the other end being scooped out as a water receptacle. Water flowing into the receptacle tilts the beam, raises the pestle, but spills the water, leading to the fall of the pestle. Another primitive mill has a vertical shaft with a horizontal wheel at the bottom placed in the stream, and another consists of a water-wheel with a lengthened axle bearing pegs which act as cams and raise stamps. Wind-mills came after water-mills, and probably some of the earliest were those in Seistan, Persia, a particularly windy region. Mr. Vowles has consulted all the important early writers who have referred to these things, and his paper concludes with notes on the earliest use of steam and the observations by the ancients on magnetic and electrical properties of materials.

Astronomical Topics.

Calendar Reform.—The *Times* for Oct. 31 contains an article on the Conference of the League of Nations that has been considering this question. It appears that the Conference confined itself to recommending a fixed Easter, and postponed all other suggestions of reform. The question of the date of Easter is primarily an ecclesiastical one; other authorities can do no more than make recommendations. A consideration of some weight is brought out in the *Times* article: in one case the rules for Easter deliberately postpone it for a week after the Passover—this is when the fourteenth day after the tabular new moon falls on a Sunday; Easter is kept a week later. A fixed Easter would generally be within a fortnight of the Passover, and the difference between a week and a fortnight does not appear to be a vital one. There are two points in the present secular calendar that are inconvenient in astronomical calculations: the absence of system in the lengths of the months, and the insertion of the leap-day at the end of the second month instead of at the end of the year. Regret will be felt that the Conference did not come to any decision on these matters.

Determination of the Mass of Triton, Neptune's Satellite.—A note in NATURE for Sept. 5, p. 416, gave a summary of the research on this mass made by Dr. Nicholson and Messrs. van Maanen and Willis, using photographs of Neptune taken near its stationary point with the 60-inch reflector at Mt. Wilson. Further details of the research are given in *Pubs. Astr. Soc. Pacific* for August 1931. It appears that the result given in the former note was not quite correct; the mass that they find for Triton is 0·06 of the earth's mass, with a probable error of 0·024. If two rather poor plates are excluded, the higher value 0·09 of the earth is obtained. Even the smaller value 0·06 would make Triton by far the most massive satellite in the solar system; it would be more massive than Mercury, and nearly five times the mass of the moon.

The early notice of this work issued in the *Science Service Bulletin* implied that it was hoped that the research might throw some light on the mass of Pluto. Presumably the idea was that if Triton was found to have a higher mass than would be inferred from its light, the same was likely to be the case with Pluto.

The Numbering of Minor Planets.—The numbering of new planets is assigned to the Berlin Rechen-Institut. No planet receives a permanent number until five accurate observations, extending over several weeks, are available. A considerable number of planets that do not come up to this standard in the year of discovery have provisional orbits calculated; these sometimes enable the planet to be recovered in a subsequent year, and it can then receive a number. *Circular No. 472* of the Institut, issued on Sept. 28, assigns numbers to 31 new planets; the last of these has the number 1183. Seventeen of the 31 have been observed at more than one opposition. Planet 1930 *SQ* receives the number 1170; it had been hoped that this planet would prove to be identical with 330 Adalberta, which has been missing since 1892, the year of its discovery. The identity has presumably been found untenable.

Some hundreds of planets, in addition to the 1183 numbered ones, have had approximate orbits deduced, but await reobservation before being definitely enrolled.

The work of following the records of these small planets keeps the Rechen-Institut very busy; two or three circulars are issued every week.

The South African Association.

GRAHAMSTOWN MEETING.

THE twenty-ninth annual meeting of the South African Association for the Advancement of Science was held in Grahamstown on July 6–11, 1931, under the presidency of Prof. J. W. Bews. The meeting was very well attended and 109 papers were read. The South Africa Medal and grant were presented to Prof. H. B. Fantham at the close of the presidential address. A popular illustrated lecture was delivered by Prof. R. H. Compton on "National Parks". There was a reception by the mayor and councillors, and a whole-day excursion to Port Alfred.

The presidential address to all sections was given by Prof. J. W. Bews on "The Ecological Viewpoint", the substance of which appeared in NATURE of Aug. 15, p. 245.

The year's progress in astronomy formed the subject of Dr. H. L. Alden's presidential address to Section A. The effect of the discovery of Pluto on astronomical science was discussed and the conclusions so far reached as to its mass, reflecting power, and eccentric orbit. The close approach of Eros to the earth has led to observations on its apparent double nature, variations in brightness, apparent elongation or duplicity, and rotation of the elongation. The discovery at the Union Observatory of a variable star with a period of only 100 minutes was noted, with its possible great consequences on evolutionary developments. The occurrence of diffuse matter in space, its concentration in the plane of the Milky Way and the possible use of infra-red photography in connexion with it, and the measurement of the velocity of a distant spiral nebula were also considered.

The aims and objects of soil science formed the subject of the presidential address to Section B, given by Prof. I. de V. Malherbe. A review was given of the rise of soil science since the work of Sprengel, and special reference was made to the work of Russian scientific workers who laid the foundations of the science of pedology, devised new methods for its investigation, departed from traditional methods of analysis, and stressed the importance of the whole soil profile. The developments arising from soil profiles and soil horizons were noted. The climatic basis of soil classification was extended to other European countries and further developed by Hilgard for American soils. International soil congresses have become a feature in work on soil science, and have grown in importance and scope. The work of the six Commissions of the International Society of Soil Science was outlined, these covering soil physics and mechanics, soil chemistry, soil biology and biochemistry, plant physiological methods, soil genesis, nomenclature and mapping, and applications to soil technology. The need for research in soil science and establishment of fundamental principles for applied science were stressed.

Prof. N. J. G. Smith in his presidential address to Section C dealt with the problem of making conditions unsuited to infectious diseases (mainly illustrated from plant diseases). Environmental conditions for diseases being extremely varied, co-operation between different branches of science is possible in combating them. The parasitic fungi, bacteria and virus diseases can be controlled by making conditions uncomfortable and unsuitable for them. Sensitivity to environment was illustrated by consideration of fungal cultures, for example, day and night growths of *Helminthosporium* on barley, temperature and growth rate, the sensitivity to which promotes or hinders the spread of plant parasites, the great sensitivity of fungi to the chemical nature of their environment, associated with which was the phenomenon of 'staling' of the parasite, which, by its own activity, produces chemical substances that stop its own growth. The possible application of these chemical substances by inoculation into plant tissues and of soil inoculation was indicated. The problem of keeping parasites at a distance was among the other topics discussed.

Dr. C. von Bonde discussed the correlation between marine biology and the problems of the fishing industry in his presidential address to Section D. The history of the Marine Biological Survey of South Africa was traced from its inception in 1895. In 1929 a new specially constructed survey ship was commissioned. In addition to investigation of the effect of trawling on the Agulhas Bank, further prolific trawlable areas have been found. Many other lines of work are in progress. These include intensive continuous study of the plankton and its fluctuations, seasonal variations in migration of fish, with their dependence on currents, salinity, phosphate and nitrate content of water, tagging experiments by special means for study of migration, scientific legislation with the view of conservation of supply. The fisheries survey work demands a complete biological and physical survey of every hydrographic basin and the whole coast of the Union, determination of life-histories of all animals and plants of economic importance and their associations, the physical and biological problems connected with artificial culture, an effective code of laws, schools for training fishery investigators and administrators, and the survey working in co-operation with the universities.

The presidential address to Section E, delivered by Mr. A. J. H. Goodwin, dealt with problems of association and chronology in prehistory. Speculation on prehistoric man's habits from man's physical and cultural remains was deplored. Association, chronology, and technology were stressed, also correlation with related branches of science. Simplicity is an ideal. Terminology and lax use of it has caused misunderstanding, and the use of such terms as culture and industry were therefore discussed. Cultural development, phases, and variations in South Africa are of some difficulty not experienced elsewhere. Phase is considered a change in fashion, variation a major cultural development brought about by a major force. The importance of association and some of its pitfalls were noted, also the difficulties due to muddled use of racial and cultural terms. The vexed question of patination and dating was discussed in general and with special reference to dating of petroglyphs. The desirability of correlation of chronological series from individual sites to provide generalised series for zones was emphasised.

"Intelligence, Environment, and Heredity" was the subject of Prof. R. W. Wilcocks's presidential address to Section F. The question of interaction of environment on heredity and vice versa was discussed in relation to intellectual efficiency. The many types of researches in connexion with the problem were outlined, such as correlations between blood relatives, estimate of intelligence of pupils by teachers, concomitant variations, correlation between intelligence of siblings and that found between various physical characters. The results of work on twins were considered. The literature relating to attempts to get correlations between environmental factors and intellectual efficiency was reviewed, the conclusion being that apparently marked changes and differences of

environment do not affect intelligence quotients of children to any great extent. A brief mention of the South African Group Intelligence Tests results was made. The average I.Q. of 3281 ' poor white ' children of ages 120 to 155 months showed a definite tendency to sink with increase in chronological age, which is ascribed to unfavourable environmental conditions under which the ' poor white ' child lives.

In Section A astronomers dealt with the cause of a nova outburst, second order terms in differential refraction in the measurement of photographic plates, comparison between observations on a comet and an ephemeris and the expanding universe. Meteorological papers were concerned with Rhodesian rainfall and the meteorite at M'Bozi, Tanganyika. Soil reclamation and water provision in arid countries were of much interest and the goodness of fit of Dieterici's equation was discussed. Engineers were interested in papers on induction heaters, electric current and the human body, and road construction and maintenance problems in South Africa. An interesting paper was contributed on the historic determinations of the longitude of the Cape.

In Section B papers of chemical interest dealt with the sugar-acid relationship in oranges, the essential oils of *Empleurum serrulatum*, the recent results of plant poison work, the value of valve potentiometers in physico-chemical work, and electrically heated vacuum desiccators. Accounts were given of the mineral springs of South Africa and of the register of medicinal waters of the country. Natural products of the Union such as Iceland spar and the clay responsible for the ceramic industry at Grahamstown were of interest, as was the paper on the products of native iron smelting. The nature and significance of the soil colloidal complex interested geologists and agriculturalists alike.

In Section C important papers on germination of wattle seeds, the germinating capacity of certain native South African seeds, on the vegetation of Natal, and on the siccation process were contributed. In systematic botany there were revisions of the genera *Lopholœna* and *Sutherlandia*, the evolutionary tendencies of the Labiatæ, new species of *Juncus*, and the parasitism of *Harveya*. Mycological papers dealt with new species of South African fungi, bacterial diseases of grain, physiological forms of *Puccinia graminis*, anthracnose of almonds, and new diseases of potatoes. Agricultural problems included studies in pasture management, grass or bush in the Karroid areas, physical properties of wattle soils, soil depletion, experiments on the control of *Selago*, and the fertility factor in turf production.

In Section D a number of interesting new parasitic Protozoa and the Protozoa from Kalahari soils were described. A series of papers dealt with various Amphibia from the points of view of morphology, osteology, and economics. The mammalian basicranial axis and the descent of the mammalian vomer from the reptilian parasphenoid were discussed. The embryological development of the beetle, *Euryope terminalis*, was described and beautifully illustrated. Methods of marking insects taken at regular intervals in quantitative samples, the therapeutic uses of detoxicated snake venom, and fish mortality were of interest. The native beliefs concerning pregnancy and child-birth, with their effects on public health administration, formed a useful practical contribution. A series of papers dealing with sheep and wool research, density and staple length, variation in the merino fibre, correlation between crimp and diameter of wool, and the blowfly menace were taken in a special sheep and wool subsection. Fine exhibits of small mammals from south-west Africa, of deep-sea fishes, of extinct mammals associated with the Taungs skull, and of curious letter-like markings on the mouth of a snoek were displayed.

In Section E an account was given of Bushman paintings at Quthing, Basutoland, and of the present-day Basuto copies of them, the skeletal remains of cave dwellers of the Outeniqua Mountains were described, and also skeletal material from early graves in the Riet River valley. The traces of Bushman occupation in Tanganyika Territory were detailed, and an interesting historical and philological investigation of the lost tribes of the Cape was given. Artefacts from Melkhoutboom and implements from Healdtown were described, also rock engravings and suggestions as to their significance and age. Superstitions of coloured people in Knysna and traditions connecting the Bantu and Zimbabwe were discussed, and a paper on native music dealt with the mystery of the Grand Gom-gom.

In Section F papers of much economic interest dealt with provincial councils from the point of view of political science, with indirect rule in Tanganyika, and with an analysis of the contributions to family support of women workers on the Witwatersrand. The quantitative valuation in ethics and the question of the retention of the distinction between sensation and perception were considered. Educationists were interested in investigations into intelligence tests in South Africa and in experiments in vocational guidance. Two papers of much historic interest dealt with the making of a Cape governor, Sir Benjamin D'Urban, and with early revenue and taxation in South Africa. Another most interesting paper dealt with the new cosmology in its historical aspect, Plato, Newton, and Whitehead being considered. An account of the International Institute of Intellectual Co-operation was given at a meeting of all sections.

The next annual meeting of the Association will be held at Durban in July 1932, under the presidency of Prof. P. J. du Toit. H. B. F.

Metallurgical Spectrum Analysis.

TWO papers on metallurgical spectrum analysis, presented at the recent meeting of the Institute of Metals at Zurich, " Application of the Spectrograph to the Analysis of Non-Ferrous Metals and Alloys ", by H. W. Brownsdon and E. H. S. van Someren, and " The Spectrographic Assay of some Alloys of Lead ", by D. M. Smith, represent the latest developments of a method of metallurgical analysis which appears to have been first suggested and used by W. A. Miller, assayer to the Mint, in 1863. The theory and technique of metallurgical spectrum analysis were elaborated by physicists having academic interests, but it is noteworthy that the present papers, and others recently published, emanate from the research departments of industrial concerns—Imperial Chemical Industries, Ltd. (Metals), and the British Non-Ferrous Metals Research Association ; moreover, these papers indicate that spectrographic methods have been adopted for particular routine assays. Now that the importance of the presence of small quantities of foreign metals in alloys is appreciated, though in individual cases the quantitative relations may be quite unknown, it is customary for specifications to set rigorous limits for the content of these foreign metals permissible ; limits which, in the absence of precise knowledge, are often very low. It is in the

works control of the production of such alloys that the methods described in these papers are particularly valuable.

The method most favoured by these writers is the simplest available, and it is the one most capable of general works use, since the instrumental routine does not require a high degree of technical training in the operator: reading and interpreting the spectrograms requires more training. Direct visual comparison is made of the spectrogram of a standard alloy with the spectrogram of the alloy to be assayed. For the examination of brasses, the authors of the first paper use a pair of electrodes, the positive being pure copper, the negative being the sample to be assayed. Spectra of arcs of all the standard alloys are run in this way and photographed with the standardised routine, and from an examination of the spectrograms, tables are prepared showing the relation between the intensities of the lines of the metal being determined and neighbouring copper lines. An example is shown in the accompanying table.

MANGANESE IN BRASS.

Manganese Line.	2949.	4236.
Manganese, per cent		
0·01	*b.v.* $<$ / $=$ / $>$ Cu 2858	
0·02		
0·04		
0·1	$<$ / $=$ / $>$ Cu 2997	
0·2		
0·3	$<$ / $=$ / $>$ Cu 2883	$<$ / $=$ / $>$ Cu 4249
0·4		
0·8	$<$ / $=$ Cu 2961	
1·6		

b.v. signifies barely visible.

The spectrogram of the sample to be assayed is taken with the same routine, and by a comparison of the intensities of the manganese line 2949 with the copper lines 2858, 2883, 2961, and 2997, and of 4236 manganese with 4249 copper, the manganese content of the brass is determined.

For the examination of lead alloys, a high tension spark discharge was used, both electrodes being of the metal examined. Relative intensity tables were prepared, in which the pairs of lines to be compared consisted of one line of the metal to be determined and a neighbouring lead line, but were otherwise similar to Table 1.

Preliminary experiment must be made to determine whether arc or spark excitation shall be used, what the arc or spark gap shall be, whether a condensing lens is to be used, and to standardise carefully the electrical conditions of the excitation and the photographic technique. It is evident from the papers under review and others recently published that different workers evolve different routines to suit their particular problems and equipment. Such papers as the present ones are valuable in that they give complete working details for the determinations of which they treat, as shown in the following table.

Alloy.	Metal determined.	Percentage range for which data are available.	
Brass . .	Lead	0·005	5·0
	Tin	0·005	1·3
	Iron	0·005	1·2
	Nickel	0·01	15·0
	Aluminium	0·01	2·0
	Manganese	0·01	1·6
Lead alloys	Tin	0·002	9·0
	Antimony	0·03	15·0
	Cadmium	0·0001	1·0
	Arsenic	0·03	1·5
	Bismuth	0·0003	0·15
	Copper	0·0002	0·06
	Zinc	0·001	0·06
	Silver	0·0006	0·002
	Thallium	Data for	0·001
	Mercury	Data for	0·005

In some cases these figures do not represent the extreme limits over which the methods can be used, but those which the writers have used in practice. When most of the observations will involve very small quantities, a modified procedure with longer exposure and development will be used; while for determinations which are mostly more than one per cent, it will often be advantageous to use the logarithmic wedge sector referred to later.

D. M. Smith deals, further, with the preparation of standard alloys, an important preliminary to putting a spectrographic routine into works operation; and with a more refined method of making the intensity comparisons. A simple spectro-photometer, the logarithmic wedge sector of Scheibe and Neuhäusser, is used: its use gives not so much an increased accuracy as an extension upwards of the range over which the equipment may be used for making determinations.

The accuracy to be obtained from both these methods is about ten per cent of the amount of the constituent present, over the range for which the method is applicable. Thus 0·1 per cent would be returned as between 0·09 and 0·11 per cent; 10 per cent would be returned as between 9 and 11 per cent.

A. A. FITCH.

Work of the Radium Commission.

THE first Annual Report of the work of the Radium Commission, published this time last year, gave an outline of the policy of the Commission, and stated that the radium was to be used primarily for the treatment of malignant disease. In the first instance, the faculties of medicine at universities throughout Great Britain, excluding Oxford and Cambridge, were approached, and negotiations with centres in London were made irrespective of the University.

The second Annual Report, just published,* shows that the year has been largely occupied in developing the work at the national radium centres. Since the Commission's scheme was launched, a number of medically qualified men have taken up radium therapy and by courses of study in England and abroad have prepared themselves for the position of radium officers. The wisdom of the policy of concentration of radium therapy at centres where the work can be properly organised can scarcely be doubted, for it is becoming generally recognised that this is a highly specialised kind of treatment, and to carry it out satisfactorily there has to be a certain amount of co-ordination; pure medicine, surgery, radiology, pathology, and physics all play their parts. In these circumstances, it is obvious that the best treatment can only be procured where there is a real appreciation of the many factors that should decide and control the exact methods to be adopted.

It has been necessary to enlarge on the original scope of this radium service, for owing to the uneven

* Second Annual Report of the Radium Commission. Pp. 32. (London: H.M. Stationery Office, 1931.) 6*d*.

geographical distribution of the universities with medical schools where the twelve national radium centres had been established, it became obvious that there were considerable areas in England which could not be adequately covered by them. It is likely, in the near future, that regional radium centres will be established to serve these areas, the main policy of concentration at centres adequately staffed and equipped still being preserved.

The chief aim of the Commission for the first five years of its existence is not only to get the best facilities for radium treatment at these recognised centres, but also to be able to assess quantitatively at the end of this time exactly what the value of the radium has been in the treatment of cancer. All the centres keep their clinical records on forms which have been devised and issued by the Commission, and the information from these forms is to be collected yearly and assembled on statistical cards, the general form of which has been agreed upon in consultation with Prof. Major Greenwood. In this way it should be possible year by year to obtain information of the number of people treated, the various sites of cancer which have been treated, all technical details of the treatment, and progress of the patients.

Reference is made in the Report to the work at the Westminster Hospital with what is known as the 'four gramme bomb'. The trial with this appliance was limited in the first instance to cases of malignant disease originating in the breast, stomach, and prostate, and after a period of more than a year the conclusion has been reached that, under present conditions, this form of therapy cannot be recommended for the treatment of cancer in these regions. The Commission takes the view that surface treatment with radium may be better developed by dividing the bomb into smaller units.

Under the terms of its charter, the Commission has two main obligations imposed upon it in administering the national radium; and whilst it has considered that its most pressing duty is to "promote the treatment of the sick throughout Great Britain", it has also taken steps to forward the "advancement of knowledge of the best methods of rendering such treatment". With this latter object in view, it has allocated 1 gm. of radium element to the Medical Research Council and 0·18 gm. to the National Physical Laboratory. The policy of making such allocations to large corporate bodies in touch with individuals specially qualified to conduct the kinds of research work involved obviously has many advantages. As stated in the present Report, it is an encouraging sign of the activity of experimental research in radium that within a few months of completing the arrangements with the Medical Research Council ninety-five per cent of the loaned radium had been allocated to research groups.

Human Embryology.

OCCASIONALLY children are born with the terminal part of an arm or leg represented by a mere rudiment, or a whole segment may be missing as if an amputation had been performed within the uterus. Dr. George Streeter, director of the Carnegie Laboratory of Embryology, has made an important addition to our knowledge of such abnormalities (*Contributions to Embryology*, 1930, vol. 22, pp. 3-46). Having numerous examples of such abnormalities at his disposal, he has been able to throw light on many points which have hitherto been obscure.

It has usually been supposed that fibrous bands—known as amniotic bands—formed round the growing limb of the fœtus, causing a constriction, ultimately led to the death and shedding of the distal part of the limb. Dr. Streeter's investigations throw a new light on these encircling bands. They are not formed from the amnion but are developed as fibrous rings from the tissues of the necrosing limb. A survey of the evidence collected and tabulated by Dr. Streeter leaves no doubt in the medical mind that intra-uterine amputations are the result of a partial failure of the placental circulation, which leads to gangrene of the fœtal limbs—just as a partial failure of circulation in the adult may lead to gangrene of the extremities.

Fœtal tissues react to lack of blood quite differently from adult tissues. At the zone where separation is to take place between the living and dead parts of the fœtal limb, the lymph thrown out becomes organised and forms the constricting rings of tissue, known as 'amniotic bands'. The unnourished segment of the limb, being bathed in amniotic fluid, undergoes only partial death, parts of it surviving to form an irregularly shaped hand or foot.

Curiously enough, liability to intra-uterine amputation has been shown to be inherited in a few instances.

In the same volume, Dr. R. H. Hunter clears up certain obscurities relating to the development of the human vagina and hymen. In the sixth week of development the vagina is represented by a canal formed out of the fused lower ends of the Mullerian ducts. Thereafter the canal becomes represented by a cord of epithelial cells, this cord, which represents the vagina, continuing to elongate until the end of the fourth month. In the fifth month of development, the solid core of vaginal epithelium begins to proliferate rapidly on all sides, distending the canal round the corner of the uterus at the upper end and pressing against the wall of the vulva (urogenital sinus) at the lower end. The central cells degenerate and the lumen of the vagina is thus formed. The hymen, which represents part of the wall of the urogenital sinus, is formed out of the vagina-vulvar junction by the expansion of the lower end of the vaginal cord. The phylogenetic significance of these vaginal changes is still unexplained.

University and Educational Intelligence.

BELFAST.—Dr. J. S. Young, lecturer in experimental pathology and assistant director of cancer research in the University of Leeds, has been appointed Musgrave professor of pathology.

CAMBRIDGE.—Mr. A. G. Brighton (Christ's College) has been appointed curator of the Sedgwick Museum of Geology.

The Council of the Senate recommends that the Goldsmiths' readership in metallurgy be discontinued, and that a Goldsmiths' professorship in metallurgy be established, with a stipend of £1200 a year. The General Board recommends that a new faculty of geography and geology be instituted in the University. This faculty would include the Departments of Geology, Mineralogy and Petrology, Geography, Geodesy, and Geophysics.

At Emmanuel College, Prof. C. E. Tilley, professor of mineralogy and petrology, has been elected to a professorial fellowship.

V. V. Narlikar (Fitzwilliam House) has been elected to an Isaac Newton studentship, and H. R. Hulme (Gonville and Caius College) has been elected to an additional Isaac Newton studentship.

LONDON.—Dr. F. C. Benham, Sir Ernest Cassel lecturer in commerce at the London School of Economics, has been appointed University reader in

commerce, and Mr. R. J. V. Pulvertaft, pathologist at St. Thomas's Hospital, has been appointed University reader in pathology (Westminster Hospital Medical School). The title of reader has been conferred on Dr. Nora Edkins, lecturer in physiology at Bedford College.

APPLICATIONS are invited by the Royal Society for the Moseley research studentship, value £350, for the furtherance of experimental research in pathology, physics, and chemistry, and other branches of science, but not in pure mathematics or astronomy. Applications must be made by Dec. 15, upon a special form, to the Assistant Secretary, Royal Society, Burlington House, W.1.

AT the recent general parliamentary election, besides those members for university constituencies who were returned unopposed, as announced in NATURE for Oct. 24, p. 732, the following candidates have been elected: University of London, Sir Ernest Graham-Little; Combined English Universities, Miss E. Rathbone and Sir Reginald H. Craddock; University of Wales, Mr. Ernest Evans.

THE award of the John Gray Jubilee Scholarship has just been made to Mr. G. Alan Thompson, a research student of the Gas Engineering Department of the University of Leeds. This scholarship was endowed by Mr. John Gray, a past-president of the Society of Chemical Industry, on the occasion of the celebration of the jubilee of the Society this year. It is tenable at such place of learning as the council or president may prescribe, and preference will be given to students who have already graduated in a university and are sons of members of the Society of ten years' standing.

Birthdays and Research Centres.

NOV. 10, 1861.—Dr. ROBERT T. A. INNES, Union Astronomer emeritus, Johannesburg.

At present I am working on the motion of the 12-year periodical comet 1927 *f*. I am also trying to find further grounds for the hypothesis that changes in the earth's climate are in the main due to impacts with the comæ of comets, and am examining and making further applications of Cowell's process to the motions of the major planets.

NOV. 12, 1863.—Prof. ALFRED W. PORTER, F.R.S., emeritus professor of physics in the University of London.

The work on which I have expended most effort during the last few years is divisible into several parts. (1) The calculation of surface tensions from experimental measurements on the ascent of liquids in tubes and by the bubble method. The part played by the angle of contact in the latter method is still a subject for discussion, though something has been done to clear the ground. For the tube method, I have given diagrams enabling the effect of the contact-angle to be allowed for (when it does not exceed 35°) with an accuracy surpassing that required in practice. (2) The interpretation of the Joule-Thomson effect, especially in regard to steam and to refrigerating materials. (3) The vapour pressures of binary and ternary mixtures. (4) The variation of the viscosity of colloids with shear. (5) The resolving power of optical instruments. Some work has been published on all these problems; further work is being more or less slowly elaborated, especially in regard to the Joule-Thomson effect.

Societies and Academies.

LONDON.

Royal Society, Nov. 5.—Sir F. Gowland Hopkins and K. A. C. Elliott: The relation of glutathione to cell respiration with special reference to hepatic tissue. The relative capacity of various mammalian tissues to reduce the disulphide form of glutathione under anaerobic conditions has been determined. The course of the oxidation of the thiol group during the survival respiration of the hepatic tissue of various animals has been followed. That the concentration of certain metabolites in the liver is wholly, or in part, responsible for the maintenance and amount of reduction is shown by the effects of administering or withholding food. In general the initial marked delay in the disappearance of the – SH group during aeration is observed only in the liver of well-fed animals; after relatively brief periods of fasting it is much lessened and may not be observed. If extra glutathione in the disulphide form be added to the freshly excised tissue before aeration, the existence of residual active hydrogen is revealed. In spite of vigorous aeration the concentration of – SH then rises during the earlier periods of survival, though ultimately the whole is oxidised. The amount of this extra pressure-head of hydrogen consistently differs in the livers of different species. The origin of the active hydrogen which reduces the disulphide grouping is at present unknown. The transport of hydrogen to molecular oxygen by the path in question, though representing but a small part of the total respiration, may, therefore, prove to represent a specialised and significant aspect of tissue oxidations.—Lord Rutherford and C. D. Ellis: The origin of γ-rays. Calculations are made of the probability of escape of the α-particles from radium C′ and of the average time of transition of the α-particle for different energies of the γ-ray. The strongest α-ray group, which corresponds to the emission of a β- or γ-ray of energy $1{\cdot}426 \times 10^6$ volts, represents an abnormal mode of transition compared with other groups. The time of transition is very long, and it may be, as suggested by R. H. Fowler, that the transition is radiationless, the surplus energy being directly transferred to one or more of the outer electrons of the atom. Many of the lines in the β-ray spectrum may be a result of similar radiationless transitions. In explanation of the complicated γ-ray spectrum of radium C′ it is suggested that more than one α-particle in the nucleus may occupy the same energy level.—A. V. Hill: Myothermic experiments on the frog's gastrocnemius. An arrangement is described by which the 'initial' heat set free in the contraction of a frog's gastrocnemius can be measured in absolute units. A single fine thermocouple of constantan-iron is employed, the 'hot' junction lying inside the muscle. It may be applied to single twitches, to groups of twitches, or to tetani up to 25 seconds in duration. The mean value of Tl/H, the isometric heat coefficient in a twitch, is 13·4. This is twice the mean value found in sartorii. The difference is due to the fact that in gastrocnemii the fibres, or parallel fibre bundles, run, on the average, only half the length of the muscle. A modification is described of the method recently suggested by Bozler of 'calibrating' by condenser discharges. This is far simpler and more accurate than the old method employing an alternating current. The specific heats of muscle and blood have been determined. For a given water content they are the same. The density of a tissue depends upon the amount of solid it contains. This provides a simple and accurate method of measuring, without the labour of drying and weighing, the percentage of solid in a muscle.

PARIS.

Academy of Sciences.—Sept. 28.—**Ernest Esclangon**: The observation of the eclipse of the moon of Sept. 26, 1931, made in Haute-Provence. The atmospheric conditions were exceptionally favourable. The most striking feature of the eclipse was the marked difference in the coloration and intensity of the earth's shadow, as a function of the distance from the centre of the shadow.—**E. Mathias** and **G. Grenet**: The electric field at the summit of the Puy de Dôme. A Benndorf recording electrometer has been set up in the dwelling-house, and the coefficient for converting these readings into those given at the summit (1440 metres) determined. A table showing the diurnal variation is given.—**Lucien Daniel**: The hybrids of the annual sunflower grafted on the Jerusalem artichoke. Grafting, in certain cases, is a factor capable of producing new variations.—**M. Ghermanesco**: The n-metaharmonic functions.—**Walter Saxer**: Families of meromorph functions of several variables.—**Henri Poncin**: The movement of a fluid round a cavitation.—**H. Mémery**: Some remarks on the duration of the solar period.—**L. Goldstein**: The intensity distribution in the continuous bands of the spectrum of hydrogen.—**W. Swietoslawski**: A new boiling-point method for studying ternary heteroazeotropes.—**E. Carrière** and **Janssens**: The determination of fluorine as calcium fluoride. Reply to a criticism of P. Maugnaud. Experiments on the magnitude of the possible error in the results caused by the co-precipitation of calcium carbonate with the calcium fluoride. It is shown that the error due to this cause is negligible.—**Georges Bohn** and **Mme. Anna Drzewina**: The influence of metallic silver on the calcification of the larvæ of the sea-urchin. If into water containing young sea-urchin gastrulæ a very thin sheet of silver is inserted for a time less than one minute, the pluteus has no skeleton and the calcification is prevented as long as the water remains unchanged. But if a trace of amino-acid is added along with the silver, the calcification proceeds normally.—**Paul Wintrebert**: The contractility of embryo cells, producing shape, a necessary factor in development, in amphibians.

ROME.

Royal National Academy of the Lincei, April 26.—**S. Pincherle**: A special linear operator.—**F. Conforto**: Mathematical formalism in a continuous functional space ruled by a linear element of the second species.—**R. Caccioppoli**: A method of summation in the calculation of infinite matrices.—**M. Villa**: The singularity of the Jacobian of $(r+1)$ hyper-surfaces of space of r dimensions.—**N. Cioranescu**: The summation of trigonometric series.—**P. Mentré**: The differential forms of a complex of straight lines.—**A. de Mira Fernandes**: Concurrent directions.—**Luca Teodoriu**: The zeros of the derivatives of a holomorph function.—**D. Bonvicini**: Certain fundamental theorems of electrodynamics and of the statics of elastic solids (2). Thermodynamical theorems corresponding with Castigliano's theorem, with Volterra's theorem of reciprocity, and with Colonnetti's second principle of reciprocity are enunciated.—**G. Valle**: Experimental investigations on the flash discharge. In experiments on the passage of electricity through rarefied gases, the course of the static characteristics in the various types of stationary régime of the flash discharge and the maximum value reached by the current intensity at the beginning of the discharge have been investigated.—**B. Rossi**: Absorption and diffusion of the penetrating corpuscular radiation in lead and iron. This radiation is diminished in intensity by $23{\cdot}2 \pm 1{\cdot}6$ per cent on passage through a screen of lead 9 cm. in thickness, and by $21{\cdot}7 \pm 1{\cdot}6$ per cent by a screen of iron 11 cm. thick, which contains an equal number of electrons per square centimetre. Diffusion is found to be of secondary importance and incapable of affecting appreciably the form of the absorption curve. Both the above values are distinctly lower than those obtained by Steinke (1930), the former being in good agreement with the value, 24·6 per cent, given by Bothe and Kolhörster (1929) for the absorption by a layer of gold 4·1 cm. thick.—**Algeri Marino**: Conditions of equilibrium in a Wheatstone bridge for measuring audio and radio frequency.—**L. Sanzo** and **F. Pirrone**: Irradiation of sea water by ultra-violet rays and its action on the velocity of alcoholic fermentation of glucose solutions. Further experiments show that the irradiated sea water activates alcoholic fermentation only if the period during which the water is exposed to the rays does not exceed a certain value, this being three hours under the conditions employed. The activity is due partly to the sea water considered as a solution of certain salts in certain proportions, and partly to an undetermined factor, which loses its effect if the sea water is either boiled for twenty minutes or evaporated to dryness and made up to the original volume with sterile distilled water.—**S. Sorrentino**: Mount La Queglia in Abruzzo. The geological formation of this mountain is described.—**V. Rivera**: Factors exciting increase of vegetal neoplasms by *B. tumefaciens*. In the experiments described, pelargoniums inoculated with the bacterium were completely encased in either hermetically sealed leaden sheaths or wooden sheaths lined with black paper. The plants enclosed in wood developed slight neoplastic formations at the zone of inoculation, whereas those in lead developed such formations to a greatly enhanced extent and formed also a number of aerial roots with positively geotropic development. The difference in behaviour in the two cases is ascribed mainly to the different humidity of the air. The phenomena are influenced also by the absence of light and by the ionisation of the air.—**R. Perotti**: Mycobacteriosis.—**C. Gaureschi**: The otocysts of urodele amphibia form a mosaic system (experimental demonstration).

SYDNEY.

Royal Society of New South Wales, Aug. 5.—**R. T. Baker**: On a fossil timber from the Sydney Harbour Colliery. The fossil was 20 ft. long and was taken from a depth of 2225 feet. The anatomical structure was very well preserved, which enabled it to be placed systematically as a conifer, resembling the genus *Callitris*. Its greatest affinity was with *Antarcticonyton Priestleyi*, Seward, found by the second Scott expedition, and so was named *A. Raei*. Calcium carbonate was thickly deposited on the cold-weather side of the tree, and also in numerous channels throughout the wood structure.—**W. R. Browne**: Notes on bathyliths and some of their implications. The division into synchronous and subsequent bathyliths is emphasised, the main contrasting characters of the two types are enumerated, and examples from Australia are described. The underground extensions and the probable shapes of bathyliths are discussed, and explanations are suggested for the association of synchronous bathyliths with strongly-folded and with subsequent moderately folded strata. Some stratigraphical and palæogeographical implications of bathyliths are pointed out. Since it was injected in connexion with the collapse of a geosyncline, the

existence of an outcropping bathylith of determinable geological age implies the former existence, above and around it, of sediments belonging to a certain geological period. The use of this principle is exemplified in its application to a few Australian palæogeographical problems.

Official Publications Received.

BRITISH.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1355 (Ae 486—T. 2606, T. 3011): Experiments on Models of a Compressed Air Wind Tunnel. Compiled by Dr. R. Jones and A. H. Bell. Pp. 22+14 plates. 1s. 3d. net. No. 1372 (Ae. 499—T. 3096): Ventilation of 24-ft. Wind Tunnel. By B. Lockspeiser. Pp. 10+4 plates. 9d. net. No. 1394 (Ae. 515—T. 3078): A Study of Slots, Rings and Jet Control of the Boundary Layer. By H. C. H. Townend. Pp. 31+16 plates. 1s. 9d. net. No. 1395 (Ae. 516—T. 3038 and 'a'): Interference of a Streamline Nacelle on a Monoplane Wing. By E. Ower and C. T. Hutton. Pp. 17+7 plates. 1s. net. (London: H.M. Stationery Office.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 47: Radio Research Board, Report No. 1. 1: Corrections to Field Strength Measurements with Loop Antennae, by W. G. Baker and O. O. Pulley; 2: A Radio Field Strength Survey within 100 Miles of Sydney, by W. G. Baker and O. O. Pulley. Pp. 32. Bulletin No. 48: The Experimental Error of the Yield from Small Plots of 'Natural' Pasture. By Dr. J. Griffiths Davies. Pp. 22. Bulletin No. 49: Factors affecting the Mineral Content of Pastures, with Particular Reference to the Environmental Conditions incidental to Southern Australia. By Dr. A. E. V. Richardson, H. C. Trumble and R. E. Shapter. Pp. 47. Pamphlet No. 19: Black Disease; a Short Description of its Nature and Means of Prevention. By A. W. Turner. Pp. 12. (Melbourne: H. J. Green.)

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 2: Studies on the Inheritance of Corolla Colour and Petal Size in Asiatic Cottons. By J. B. Hutchinson. Pp. 29+1 plate. (London: Empire Cotton Growing Corporation.) 2s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 10: Report of the Irish Radium Committee for the Year 1930; including Reports by Oliver Chance, Andrew Charles, John A. Gerachty, P. MacCarvill, Oswald J. Murphy, C. Conor O'Malley. Pp. 99-117. 1s. Vol. 20 (N.S.), No. 11: On a Method of Distinguishing the Seedlings of Swedish Turnip (*Brassica napus* L. var. *Napobrassica* (L.) Reichb.) from those of Rape (*Brassica napus* L. var. *Biennis* (Schübl. et Mart.) Reichb.). By M. J. Gorman and H. A. Lafferty. Pp. 119-124+1 plate. 1s. Vol. 20 (N.S.), No. 12: The Influence of the Work of Sir William Rowan Hamilton on Modern Mathematical Thought. By Prof. A. W. Conway. Pp. 125-128. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

The Changing World: a Broadcast Symposium. 1: Industry and Trade. By Prof. Henry Clay. Pp. 48. 4d. 2: The New Spirit in Literature. By Harold Nicolson. Pp. 40. 4d. 3: Science in Perspective. By Prof. H. Levy. Pp. 48. 4d. 4: The Modern State. By John A. Hobson. Pp. 44. 4d. 5: Learning to Live. By John Macmurray. Pp. 48. 4d. (London: British Broadcasting Corporation.)

FOREIGN.

Journal of the Federated Malay States Museums. Vol. 15, Part 2, August. Pp. 43-78+plates 9-21. (Kuala Lumpur.)

Federated Malay States. Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1930. By Dr. H. A. Tempany. Pp. ii+31. (Kuala Lumpur.)

Japanese Journal of Botany. Transactions and Abstracts, Vol. 5, No. 4. Pp. v+371-456+89-119. (Tokyo: National Research Council of Japan.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 1: Mathematics. Vol. 1, No. 2, August. Pp. 47-155+267-273. (Sapporo.)

U.S. Department of Agriculture. Technical Bulletin No. 255: Life History of the Codling Moth in the Rogue River Valley of Oregon. By M. A. Yothers and E. R. Van Leeuwen. Pp. 35. (Washington, D.C.: Government Printing Office.) 10 cents.

Det Kgl. Danske Videnskabernes Selskab: Mathematisk-fysiske Meddelelser. Bind 11, Nr. 2: Manomètre à contact optique et son emploi pour la détermination du triple point de l'eau. Par K. Prytz. Pp. 46. (København: Andr. Fred. Høst et fils.) 2.00 kr.

Svenska Hydrografisk-Biologiska Kommissionens Skrifter. Ny serie, Hydrografi 10: Svenska Strömmätningar i Kattegatt 1930. Av T. Gustafson och B. Otterstedt. Pp. 43. (Göteborg: Wald. Zachrissons Boktryckeri A.-B.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 32, Part 1: Studies on the Japanese Saprolegniaceae. By Masaji Nagai. Pp. 43+7 plates. (Tokyo: Maruzen Co., Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 316-324: Über die Polymerisierung der Methylester höherer ungesättigter Fettsauren, 8: Polymerisation der Methylester der Linolen- und Linolsäure, von Kiichiro Kino; Über die Polymerisierung der Methylester höherer ungesättigter Fettsauren, 9: Hydrierung der angenommenen intrapolymerisierten Methylester, von Kiichiro Kino; Zur Kenntnis der Ligninbildung ion Pflanzenkörper bei der Verholzung, von Keiiti Sisido; On the Stress Distribution of an Angle Plate, by Zirô Tuzi; On the Prevention of Explosion Danger in Oil Tanker—Optical Analysis of very weak Mixture of Petroleum Vapour, by Zirô Tuzi and Oosi Kadita; On Cracks and Fissures, their Physical Natures and Significance, by Torahiko Terada; Experimental Studies on Form and Growth of Cracks in Glass Plate, by Morisô Hirata; On the Micro Method for Determination of Nitro Groups in Aromatic Compounds (Abridgment), by Suttekiti Maruyama; On the Mechanism of Mutarotation of *d*-Methylen-Camphor of the Primary Amine (Abridgment), by Taro Hayashi. Pp. 127-203. (Tôkyô: Iwanami Shoten.) 1.00 yen.

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1930. By William Henry Fox. Pp. 78+5 plates. (Brooklyn, N.Y.)

The Rockefeller Institute for Medical Research. History, Organization, Present Scope of the Scientific Work, Buildings and Equipment, Publications. Pp. 36+2 plates. (New York City.)

CATALOGUES.

The Best Books on Nature Study. (Foyle's Guides to Literature.) Pp. 40. (London: W. and G. Foyle, Ltd.)

Botany, Gardening, Herbals, etc. (No. 191.) Pp. 44. Conchology, Entomology, Geology, Ornithology, Zoology (Vertebrate and Invertebrate). (No. 192.) Pp. 12. (London: Dulau and Co., Ltd.)

W. Junk. 1: Verlag, Publications, Livres de fonds; 2: Antiquariat, Second-hand Books, Livres d'occasion. Pp. ii+142+vi+143-296+8 Tafeln. Berlin: W. Junk.)

Diary of Societies.

FRIDAY, NOVEMBER 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—N. Patterson: The Training of an Oto-laryngologist (Presidential Address).—E. W. Williams: Treatment of Suppurative Meningitis.—Dr. D. McKenzie: Some Graphs Illustrating Otosclerosis.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Sir Arthur Eddington: The Expanding Universe (Presidential Address).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Pathology of Hydrocephaly.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Ll. B. Atkinson: The Mechanical Aspects of Electricity (Thomas Hawksley Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Sections of Society of Dyers and Colourists, Institute of Chemistry, and Chemical Section of Manchester Literary and Philosophical Society) (at College of Technology, Manchester), at 7.—Prof. H. Mark: The Significance of the New Cellulose Models (Molecular Structure) for the Technical and Dyeing Properties of the Fibre.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—F. C. Knowles: Inaugural Address.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Prof. G. T. Morgan: Chemistry of Low-Temperature Tars (Jubilee Memorial Lecture).

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Institute of Chemistry) (at Thomas' Cafe, Swansea), at 7.30.—Dr. Sladden: Chemistry in the Service of the Doctor.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. P. Quarrell: The Cooling of the Crude Oil Engine.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Royal Institution, Liverpool), at 7.30.—N. Heaton: Modern Developments of Inorganic Pigments.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. H. W. Featherstone, J. D. Morgan, and others: Discussion on Anæsthesia for Diathermy and Endoscopy.

SATURDAY, NOVEMBER 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. E. Yerbury: Present-Day Architecture on the Continent (1): Modern Buildings in Holland.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—W. B. Gourlay: Plant and Animal Collecting in Chili (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London) (Informal Meeting), at 6.45.—Debate on: That a College Education is Desirable in the Training of a Mechanical Engineer.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—J. Lang: Chairman's Address.

MONDAY, NOVEMBER 9.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Brig. H. L. L. Winterbotham: The Small-scale Maps of the Ordnance Survey.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—R. Davies-Colley: Demonstration on The Border-line Tumours of Bone.

INSTITUTE OF TRANSPORT (Annual General Meeting) (at Institution of Electrical Engineers), at 5.30.—J. Paterson: The Influence of Transport on Regional Planning.

ROYAL AERONAUTICAL SOCIETY (at Film House, Wardour Street, W.1), at 6.30.—Capt. W. J. McDonough: Aeroplanes as an Aid to Mineral Exploration and the Operation of Aircraft in Sub-zero Temperatures.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. F. Shipley and others: Discussion on Lightning Protection, especially in Tropical Countries.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—R. Grierson: The Electrical Heating of Buildings.

CERAMIC SOCIETY (Pottery Section) (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—T. Sheppard: Roman Pottery Kilns at Throlum.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—W. L. Govier: Experiences with Some Electric Furnaces for Melting Copper and Copper Alloys.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School, Cambridge), at 8.45.—J. Gray: Animal Movements (illustrated by Cinematograph Films).

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Technical College, Gloucester).—E. W. Dickinson and H. W. Grimmitt: The Design of a Distribution System in a Rural Area.

TUESDAY, NOVEMBER 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. G. I. Finch: The Combustion of Gases in Electric Discharges (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—I. A. J. Duff: The Dilution Theory of Detonation.
INSTITUTE OF MARINE ENGINEERS, at 6.—J. L. Adam: Effects of Propelling Machinery on Hull Structures.
INSTITUTE OF METALS (Swansea Local Section) (at Y.M.C.A., Swansea), at 6.15.—Prof. D. Hanson: Some Causes of Unsoundness in Non-Ferrous Alloys.
TEXTILE INSTITUTE (London Section) (at Clothworkers' Hall), at 6.30.—Dr. J. B. Speakman: Recent Developments in the Study of Wool Finishing Processes.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—R. Grierson: The Electrical Heating of Buildings.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—R. M. Charley: Recent Progress in Large Transformers.—W. E. M. Ayres: The Application of the Induction Voltage Regulator.
INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—Dr. A. F. Burstall: Electric Welding.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section—London and District Branch) (at Borough Polytechnic), at 7.—T. G. Noble: Notes on Ventilation.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section—Manchester and District Branch) (at Engineers' Club, Manchester), at 7.—W. P. Ollett: A Summary of Modern Heating Systems.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—E. W. Dickinson and H. W. Grimmitt: The Design of a Distribution System in a Rural Area.
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—B. G. Robbins: The Training of Young Automobile Engineers.
INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—A. H. Mundey: Die-Casting.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Dr. Isabella Gordon: Reversal of Sex in Crustacea.
INSTITUTION OF WELDING ENGINEERS (North-Western Branch) (at College of Technology, Manchester), at 7.30.—A. Y. Stirrat: Carbon Arc Welding.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. Bernard Hart: Psychology and Psychiatry (Presidential Address).
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Sir William Willcox: The Practical Relationship of Bacteriology to Pharmacy and its Influence on the Curriculum.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—C. W. M. Hart: Grave Posts of Melville Island.
ROYAL PHOTOGRAPHIC SOCIETY.—Dr. D. A. Spencer: Modern Developments in Colour Photography.

WEDNESDAY, NOVEMBER 11.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.—W. S. Perrin: Some Landmarks in the History of Rectal Surgery (Presidential Address).
INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—Dr. G. H. Gulliver: Mechanical Testing of Materials.
INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—R. M. Charley: Recent Progress in Large Transformers.

THURSDAY, NOVEMBER 12.

ROYAL SOCIETY, at 4.30.—*Papers to be probably read*:—Prof. A. Fowler and Dr. J. S. Badami: Spectrum of the Hydrogen-Nitrous Oxide Flame.—S. H. Bastow and F. P. Bowden: On the Contact of Smooth Surfaces.—W. B. Mann and B. G. Dickins: The Thermal Conductivities of Saturated Hydrocarbons in the Gaseous State.—*Papers to be read in title only*:—L. C. Bailey: The Thermal Conductivities of Certain Approximately Pure Metals and Alloys at High Temperatures.—W. A. Macky: Some Investigations on the Deformation and Breaking of Water Drops in Strong Electric Fields.—M. L. Smith and B. Topley: The Experimental Study of the Rate of Dissociation of Salt Hydrates.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. S. Chapman: Tides in the Atmosphere (Presidential Address).
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss Thyra Smith: The Psychology of the Junior School Child.
INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—W. A. Benton and others: Discussion on Mechanical Testing.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Lord Trent: Chairman's Address.
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—J. E. Luckhurst: The Receiving Station at Cupar for Transatlantic Telephony.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—S. Burns: Electric Grid Change-over.
OIL AND COLOUR CHEMISTS' ASSOCIATION (London Section) (at 30 Russell Square, W.C.1), at 7.30.—R. G. Daniels: Paint Industry in the Future.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.
INSTITUTE OF METALS (London Local Section) (at Royal School of Mines), at 8.—Dr. W. J. P. Rohn: Some Recent Advances in Rolling Plant.

FRIDAY, NOVEMBER 13.

BIOCHEMICAL SOCIETY (at Imperial College of Science and Technology), at 3.—T. Moore: High Potency Vitamin A Concentrates.—S. H. Piper: X-Ray Analysis of Certain Long Chain Paraffins, Ketones, and Alcohols.—A. C. Chibnall: The Metabolism of Plant Waxes.—G. H. Bell and A. R. Craig Paterson: A Chart for *p*H Calculations.—J. A. B. Smith: The Glyceride Fatty Acids of Certain Forage Grasses.—C. R. Harington and S. S. Randall: Synthesis and Properties of *i*-β-Hydroxyglutamic Acid.—W. L. Davies: The Inactivation of Lipase in Dairy Products by Traces of Heavy Metal Salts.—J. Pryde and R. T. Williams: The Structure of Borneol Glucuronic Acid Synthesised *in vivo*.—T. S. G. Jones and E. T. Waters: A Note on the Sugar of the Nucleic Acid of *Bacillus Tuberculosis*.—H. J. Phelps: The Influence of Hydrogen-ion Concentration on the Response of Tissues to Histamine.—P. V. McKie: The Nitrogen Metabolism of the Lupin Seedling.—A. C. Chibnall and R. G. Westall: The Estimation of Glutamine in the Presence of Asparagine.—J. M. Gulland and W. H. Newton: Observations on the Purification of the Oxytocic Principle of the Posterior Lobe of the Pituitary Gland.—*Demonstrations*:—S. H. Piper and A. C. Chibnall: Apparatus for Distillation in High Vacuo of Substances with a High Melting Point.—G. H. Bell and A. R. Craig Paterson: A Chart for *p*H Calculations.
ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Lt.-Col. M. L. Ferrar: The New Penal System in the Andamans.
MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—J. W. Hobson: The Care and Maintenance of the Industrial Steam Locomotive.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—W. A. Bishop: Short Wave Transmission.
INSTITUTION OF WELDING ENGINEERS (at Chamber of Commerce, Birmingham), at 7.—E. W. Thompson and A. Jeavons: Some Details of the Progress reached in Forge and other Welding in Boiler Works Practice.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.
INSTITUTE OF METALS (Sheffield Local Section) (at University, Sheffield), at 7.30.—E. A. Smith: Engineering Silver Solders.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—D. McDonald: Platinum.

SATURDAY, NOVEMBER 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. E. Yerbury: Present-Day Architecture on the Continent; Modern Buildings in Scandinavia.

PUBLIC LECTURES.

SATURDAY, NOVEMBER 7.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—A. W. Siddons: The First Two Years of Geometry in a Secondary or Preparatory School.
HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Age of Dr. Johnson.

TUESDAY, NOVEMBER 10.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15.—Dr. Harriette Chick: Vitamins and Disease. (Succeeding Lecture on Nov. 17.)

WEDNESDAY, NOVEMBER 11.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. Winifred Cullis: The Health of the Woman Citizen.

THURSDAY, NOVEMBER 12.

SCIENCE MUSEUM, SOUTH KENSINGTON (in connexion with Exhibition of Modern Glasses), at 4.45.—R. F. Taylor: Sheet and Plate Glass.

FRIDAY, NOVEMBER 13.

KING'S COLLEGE, LONDON, at 5.30.—J. Benda: L'exploitation de la Science par la Littérature au 19e Siècle.
BEDSON CLUB (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—Prof. J. Read: Some Researches on Essential Oils.
CHADWICK TRUST LECTURE (at Gateshead).—Sir Robert Philip: The Outlook on Tuberculosis—Now and Then.

SATURDAY, NOVEMBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Nature at Home.

DISCUSSION.

THURSDAY, NOVEMBER 12.

FARADAY SOCIETY (at Chemical Society), at 8.—Discussion on the following papers by Dr. E. W. J. Mardles:—
(*a*) The Oxidation in Air of (*a*) Carbon Disulphide, and (*b*) Carbon Monoxide.
(*b*) The Oxidation of (*a*) Hydrogen, (*b*) Methane, and (*c*) Coal Gas in Air.
(*c*) Comparative Study of the Vapour Phase Oxidation in Air of (*a*) Ethane and Ethylene, (*b*) Pentanes and Amylenes, (*c*) Ethyl Alcohol and Amyl Alcohol, (*d*) Acetaldehyde and Valeraldehyde.
(*d*) The Oxidation of Fuel Vapours in Air: Experiments with (*a*) Aromatic Hydrocarbons, (*b*) Cyclohexane, and (*c*) Cyclohexene.
(*e*) The Oxidation of Acetylene in Air.

CONGRESS.

NOVEMBER 7 to 11.

ALLGEMEINE MITGLIEDERVERSAMMLUNG DER AEROARCTIC (at Berlin).
Saturday, Nov. 7.—Prof. Weickmann: Die Wetterlage vor und während der Forschungsfahrt des "Graf Zeppelin" und ihr Einfluss auf den Kurs der Expedition.
Prof. R. Samoilowitsch: Die geographischen Beobachtungsergebnisse.
Dr. Ljungdahl: Die erdmagnetische Ausrüstung und die Beobachtungsergebnisse.
Lt. Comdr. Smith u. Dr. Kohl-Larsen: Über die Eisbeobachtungen.
Prof. Moltschanoff und Prof. Weickmann: Die aerologischen Instrumente und Beobachtungsergebnisse.
Sunday, Nov. 8.—Prof. v. Gruber und Dr. Aschenbrenner: Über die photogrammetrische Ausrüstung, die Arbeits- und die Auswertungsmethoden des auf der Expedition gewonnenen photogrammetischen Beobachtungsmaterials.