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CONTENTS.

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Research and Industrial Revival.

AMONG the duties charged on the Advisory Council for Scientific and Industrial Research is that of advising on steps to be taken for the advancement of trade and industry by means of scientific research. It was therefore inevitable that in a year of such persistent industrial depression and unemployment, the Advisory Council should be concerned with means by which science could assist in larger measure the restoration of our industries to full health. While the diagnosis of our present difficulties lies outside its scope, the latest report of the Advisory Council (Cmd. 3789) does not hesitate to assert that the increased use of scientific knowledge and scientific methods by our competitors abroad has been an important factor in the loss of our pre-eminent industrial position.

No spectacular results characterise this report, and their absence tends rather to emphasise the immense and far-reaching contribution which the work of the Department of Scientific and Industrial Research is quietly making in every section of our industrial and national life. While, however, there are many industries which have come to realise that our industrial position cannot be recovered unless our natural advantages are exploited to the full and all agencies available are employed for increasing our efficiency, the report affords no warrant for an easy optimism that the importance of research has been generally or even adequately appreciated either in industry or in the State.

It is not merely that there are still many firms which are prone to reduce expenditure on research at the first signs of financial stringency and to forget that it is in times of slack trade that research for future developments is of most importance. The case of the William Froude National Tank provides a pertinent example of the danger of this attitude. As is stated in the report of the Advisory Council, owing to the increasing demands of testing work it had become almost impossible to continue research work in the William Froude Tank constructed at the National Physical Laboratory in 1909–10 through the generosity of Sir Alfred Yarrow. The Council accordingly had recommended that a second tank should be erected for research in connexion with ship resistance and propulsion, and for tests on ship forms, propellers, etc., half the cost of which, up to £10,000, should be borne by the Department.

While the depressed condition of the shipping and shipbuilding industries may be the cause of the unsatisfactory response to this offer, it cannot

be regarded as an explanation. In consequence of the congestion of work in the existing tank, not only was research being hindered, but also orders for testing were accumulating to such an extent that they were frequently withdrawn and sent to the Continent, where in recent years similar facilities have greatly increased. It is obvious that if the testing of ship designs is better carried out abroad, orders for construction are likely to follow them abroad. By its failure to respond to this offer, the shipping industry clearly was committing suicide, and had not the Advisory Council, in view of the vital importance of this industry to the nation, revised its recommendation and suggested that the whole capital cost of a new tank should be provided initially by the State, the depression in the shipping and shipbuilding industries must inevitably have increased to a point from which any recovery in competition with Continental rivals would have been impossible.

The shipping and shipbuilding industries can only be conducted with economy and efficiency if scientific knowledge is applied adequately and at the right time. The demand for tests indicates that this is partly realised by the industry, but the rather discreditable episode demonstrates that the scientific outlook does not exercise a decisive influence on the direction of the industry. In fact, the industry betrays a tendency to depend upon the State for assistance that should rightly be provided by its own efforts; the debilitating influence of such aid upon individual *moral* has been the most unfortunate result of much otherwise valuable legislation in social reform.

Praiseworthy as have been the efforts of the research associations and valuable the results already achieved, the Advisory Council records that here again its chief anxiety is as to the financial stability of these associations. This opinion is noted in spite of conclusive demonstration that the greater application of science to industry through such associations is one of the most important factors in industrial recovery. While the Advisory Council looks to a time when research associations will be able to dispense altogether with financial assistance from the taxpayer, it is pointed out that the taxpayer benefits directly from such industrial research, which is gradually raising the standard of living.

The problem, indeed, is not entirely one of financial support, for some research associations are at the moment actively seeking not so much to achieve further results as to secure the utilisation of those already obtained by the industries they serve. To further this, development sections have been organised by a number of research associations, and the Advisory Council recommends that adequate provision should be made for the maintenance and extension of such work. It is, of course, the closer contact between the management of research and production inherent in the organisation of research departments by large industrial firms which gives such departments a decided advantage over the research association. The latter is essentially designed for the benefit of those firms unable to bear the full cost of such a research organisation and the cost of investigating fundamental principles, and the success of the research association largely depends upon the willingness of the members of the association to co-operate in the submission of both information and problems as well as in the utilisation of results.

The evidence indicates that a disconcerting lack of appreciation of the fundamental importance of scientific research and even of the value of co-operation still pervades important sections of our basic industries. Under modern conditions, the idea of trade secrecy still cherished by a few of our industries has lost its value, and trade secrets are never long hidden from the scientific investigator. Development now depends on co-operation and the prompt application of accurate knowledge, and until these habits of co-operation and research have been acquired by such industries, their recovery inevitably lags and the position of the research associations remains precarious.

Not the least serious effect of such unstability is that exerted upon the recruitment of the scientific staff. It is of the utmost importance to our industrial future that men of proved scientific ability should be recruited and retained for industrial research of this type. This cannot be secured if the financial position of the research workers is not reasonably assured; nor indeed can we expect the most efficient work if their minds are disturbed by serious financial uncertainty. The Advisory Council strongly urges the support of superannuation under the Federated Superannuation Scheme of the Universities, which allows a man to contribute for the future irrespective of his continued employment at a particular institution.

On the more effective organisation of support for research associations generally, the advantages of a compulsory levy are indicated; and the Advisory Council urges the consideration of such methods by the research associations, and

expresses the hope that if statutory authority is necessary, Parliament will place industries in a position to provide the necessary funds when a sufficiently large majority of the firms in any industry express their desire for the imposition of such a levy. Before, however, any such levies could be arranged, it would appear that a very much wider education of the industries concerned on the importance of scientific research and its relation to industrial development is required. The growth of co-operation appears to be hindered by the same forces which have delayed the much-needed rationalisation and reconstruction of some of our basic industries, and here again their removal is largely dependent on education. The report of the Department of Scientific and Industrial Research provides invaluable material for such an educational campaign, and at the present time should be used to the utmost by all who are concerned not merely with the restoration but also with the expansion of our industries.

Radio Principles and Practice.

(1) *Elements of Radio Communication.* By Prof. John H. Morecroft. Pp. x+269. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 15*s.* net.

(2) *Radio Telegraphy and Telephony: a Complete Textbook for Students of Wireless Communication.* By Rudolph L. Duncan and Charles E. Drew. Pp. x+950. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 37*s.* 6*d.* net.

(3) *Radio Traffic Manual and Operating Regulations.* By Rudolph L. Duncan and Charles E. Drew. Pp. ix+187. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 10*s.* net.

(4) *Radio Data Charts: a Series of Abacs providing most of the Essential Data required in Receiver Design.* By Dr. R. T. Beatty. Pp. 82. (London: Iliffe and Sons, Ltd., 1930.) 4*s.* 6*d.* net.

THE professional worker in radio telegraphy is sorely embarrassed by the natural and simple request so often addressed to him by his non-specialist friends, "Tell me what book on wireless I ought to read, so that I may have an intelligent appreciation of what is happening in and behind my broadcast receiver". He is unable conscientiously to prescribe any single book that will tell the whole story, reasonably fully, in due proportion, and in a language suited to the reader with a general education. A general education must not be assumed to include advanced physics, mathematics, electrical engineering, meteorology, solar physics, and the like. He may feel that he would like to write such a book: it could be done now with some show of authority, of definiteness, and of simplicity; but he has his daily work to do, and so he turns hopefully to each new book list. The spate of deplorably inadequate popular expositions which was released by the advent of broadcasting is now happily abated; books, such as these before us, may be expected to contain an informed and balanced survey of the fields indicated in their titles. Is one of them the book for his listening friends? Or for himself?

(1) Those who know Prof. Morecroft's larger volume come to his newer book with a high standard already set. This "general review of those parts of the alternating current theory which are of fundamental importance in radio, followed by the specific application of these principles to radio telegraphy and telephony", comes near to being a very good book indeed. Its greatest merit is that it is never misleading. It omits some things that one would like to see discussed, but the matters selected for discussion are well proportioned, interestingly treated, and quantitatively estimated. Its greatest demerit is that the author's familiarity with the concepts of the art leads him to forget at intervals the standard which he assumes for his readers, so that while generally he gives detailed elementary discussions of fundamental phenomena, at times he confronts the student, devoid of "mathematical preparation more advanced than algebra", with unexplained novelties such as uniformly rotating vectors, lagging currents, hysteresis, mutual induction, microvolts per metre, envelopes, and so on. Its second fault is that undue compression leads to loss of clarity. One feels that a five per cent increase in bulk would give a twenty per cent increase in intelligibility and accuracy. For example, the statement that "the number of complete cycles of flow is called the frequency of the current" is inexcusably lax. Again, "coefficient of coupling" is introduced as a purely magnetic quantity, without any warning that capacitative couplings are of profound importance in every broadcast receiver.

The concluding part of the book describes typical apparatus, and is satisfactorily definite about numerical values. Ten pages of 'problems' at the end will be useful to the serious student. The book is delightfully produced and pleasing to handle. The block-maker might, however, in the next edition allow us to read the graduations on

the footrules set up beside pieces of apparatus to give the scale.

(2) The larger work by Messrs. Duncan and Drew, more ambitious in title, and apparently wider in scope, is much less satisfactory in execution. At the best it reaches a level of pedestrian usefulness to the operator of some specific commercial sets, and at the worst it comes dangerously near sheer nonsense. The over-all effect is extremely irritating. Four pages of instruction on the care of the motor generator do not make amend for this astonishing picture of a magnetic field:

"The lines along which the filings are arranged are known as 'lines of force'. . . . The lines of force leaving the north pole re-enter the magnet at the south pole, and are considered as having travelled through an infinite amount of space medium from the time they left the north pole until they re-enter the south pole. The lines of force which issue forth from a weak magnet supposedly extend as far distant as those from a strong magnet, but since, in the latter case, the lines of force are unable to get far away from each other, they are packed very closely together because they occupy the same space medium as the lesser number of lines which issue from the weaker magnet. A magnetic field of great density possesses great strength, and the strength of a magnet is dependent upon the closeness of the lines of force rather than the distance they extend."

Nor does the appearance of meticulous care in the prescription of No. 100 carborundum and oil for grinding quartz crystals offset the carelessness of the statement, on the same page, that "the oscillations . . . are produced at a very high frequency, proportional to the crystal's thickness".

The physicist will be startled by the statement, "A molecule, however, is composed of *atoms*, millions of them, about which *electrons* are presumed to revolve". The mathematician will be no less startled by "Fig. 59.—A logarithmic curve", which has a constant slope from the origin to abscissa 5 and zero slope from abscissa 12 onwards. Neither will be startled by the statement, ". . . a temperature of absolute zero. This, of course, is an extremely low temperature." . . .

The only way in which the authors might make a passably good book out of this volume would be to reduce it explicitly to be a book of detailed instruction in the use of named apparatus, and to avoid any attempt to explain principles.

(3) The scope of this paper-covered volume is thus defined in the authors' foreword: "Government and commercial traffic rules and regulations prescribe the manner in which radio communications shall be handled. These operating instructions are embraced in this volume, with other instruction, which should be followed as closely as actual conditions permit. A uniform procedure in moving radio messages should be the aim of professional radio operators." It comprises six chapters, dealing respectively with: Acquiring the code—Use of "Q" signals: Operating rules and regulations of the Radiomarine Corporation of America: International Radiotelegraph Convention: U.S. Radio Act of 1927: Ship Act of July 23, 1912: Regulations governing the issuance of radio operators' licences. While much of the text is, naturally, concerned with American conditions, the peculiarly international character of wireless communications makes this book of use to wireless operators of other countries.

(4) The modesty of price of this valuable work is equalled only by the modesty of its title. The avowed purpose of the book is to give the wireless designer a ready means of solving his problems without recourse to complicated formulæ and mathematics. But the student who is wise enough to forget that it is a handbook and to take it as a supplementary text-book will find that, in working through its thirty-nine abacs with the explanatory notes attached to each, he has acquired at once a familiarity with and a respect for the nomogram as a powerful aid to quantitative design in any field, and a sound knowledge of the principles of quantitative design in the field of wireless.

The general reader will probably be pleasantly surprised to find how completely the design of wireless receivers has been lifted out of the 'trial and error' state in which it remained for many years. The reader who does not require conversion to belief in the abac as a labour-saving device, will yet find food for admiration in the ingenuity which has been exercised to permit the use throughout the book of standard straight-line logarithmic scales, aided where necessary by ungraduated curves to which the ruler or other alignment indicator is made tangent in the setting. The publishers might well include, in the new edition which will certainly be called for, a transparent scale on thin celluloid, which is much more convenient for use than the opaque implement suggested by the instruction to use a 'ruler' for alignment.

The only faults which have been detected in this carefully arranged work are very minor ones. The numbering does not appear to be entirely systematic: there is an abac No. 18 and a No. 18*a*;

No. 19 has " stage 1 ", " stage 2 ", and " stage 3 ", represented by separate sheets; while Nos. 24*a* to 24*e* have no No. 24 associated with them. Perhaps more important is the misprint in No. 22, where the relative transmission, in the case chosen to illustrate the use of the abac for " Transmission of sidebands by a tuned circuit ", is stated to be 0·447 instead of 0·707.

The author and his publishers are to be congratulated on the production of a work representing amazingly good value for money.

To sum up, the book for the professional worker is certainly Dr. Beatty's, and the professional worker's inquiring friend will find it wholesome, if concentrated, meat. The friend will find Prof. Morecroft always interesting, never misleading, but sometimes incomprehensible; he will find Messrs. Duncan and Drew frequently misleading, and too speciously comprehensible to be safe.

Science in Literature.

H. G. Wells: a Sketch for a Portrait. By Geoffrey West. Pp. 316. (London: Gerald Howe, Ltd., 1930.) 10*s.* 6*d.* net.

IF the function of a biographer is to produce a living picture of his subject for his own and future generations, he will not have succeeded in his task unless he himself fades completely in word and in spirit from the pages of his biography. In providing us with this story of the struggles of a great man, Mr. Geoffrey West has done his work well, for as we turn over the pages of this volume and live through the intimate history of Mr. H. G. Wells, the authorship of the work itself drops completely from our ken. This is as it should be, and thus an excellent portrait has been produced.

Those of us who are now struggling through the lean and hungry forties and can look back on their early youth, twenty or more years ago, inspired as it then was by the glamour of the scientific romances and of the social philosophy of Mr. H. G. Wells, are not likely to forget the debt which they owe him. The rising generation of the 1900's, caught between a decaying Victorianism and a rebellious modernism, threw itself with energy into the fight for what it, in its early enthusiasm, called Progress. Manhood may mature the judgment, or temper the impatience of youth, but if the altered values of this post-War age in matters of convention and social outlook are at all to be associated with the activities of any group of men, eminent among that band must be the early Wells.

The story of the man is no tale of a silver spoon. Born and bred in respectable poverty and Victorian gentility, dogged by persistent ill-health, he staggered through many vicissitudes, from inefficient drapery assistant through overworked private school teacher, to the feet of Huxley at South Kensington. There early he saw a vision of science in the service of man, and he pursued it relentlessly. Material success came to him, but the vision remained a vision.

In a sense, one need not produce a biography to reveal the history of a writer. A craftsman proceeds straight from experience, and the writings of Wells reflect the structure of the man. A pioneer in scientific fiction, he quickly sensed the dramatic element in a field that had not so far been exploited at all, and so he insinuated into the minds of his readers the amazing possibilities of science. Throughout thirty years of strenuous writing, there runs this extraordinary thread of continuity in his work—the same theme—that the universal solvent of ignorance is scientific knowledge, scientifically applied: this, whether the problem be moral or pedagogic, social or industrial, national or international. To the young men who grew up in this hectic period of problem play and problem novel, he was at once a strength and a goad. As boys, we passed easily from the schoolboy " Dormitory Flag " stage, to Wells and the " Time Machine ", " War of the Worlds ", and " When the Sleeper Wakes ". A new universe stood revealed before us, a universe of science and imagination, a world of dizzy possibilities. It remained only to give direction to this awakened fervour, to set this torch to the ready sense of social and industrial injustice, in order to fire the reformist and inflame the revolutionary spirits of the younger generation. " Anticipations ", " Mankind in the Making ", " A Modern Utopia ", " This Misery of Boots ", " New Worlds for Old ", " First and Last Things ", came in hammering succession, and the younger men became violent propagandists, a nuisance to friends and foes alike.

As we look back on these easily impressionable years, it is amazing to recognise the uncanny gift of the man. He said the things we ached to say. His work may date, but it was ripe, just ripe, for its time. Wells has never claimed to be more than a journalist, but if so, his journalism was unique.

The middle period of Wells is a tale of adolescent struggles, of the scientific exposure of sex, and of a determination to accustom the mind of the reading public to think boldly and openly of the matter, as one would of any scientific problem. In this he fought not merely a narrow Victorian convention,

but also a taboo with its roots deep in man's early history. In the eyes of those who still have faith in the open discussion and scientific analysis of secret matters, to H. G. Wells must be given a great measure of credit for a great achievement.

Times have changed and we have moved fast since these days, but the indefatigable Wells has effected some amazing revolutions. He has multiplied the reading public many-fold; he has forced it to read history in fat volumes and to study biology in the nude. Beginning his career as an underling in a small private school, he has become the greatest public teacher now living.

It is not easy to judge his later activity. In an atmosphere of sullen suspicion and industrial chaos, an aftermath of five years of slaughter, he is still idealist enough to pin his faith to international co-operation, and yet realist enough to disavow political parties and the League of Nations. And now at this stage, still yet in his prime, he projects a work on scientific economics. The thread is still unbroken; the vision still beckons him on, but his young men are now mentally middle-aged and disillusioned. He has outlived them all; but the rising generation is equally disillusioned.

H. LEVY.

Movement of Solutes within the Plant.

Die Stoffbewegungen in der Pflanze. Von Prof. Dr. Ernst Münch. Pp. vii + 234. (Jena: Gustav Fischer, 1930.) 12 gold marks.

IN recent years, this subject has again been much in the forefront of discussion; English readers will recall particularly Dixon's onslaught upon the efficiency of the phloem for downward movement of organic solutes, and Curtis's staunch advocacy of the capacity of this tissue to take not only sugars but even nitrates in any direction, as also the series of papers by Mason and Maskell upon the movement of sugar (see NATURE, **123**, pp. 133-135) and nitrogen (see NATURE, **126**, pp. 973-974) in the cotton plant, which supply valuable data which must be taken into account in any future attempt to elucidate the mechanism of movement of solutes in the plant.

Unfortunately, Dr. Münch, whose monograph on this subject seems in some respects to break new ground, is unaware of these recent papers by Mason and Maskell; but his contribution is interesting and suggestive, in part perhaps because the point of view is rather that of forest botany than purely academic botany, and one main service his monograph performs is to bring again under notice an earlier valuable contribution which was published in a forestry journal.

Dr. Münch's main thesis is that the system moving water and solutes in the plant may be conceived as consisting of two main components, which may be represented schematically as in Fig. 1. On one hand is the lifeless, permeable woody system, full of water, and represented in this scheme by the vessel of water in which the semi-permeable cells *A* and *B* are immersed. *A* and *B* represent semi-permeable living cells, connected by a tube with porous, permeable plates at intervals, the sieve tube with sieve plates. In the plant, *A* and *B* represent living tissues, abutting on the xylem, connected by phloem. When *A* is at a higher osmotic pressure than *B*, water will be drawn into *A* and driven out of *B*, whilst

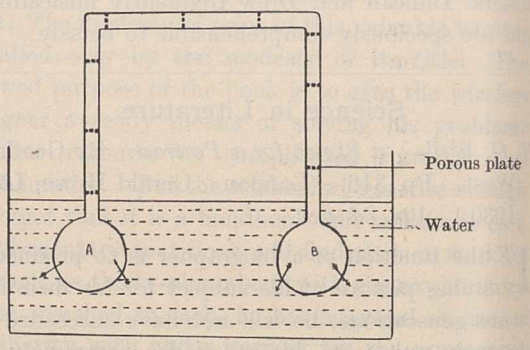

FIG. 1.

the contents of *A* will move along the connecting tube into *B*, so long as the concentration at *A* remains higher than in *B*. In this manner sap at a higher concentration is drawn along the sieve tubes towards regions of lower concentration; from assimilating leaves, for example, downwards to the growing cambium or upward into a growing fruit.

In this connexion, Münch recalls certain earlier experiments of T. Hartig and describes interesting observations of his own, which demonstrate that if an incision is made into the phloem of the tree in summer, especially just prior to leaf-fall, a definite exudation of sap occurs, sufficient quantities being obtained with patience to permit of some chemical analysis. As these drops of sap exude, the pressure in the sieve tube rapidly falls, especially below the cut, so that no more sap exudes from other cuts above and below for a certain distance, which is often much greater below than above. These experiments certainly demonstrate the existence of a positive pressure in the contents of the sieve tubes of the current year's growth; but for the system Münch postulates, the flow after

incision seems very slight, and certainly there is little evidence of the vigorous flow through the uncut sieve tubes, as a result of this osmotic, hydraulic mechanism, which the author seems to think is taking place.

The sugars moving downwards in the phloem have to reach this tissue from the assimilating cell of the leaf, and Dr. Münch tackles anew this great stumbling-block in translocation theories. How does sugar, so slow in penetrating the normal living cell, manage to move so quickly from the green assimilating cell of the leaf mesophyll into the veins and thus out of the leaf? Dr. Münch suggests that the sugar movement may be brought about by different osmotic pressures in adjacent cells, forcing the contents of one cell into the other along the protoplasmic connexions or plasmodesma. The sugar in this case is assumed to be in the plasma, not in the vacuole, and to be forced through from cell to cell, moving in the plasma of the plasmodesma strand. In the sieve tube, on the other hand, the vacuole is thought to be continuous through the larger pores in the sieve plate, and the sugar is thought of as moving with the water in the manner previously described.

These distinctly unusual conceptions of solute movement are accompanied by calculations, based largely upon the assimilation rate of trees, rate of increment of wood, etc., which involve so many assumptions that their value is doubtful, though it is admitted that numerical tests should be applied to our theoretical ideas as to the mechanism of transport at the earliest possible moment. But when the increment of wood in the season's growth is used as a basis upon which to calculate the amount of substance that has passed through the inner surface of the cambium by 'exosmosis', the reader may wonder whether the processes of growth and cell division, by which the original framework of these wood cells has been laid down, have not been too completely neglected.

Dr. Münch has probably done considerable service to botany by directing attention anew to these easily repeatable experiments, which demonstrate that the contents of the young sieve tubes are under pressure, and a pressure which apparently originates from above. A re-examination of the possible rôle of the fine plasmodesma strands in the movement of substance in mass is also certainly required, but his monograph will probably not convey to most readers the impression that these problems are solved and the physical mechanism of movement of substances in the phloem now placed beyond doubt.

Our Bookshelf.

Als Naturforscher in Indien. Von Prof. Dr. Hans Molisch. Pp. xii + 276. (Jena: Gustav Fischer, 1930.) 13 gold marks.

PROF. MOLISCH'S book is a record of a visit to India in the winter of 1928–29. The visit was the outcome of an invitation from Sir Jagadis Bose to the Austrian plant physiologist that he should make his home at the Bose Institute in Calcutta, and that whilst studying the methods and ideals of this establishment, he should give occasional lectures to the workers on matters in his own field, and also carry out any research he desired. During the course of the visit, Prof. Molisch had full opportunity of seeing India, observing the customs of its peoples, its flora and botanic gardens. His various experiences are set down in full, even with intimate detail, the result being rather heterogeneous. Nevertheless, the movement, beauty, and sunshine of India continually find their way into the pages of a book generally loosely knit and lacking in construction. The photographic illustrations (more than a hundred in number), which deal with all sorts of subjects, are a great feature; they are well selected and well reproduced, largely atoning for the author's lack of literary style. Like many travellers, Prof. Molisch finds it easier to take good landscapes, crowd pictures, and portrait studies of individuals than to produce good habit pictures of plants.

The author deals faithfully with his mission as expounder of the work and inspiring personality of Sir J. C. Bose, though he does not always accept the precise conclusions that have been drawn. Apart from these sketches of the activities of Bose, many chapters are devoted to the vegetation of India, especially from the biologist's point of view. There are sections on leaf-fall, the water hyacinth nuisance, mangroves, ants, and numerous physiological and biochemical matters, as well as on botanic and other gardens. In a sympathetic account of the Calcutta Botanic Gardens, an appeal for a laboratory, equipped for physiological work, is included. Other sections deal with social observances, education, hygiene, and the present-day ideals of India. Besides a visit to Darjeeling (where Bose has a hill-station), attractive accounts are given of some of the principal cities of India and the native State of Jaipur. As a whole, the book shows observation, a capacity for being pleased, and a point of view which differs considerably from that of the ordinary tourist.

F. W. O.

Die Tierwelt der Nord- und Ostsee. Begründet von G. Grimpe und E. Wagler. Herausgegeben von G. Grimpe. Lieferung 17. Teil 2.d_2: *Peridinea*, von Nicolaus Peters; Teil 3.d: *Scyphozoa*, von Thilo Krumbach. Pp. 13-84 + 88. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 13·50 gold marks.

DR. N. PETERS, who has done much work already on the peridinians or dinoflagellates, gives a good and detailed survey of the group. It is well known

that they combine holophytic with holozoic nutrition and therefore are claimed by both botanist and zoologist. Some apparently feed exclusively as plants, others as animals, but many feed in both ways. The larger naked forms engulf others of their kind, as well as diatoms and other small prey. The presence of a large eye with well-developed lens in some of these and nematocysts in *Polykrikos* and others give a special interest to these unarmoured forms. Here we find chain formation both in the naked and armoured species, and the beginning of a multicellular state in which individuals are permanently fused and the nuclei are fewer in number than the cells themselves. There are many species known from the North Sea and Baltic, but not so many as there are in the Channel, possibly because the region has not been worked so much for these creatures. All species are well figured and they are easy to identify. We note the absence of *Noctiluca*, which is treated separately in another part of this publication.

Dr. Krumbach in his account of the Scyphozoa (Part 3.d) shows that of the five orders three are represented here—the Lucernariida with four genera and five species, the Semæostomeæ with four genera and four species, and the Rhizostomeæ with one genus and one species. Structure, feeding, and reproduction are fully dealt with, and the author gives a very clear description of the various members of the Scyphozoa, which is well illustrated and up to date.

(1) *British Prime Ministers of the Nineteenth Century.* By Prof. F. J. C. Hearnshaw. (Benn's Sixpenny Library.) Pp. 80. (London: Ernest Benn, Ltd., 1930.) 6*d*.

(2) *Daily Life in Parliament.* By H. Snell. (Routledge Introductions to Modern Knowledge.) Pp. 74. (London: George Routledge and Sons, Ltd., 1930.) 6*d*. net.

(3) *Sinon: or The Future of Politics.* By E. A. Mowrer. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd., 1930.) 2*s*. 6*d*. net.

THESE books may suitably receive notice within one paragraph, being respectively concerned with political life of the past, the present, and the future. Dr. Hearnshaw deals succinctly, but engagingly, with the succession of premiers who guided the Empire's fortunes during a period commencing with Addington and concluding with Lord Salisbury, coincident with the closing of the Victorian era. Mr. Snell presents a description of the parliament of to-day, sufficiently realistic to be welcome. Mr. Mowrer's contribution is necessarily on less secure ground, as it deals in surmises, based, it is true, upon a logical progression from existing facts and tendencies towards a conceivable future. His remarks are cogent and well-balanced. "We cannot eliminate natural inequality", "Standardised minds are a relapse of the race into the tribe", "Under a rational system failure to vote would be penalised". The author's remarks upon Russia and Italy are worthy of close attention. Perhaps not unreasonably, he is somewhat pessimistic—"Not for nothing was Sinon reputed the son of that Sisyphus condemned to perpetual stone-(or was it log-) rolling", "What is history but one long series of reforms that have failed?" For the world as a whole, Mr. Mowrer foreshadows internationalism as the over-riding government of to-morrow. P. L. M.

Couleurs (étude physique) et colorimétrie: Conférence faite au Conservatoire National des Arts et Métiers le 7 mai 1930. Par Prof. P. Fleury. (Conférences d'actualités scientifiques et industrielles, 12.) Pp. 34. (Paris: Hermann et Cie, 1930.) 5 francs.

IN this lecture, the author points out the difficulties which the accurate specification of colour encounters owing to the physiological nature of the colour sensation. He explains how a colour may be specified by the wave-length of its dominant radiation, its luminous flux, and its coefficient of purity, or alternatively by the trichromatic method, which specifies the luminous flux of each of three standard wave-lengths, which together produce the colour sensation in question. When the sensitivity curves of each of the three sensory elements of the normal eye to light of different wave-lengths are known, one method of specification may be converted into the other. The author describes the principles on which modern colorimeters are constructed, and states that those based on the trichromatic system are the simplest and suffice for many purposes. He believes, however, that for accurate work a combination of a spectrophotometer and a colorimeter on the lines of the instruments of Nutting and of Priest is necessary. He hopes that a laboratory for the study of colorimetry will be established in France which will compare with those already at work in the United States, in Great Britain, and in Germany.

Simple Geological Structures: a Series of Notes and Map Exercises. By John I. Platt and John Challinor. Pp. 56. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1930.) 3*s*. 6*d*. net.

IN this little book, which is of an elementary character, beginners are introduced to the three-dimensional conception of geology, a knowledge of which is essential to progress in the science. The maps and sections figured, and the accompanying notes, are simple and straightforward. So far as they go, they serve their purpose admirably. A more extensive and varied use might, with advantage, have been made of the names of the major divisions of the geological succession. In this way the student would, incidentally, be assisted in acquiring familiarity with their correct order of superposition. In practice, geological maps are primarily constructed to show age-formational divisions rather than lithological bands.

The illustrations represent ideal cases, and users of the book would do well to realise, as indeed the authors suggest in their preface, that in Nature the facts are seldom either so simple or so obvious.

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.*]

Observations of a Low Altitude Aurora and Simultaneous Phenomena.

In the afternoon of Nov. 16, 1929, during my stay in Abisko in northern Sweden (N. lat. 68° 21′) I observed a rather intensive auroral ray of about 10° apparent length and about ½° apparent breadth in the west-south-west *below a completely cloudy sky*. The exact time of the first observation was 16h 18m G.M.T. After about one minute the ray disappeared, but later it appeared and disappeared several times during an interval of about ten minutes. The colour was reddish-yellow. No sound was heard.

The clouds, apparently situated behind the ray, were of stratiform alto-cumulus type and consisted of apparently thin and thick strata. The ray began in or in front of a thin stratum, crossed over a thick (more dark) stratum *without appearing less intense here*, and vanished in or in front of the next thin stratum. In the east, similar clouds covered almost completely the sky and *also the full moon*, which was visible only a few times between the clouds. Examining carefully the facts mentioned above in italics, I could not escape the conclusion that the auroral ray must be *below the clouds*, that is, at only a few thousand metres above the ground. On the other hand, it is well known that observations of low altitude auroræ are considered very doubtful and have not yet been confirmed photographically.

A few days later, Mr. Linus Eriksson, at Abisko, told me that he and some other railway employees in Abisko had observed the same auroral display about an hour earlier than I, and also noticed its appearance in front of the clouds. Also, two Norwegian engine-drivers on the railway between Abisko and Narvik in Norway had observed the same phenomenon. A report of our observations was sent to Prof. Carl Størmer in Oslo and to the Meteorologisk-Hydrografiska Anstalten in Stockholm. In his reply, Prof. Størmer very much regretted that the auroral ray had not been photographed from two places of observation, so that its parallax could have been obtained. A visual observation cannot contribute much more to the most important question if low altitude auroræ really exist than many other similar observations reported earlier. This observation of a low altitude aurora in Abisko on Nov. 16, 1929, has been printed in Swedish and French among my other auroral observations during the period September-December 1929 in "Observations météorologiques à Abisko en 1929", but as I did not wish to increase the number of doubtful observations, it has not been published more exhaustively elsewhere until now.

Reading the most interesting communication of Mr. G. C. Cummings in Nature of Jan. 17, 1931, p. 108, about a low altitude aurora observed by his brother in Norwood, Ontario, Canada, "early in the winter 1929–30", I inquired the exact time of Mr. Cummings's observation. G. C. Cummings, writing from the Bell Telephone Laboratories in New York, has kindly replied to me in a letter, from which I quote the following lines: "Having received a number of letters from various parts of the world in regard to this Auroral display, it seemed rather important to attempt to establish the exact time of the phenomenon. Accordingly, I communicated with my brother and pointed out the desirability of this proceeding and have just received his reply. . . . As nearly as he can establish it, the time was nine hours thirty minutes in the evening, Nov. 16, 1929, E.S.T. The phenomenon was observed by a number of people, among whom was a telegraph operator who remembered having delivered a certain telegram at the time he observed the Auroral display. Going back through the telegraph files, he located this telegram and was thereby enabled to fix the time within a few minutes. . . . I believe that at least two of the observations reported are almost identical to that witnessed by my brother."

9h 30m p.m. Nov. 16, E.S.T., is, however, 2h 30m a.m. Nov. 17, G.M.T., so that if Mr. Cummings observed the auroral display in the evening, it was about ten hours later than my observations in Abisko. If, on the other hand, Mr. Cummings's observation was made 9h 30m a.m. on Nov. 16, it was very near the time of the first observations of the auroral display in Abisko. Still, even if the observations have a difference of 10 hours in time, it is very remarkable that low altitude auroræ have been observed on the same day at places so widely distant, and these observations are worth attention and further investigation.

I have therefore also examined the magnetograms of the geophysical observatory at Abisko and my readings of the ionisation in a Kolhörster ionisation chamber,[1] with regard to the time, Nov. 16, 1929. Magnetic disturbance began with a pronounced *impetus* already on Nov. 15, 19h 0m G.M.T., and went on until midnight of Nov. 16. No very great disturbance occurred, however, before 14h 24m G.M.T. on Nov. 16. At this time the vertical intensity gradually decreased and showed a maximum negative disturbance of more than − 640 gamma at 15h 16m, when the record during a few minutes exceeded the limit of the magnetogram. At 15h 0m the declination made a deviation of 1° 57′ towards east, but turned immediately and made a deviation towards west, which at 15h 16m exceeded the limit of the magnetogram, that is, made an angle towards west larger than 1° 32′. Thus the total oscillation of *D* during 16 minutes was larger than 3½°. On the other hand, the horizontal intensity did not show any extraordinarily large oscillations. The extraordinarily large deviations in *Z* and *D* coincide in time approximately with the first observations of the low altitude aurora of the railway employees in Abisko. At 1h 50m a.m. Nov. 17, G.M.T., a small disturbance occurred, namely: − 58 gamma in *H*, 10′ east in *D*, and + 33 gamma in *Z*.

The following readings of the ionisation were made on Nov. 16, 1929, in Abisko. The values of *I*, or pairs of ions per c.c. and second, have been corrected for the 'barometer effect' and are valid for the mean air pressure, 720 mm. mercury, whereas those published in Fig. 1 on p. 57 of Nature of July 12, 1930, were valid for air pressure of 760 mm. mercury.

	G.M.T.	*I.*
Nov. 16	5h 34m– 7h 4m	2·56
,, ,,	7 4 – 9 3	2·68
,, ,,	9 3 –11 13	2·69
,, ,,	11 13 –13 23	2·72
,, ,,	13 36 –17 7	2·83
,, ,,	17 7 –20 19	2·74
,, ,,	20 19 –22 1	2·57
,, ,,	22 1 –23 46	2·58
,, 17	0 0 – 6 58	2·55

They show a maximum ionisation at the time of the observed auroral display, which is also in accordance with the result found from the observation in Abisko that there is an increase in the ionisation (measured at 388 metres above sea-level) during the auroræ and

mentioned in more detail in Lund Observatory Circular No. 1, 1931. Usually this increase is only 6 per cent.

It is very desirable that the other observations of the low altitude aurora on Nov. 16, 1929, mentioned by Mr. G. C. Cummings, should be published and that all observations should be compared.

AXEL CORLIN.

The Observatory, Lund, Mar. 12.

[1] Cf. NATURE, July 12, 1930, p. 57.

Measurement of the Electricity Liberated during the Downgrade Reactions of Organic Compounds.

THE liberation of electricity during certain reactions of organic compounds has been well established in previous investigations.* In the fermentation of cane sugar by yeast, it was shown that the amount of electricity liberated is proportional to the temperature and concentration of the sugar solution and to the number of active yeast cells, and is only liberated under conditions favourable to the growth of the yeast. It was also demonstrated that electricity is liberated during the action of diastase and invertase and during the decomposition of organic matter by bacteria. It is suggested that the apparatus employed might be termed a 'fermentation cell'.

The following briefly describes a method of measuring this electricity based upon the laws of the electro-deposition of metals. The apparatus (Fig. 1) consisted of a container *A* (porcelain vessel or wooden box) to hold the research material, in which was embedded a porous pot *B* containing a solution of copper sulphate, and an electrode *C*. A wire *D* firmly connected to *C* terminated in a hook *F*, from which a copper wire *E* was suspended in the solution in *B*. In order to localise any deposit of copper, the part of *E* immersed in the copper sulphate solution, except a small area at the lower end, was insulated with shellac. To serve as a control, a wire *G* similar to *E*, completely insulated except at the lower end, was suspended in *B* as in Fig. 1. For *C*, carbon rods or rods of corrosion-resisting steel, kindly given me by Messrs. Hadfield, East Hecla, Sheffield, were used, as these electrodes resisted all chemical action by the research material.

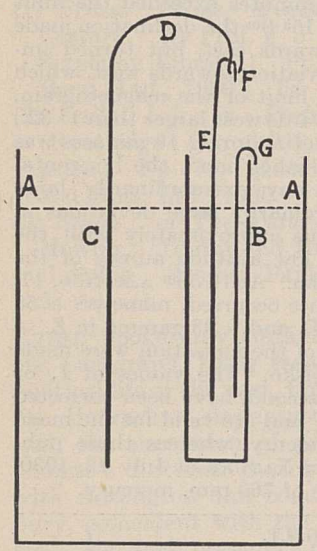

FIG. 1.

To test the apparatus, a weak solution of hydrochloric acid was placed in *A* and carbon electrodes used. After 24 hours, no copper deposit could be observed upon the ends of either *E* or *G*. This showed that no electric current had passed through the system. When, however, zinc was placed in the solution in *A* without contact with either *B* or *C*, a copper deposit commenced to form upon the end of *E*, showing that an electric current was passing through the system. The copper deposit increased as long as any zinc remained undissolved. An experiment similar in all respects, except that the acidulated water in *A* was replaced by a 15 per cent solution of Barbadoes sugar, was left undisturbed for 48 hours. After this period, a slight deposit of copper could be detected upon *E* with a lens, possibly due to bacterial action. On the addition of yeast to the solution in *A*, fermentation set in and an evident knob of copper gradually formed upon the end of *E* (Fig. 2). It will be allowed that the electro-deposition of copper was due to the chemical action of the zinc and acid in the first case, and to that of sugar and yeast in the second.

To test whether the copper deposit in the second case could be due to electricity liberated by the reduction of the copper sulphate by the dextrose and levulose in the walls of the porous pot, a fermentation cell was arranged with solutions of sugar of the same concentration in both *A* and *B*, and electrodes placed in *A* and *B* were connected to two wires dipping into a copper sulphate solution in a separate vessel. After the addition of yeast to the solution in *A*, a copper deposit formed upon the wire connected to the electrode in *A*. The fermentation cell may therefore be regarded as a primary cell, since the electrical effect cannot be attributed to leakage through the walls of *B*.

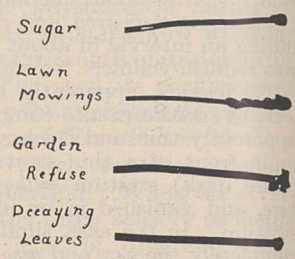

FIG. 2.

Experiments in which the research material consisted of freshly cut lawn mowings or fallen leaves pressed into a wooden box both showed a copper deposit upon *E* (Fig. 2). As a further experiment, a corrosion-resisting steel electrode and a porous pot *B* containing a solution of copper sulphate were sunk a few inches apart in a heap of garden refuse, the wire *E* dipping into *B* being connected with the electrode. In this case also, copper was deposited upon *E*. When the porous pot was removed some seven yards from the rubbish heap and the connexions maintained by an insulated wire, copper was again deposited, but much smaller in amount than when the electrode and porous pot were close together. Thus it would seem that electricity is liberated in the decay of organic matter in the soil.

Experiments show that copper is deposited during the hydrolysis of starch and sugar by weak sulphuric acid.

Evidence for the liberation of electricity in the primary cell is given by the galvanometer and the electro-deposition of metals. Precisely similar evidence is afforded during the decomposition of organic compounds. The fermentation of sugar and the decomposition of organic matter take place in a series of downgrade reactions from a higher to a lower potential, and experiments show that electricity is liberated by the enzymic activity of micro-organisms during these reactions in a manner homologous to the liberation of electricity in a primary cell.

Ordinary explanations to account for these electrical phenomena, such as differences of concentration, production of acid, or a high reducing agent round the electrode, are quite inadequate. Any differences of concentration are due to the breaking down of organic matter and the consequent release of energy. Moreover, certain of these reactions produce acids, others alkalis, and the heap of garden refuse was distinctly alkaline. No further reducing agent is

* Potter, *Proc. Roy. Soc.*, B, vol. 84; 1911: *Proc. Roy. Soc.*, A, vol. 91; 1915: *Zentralbl. f. Bakt.*, Abt. 11, Bd. 78; 1929: *British Med. Jour.*, Oct. 29, 1921.

required than may be found in the enzymic activity during the hydrolysis of starch and sugar.

The weight of copper deposit enables the weak electric currents to be accurately determined.

M. C. POTTER.

Corley Croft, New Milton, Hants,
Mar. 10.

Molecular Spectra of Mercury, Zinc, Cadmium, Magnesium, and Thallium.

To obtain a general conception of the energy states of a loosely bound molecule, we have investigated the molecular spectra of mercury, zinc, cadmium, calcium, magnesium, and thallium in emission with an apparatus capable of concentrating excited molecules in a suitable quantity. The photometric measurement of the photographic records obtained is summarised in Fig. 1, in which the intensity of a continuous spectrum is denoted by a full line, and that of the region with some structure by a dotted line.

From the results obtained, it may be generally stated that a 'band system' emitted from diatomic molecules of mercury, cadmium, zinc, and magnesium

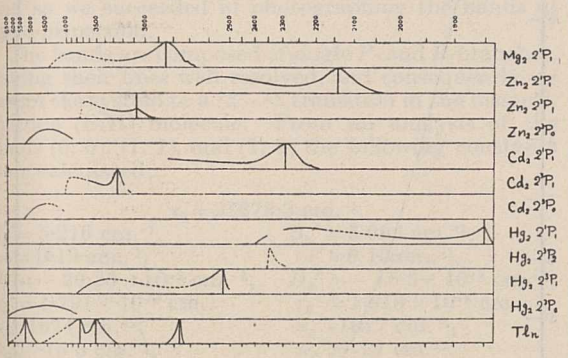

FIG. 1.

vapours has two broad maxima and one flat minimum of intensity. One of these maxima always coincides with the resonance line $1\,^1S_0 - 2\,^1P_1$ or $1\,^1S_0 - 2\,^3P_{0,1,2}$, and the other lies at the region of longer wave-length than this resonance line. The intensity of the shorter wave-length side from the resonance line gradually decreases and terminates rather suddenly at a certain position, while that of the longer wave-length side from the second maximum decreases also gradually to a certain point where the band system suddenly breaks off or melts into the continuous spectrum of wide or narrow breadth. In the region about this second maximum, there was found a generally coarse structure; the fluted bands occasionally consist of finer bands, while no bands were observed in the region near the resonance line. The frequency of convergence of the coarser bands falls somewhere between the frequency of the resonance line and this frequency, plus the energy of dissociation in frequency unit.

These experimental results and other details can be explained in the light of recent theoretical considerations put forward by Born, Franck, Condon, Winans, and Kuhn, if we assume that the intensity maximum about the resonance line corresponds to that emitted by excited quasi-molecules and the maximum on the longer wave-length side to that emitted by excited stable (quantised) molecules.

The energy of dissociation of a molecule in the normal or the excited states can be calculated approximately, as given in the accompanying table, from the difference of energies corresponding to the frequency of the resonance line and that of the shortest or the longest wave-length limit of the band system. These values for normal molecules evaluated in this manner are always a little greater than those already obtained by other observers. For example, those for the molecules Zn_2, Cd_2, and Hg_2 are 0·29, 0·24, and $\geq$0·07 volt respectively, while Winans calculated them to be 0·25 and 0·20 volt for Zn_2 and Cd_2 from the limits of the absorption spectra, and Franck, Grotrian, and Koernicke as 0·04–0·06 volt for Hg_2. These discrepancies can be explained by taking into account the effect of the kinetic energies of colliding atoms at the temperatures of this experiment.

	$1\,^1S_0$	$2\,^3P_0$	$2\,^3P_1$	$2\,^3P_2$	$2\,^1P_1$
Mg_2	0·30	..	..	..	~1·5
Ca_2	>0·18	..	..	..	?
Zn_2	0·29	<1·7	~0·7	..	<~1·2
Cd_2	0·24	<1·4 / >0·9	~0·7	..	?
Hg_2	$\geq$0·07	<2·8	<1·6 / >1·1	~0·2	<1·5

In the case of quasi-molecules, the continuous spectrum accompanying forbidden lines $1\,^1S_0 - 2\,^3P_0$ and $1\,^1S_0 - 2\,^3P_2$ is lacking or very weak, while that with the line $1\,^1S_0 - 2\,^3P_1$ is excited, and the greater the intensity the greater is the triplet separation in the atomic spectrum. The continuous band due to the transition $1\,^1S_0 - 2\,^1P_1$ is emitted intensely in the case of all the metals. From these results, it seems that the intensity rule for the atomic line holds good in the case of the continuous spectrum emitted by quasi-molecules, but similar reasoning does not hold good for the stable molecules.

Symmetrical and asymmetrical 'bands' accompanying the lines in the spectrum of thallium are probably due to thallium molecules, but nothing could be deduced as to whether the molecule is diatomic or not. At any rate, the structure of the band systems at 3776 A. and 5350 A. differs from that of the diatomic one. The continuous branch extending on the shorter wave-length side from edges at 3770·7 A. or 2766·3 A. in the 3776 A. band or 2768 A. band may be explained as the excess of energy due to the kinetic energies of the colliding atoms.

A detailed statement of the investigation will be published elsewhere.

H. HAMADA.

Physical Laboratory,
Sendai, Japan,
Feb. 17.

Relation between Electrical Resistance and Energy of Magnetisation.

IN a recent paper,[1] Gerlach and Schneiderhan have described some experiments on the electrical resistance of nickel as a function of the temperature and as a function of a longitudinal external magnetic field. They have shown that in the absence of an external magnetic field there is, in addition to the normal linear change of resistance with temperature, a term which is directly proportional to the energy of spontaneous magnetisation. The accuracy with which this relation holds good for all temperatures up to the Curie point is very striking.

Gerlach and Schneiderhan have also examined the change of resistance as a function of an external longitudinal field at constant temperature, for a range of temperature around the Curie point. The change is shown to be a maximum at the Curie point and to fall off quite rapidly both above and below this temperature. Considered as a function of temperature, the change of resistance in a given field varies in a manner strikingly like the variation of the magneto-caloric effect with temperature.[2] One is therefore again led to consider this change of resistance as being

a result of the change of magnetic energy which occurs on application of an external magnetic field, since the magneto-caloric effect is a direct measure of this energy change. There is, however, one difficulty in interpreting these results. According to Gerlach and Schneiderhan, the resistance in the neighbourhood of the Curie point varies linearly with the field. This result seems to be in contradiction to the rest of the paper, for the magnetic energy cannot vary linearly with the field over any protracted temperature range; in fact, in the quasi-paramagnetic state above the Curie point, the energy must be proportional to the square of the field. In the neighbourhood of the Curie point, the energy may be a complicated function of the 'external' field depending upon the exact relation between the intensity of magnetisation and the field.

I have examined the change of resistance near the Curie point for fields up to 7000 gauss, as against the 400 gauss maximum of Gerlach and Schneiderhan. Just below the Curie point the resistance is found to vary almost linearly with the applied field, at the Curie point it varies more slowly than the first power of the field, and then with rising temperature the relation changes progressively to a linear relation between the resistance and the square of the applied field. This is exactly the course followed by the magneto-caloric effect and is therefore in striking agreement with Gerlach's suggestion that the resistance changes linearly with the magnetic energy. The transverse effect has also been examined, and although differing greatly from the longitudinal effect at room temperatures, it gives identical results both near and above the Curie point. This would, of course, be expected if we are concerned only with an energy change.

The results of the present work, therefore, although differing in one respect from the results of Gerlach and Schneiderhan, confirm the main suggestion made by them concerning the intimate relation between electrical resistance and magnetic energy. A more detailed account of the work will be published elsewhere.

H. H. POTTER.

H. H. Wills Physical Laboratory,
University of Bristol,
Mar. 12.

[1] *Ann. d. Phys.*, **5**, 6, p. 772.
[2] Weiss and Forrer, *Annales de Phys.*, **10**, 5, p. 153.

Effect of Internal Stress on the Magnetic Susceptibility of Metals.

IN a very interesting communication in NATURE of Dec. 27, 1930, p. 990, K. Honda and Y. Shimizu show that by high pressure the susceptibility of copper is changed * from paramagnetic to diamagnetic. The following is a simple explanation of this fact, without any special theory concerning the susceptibility of metals. We assume that the high pressure, giving a diminution of density of 0·5 per cent, so far destroys the crystal lattice of the copper that parts of the metal become amorphous; then the susceptibility after the deformation may be considered as due to the diamagnetic portion of the normal lattice together with the paramagnetic parts of the amorphous metal, the latter enclosed as a gas in the crystalline copper. It is easy to calculate that, 0·5 per cent of the metal being amorphous, the susceptibility will be changed by the amount given in the communication by Honda and Shimizu. At the temperature of re-crystallisation, the amorphous parts will disappear and the metal will regain its normal susceptibility—just as observed in the experiments quoted.

W. GERLACH.

Munich, Feb. 27.

* Change of diamagnetic susceptibility with stress was found first by H J. Seeman and E. Vogt, *Ann. d. Phys.*, **2**, p. 980; 1929.

Scattering of X-Rays by Mercury Vapour.

IN a previous note [1] a calculation has been made of the intensity of total scattering of X-rays by monatomic gases according to a formula deduced by A. H. Compton [2] and C. V. Raman,[3] and fair agreement is obtained with the experiments of Barrett [4] on the scattering of X-rays by helium and argon gases.

By a photographic method, Scherer and Staeger [5] have recently studied the total scattering of copper $K\alpha$ radiation by mercury vapour for scattering angles ranging from 20° to 160°. It is certainly of interest to compare our theory with these results. In particular, as mentioned by Waller and Hartree,[6] there are

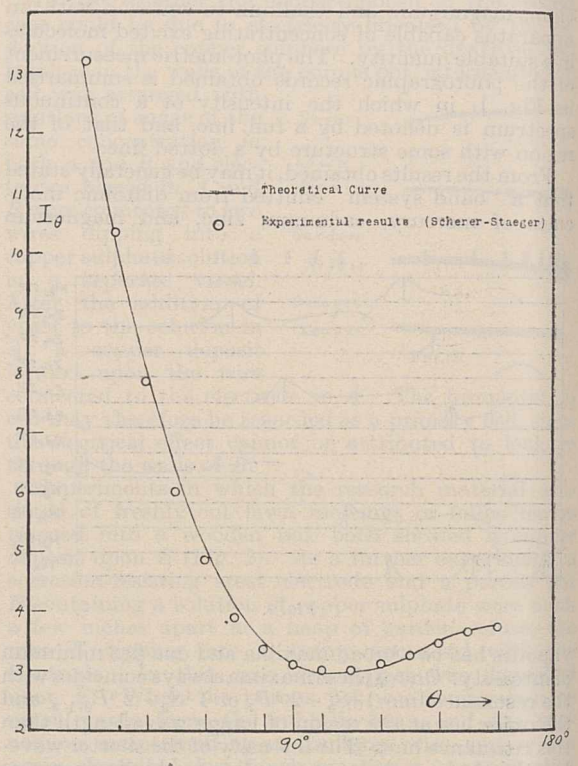

FIG. 1.

difficulties in applying the wave mechanical theory of X-ray scattering recently developed by these authors to the scattering by a heavy atom like mercury; we would like to see how our theory could account for the experiment in this case. Such a comparison is made in Fig. 1. The full curve represents the theoretical values of the scattering per atom in arbitrary units, plotted against the scattering angle θ. The encircled points are the experimental data taken from the scattering curve given by Scherer and Staeger and fitted to the theoretical curve at θ equal to 90°. It is seen that the agreement between theory and experiment is satisfactory throughout the range of the scattering angle examined.

It may be pointed out that for the scattering of copper $K\alpha$ by mercury vapour, the contribution from the incoherent scattering to the intensity of total scattering amounts to about one per cent. Thus the scattering nearly follows the well-known expression

$$I_\theta = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2C^4}F^2,$$

where F is the 'atomic structure factor' (that is, equivalent to ZF of the previous note, loc. cit.). The

F curve was calculated from the atomic field of Thomas and Fermi as previously employed.

Y. H. Woo.

Department of Physics,
National Tsing Hua University,
Peiping, China,
Feb. 17.

[1] NATURE, Oct. 4, 1930; *Proc. Nat. Acad. Sci.*, **16**, 814; 1930.
[2] *Phys. Rev.*, **35**, 926; 1930.
[3] *Indian J. Phys.*, **3**, 357; 1928.
[4] *Phys. Rev.*, **32**, 22; 1928.
[5] *Helv. Phys. Acta*, **1**, 518; 1928: cf. also Kirchner, "Allgemeine Physik der Röntgenstrahlen", p. 496.
[6] *Proc. Roy. Soc.*, A, **124**, 121; 1929.

Band Spectrum of Bismuth Hydride.

A BISMUTH arc, operating in a hydrogen atmosphere at reduced pressure (10-20 mm.), emits the line λ4722 of bismuth (Bi) with great brilliance. A faint band spectrum was found to occupy the vicinity of this line. However, using a quartz discharge vessel, fed with 0·5 amp., 1200 v.d.c., and the bismuth vapour distilling at 900° C. through a narrow end-on tube, this band spectrum comes out with great intensity, and so we succeeded in photographing the bands at large dispersion.

The bands are composed of single P- and R-branches, having their lines well resolved, and consequently we assign the system to a $^1\Sigma - {}^1\Sigma$ transition in the bismuth hydride (BiH) molecule. From an analysis of the bands (0, 0), (1, 1), and (1, 0) the following constants were calculated:

$$\nu_0 = 21278{\cdot}3 \text{ cm.}^{-1},$$

$B_0' = 5{\cdot}216$ cm.$^{-1}$,	$B_0'' = 5{\cdot}066$ cm.$^{-1}$,
$a' = 0{\cdot}19$ cm.$^{-1}$,	$a'' = 0{\cdot}16$ cm.$^{-1}$,
$D_0' = -20{\cdot}25 \times 10^{-5}$ cm.$^{-1}$,	$D_0'' = -18{\cdot}5 \times 10^{-5}$ cm.$^{-1}$,
$r_0' = 1{\cdot}791 \times 10^{-8}$ cm.,	$r_0'' = 1{\cdot}818 \times 10^{-8}$ cm.,
$\omega_0' \sim 1674$ cm.$^{-1}$,	$\omega_0'' \sim 1677$ cm.$^{-1}$,
$\omega_0' x' \sim 15{\cdot}5$ cm.$^{-1}$,	$\omega_0'' x'' \sim 21$ cm.$^{-1}$.

The vibrational frequencies ω_0' and ω_0'' were derived from the relation $D_0 = 4B_0^3/\omega_0^2$. Up to the very last lines observed ($K = 32$) the rotational structure of the (0, 0) band is well checked by the ordinary formula $F(K) = BK(K+1) + DK^2(K+1)^2$ if we add a small uncoupling term ϵK in the final term ($\epsilon = -0{\cdot}042$).

The near coincidence of ν_0 with the atomic line λ4722 and the close agreement between the constants of the initial and the final terms of the band system, make us inclined to suggest that the electronic states of the molecule originate from the corresponding states $2s$ and $^2D_{3/2}$ in bismuth, the hydrogen atom remaining unexcited. Our suggestion also harmonises with the appearance of a small, negative l-uncoupling term in the final state of the molecule. Such uncoupling terms are, according to the theory,[1] to be expected in molecular terms derived from atomic P, D terms. It is further of some interest to note that while the triplet band systems known in the spectra of NH and PH are derived from deep-lying quartet terms in N and P, the singlet system of bismuth hydride probably originates from the doublet system in bismuth.

A full report of the spectrum will appear later in connexion with the analysis of other band systems of bismuth hydride situated in the red part of the spectrum.

A. HEIMER.
E. HULTHÉN.

Laboratory of Physics,
University of Stockholm,
Mar. 9.

[1] See esp. W. Weizel, *Phys. Zeits.*, **31**, 880; 1930.

The Values of e, h, e/m, and M_P/m.

IN a recent paper,[1] I showed that the six methods usually used for deducing the value of Planck's constant, h, could be used collectively to evaluate both e and h, without assuming any direct determination of e (such as that of Millikan). This seems to be the most accurate way of estimating e and h that is so far available.

I have now repeated the calculations, using all the data referred to by Birge as suitable for estimating h,[2] as well as all the estimates of e/m given by Birge and in the "Handbuch der Physik" of Geiger and Scheel (vol. 22, p. 81). From the values of e and h thus deduced I find

$$hc/2\pi e^2 = 137{\cdot}01_7 \pm 0{\cdot}05_9.$$

This is in such good agreement with Eddington's theoretical prediction of exactly 137, that his equation is slightly more firmly established than any of the other equations relating e and h.

By assuming Eddington's equation, the values of e and h can be deduced somewhat more accurately. I give for comparison Birge's estimates.

	Birge.	Bond.	Difference.	Sum of probable Errors.
$e \times 10^{10}$	$4{\cdot}770 \pm 0{\cdot}005$	$4{\cdot}779_4 \pm 0{\cdot}001_1$	$0{\cdot}009_4$	$0{\cdot}006_1$
$h \times 10^{27}$	$6{\cdot}547 \pm 0{\cdot}008$	$6{\cdot}558_6 \pm 0{\cdot}003_1$	$0{\cdot}011_6$	$0{\cdot}011_1$
$(e/m) \times 10^{-7}$	$\left\{\begin{matrix}1{\cdot}761 \pm 0{\cdot}001 \\ 1{\cdot}769 \pm 0{\cdot}002\end{matrix}\right\}$	$1{\cdot}769_0 \pm 0{\cdot}000_46$		
M_P/m	$\left\{\begin{matrix}1838{\cdot}26 \pm 1 \\ 1846{\cdot}61 \pm 2\end{matrix}\right\}$	$1846{\cdot}5_7 \pm 0{\cdot}4_8$		

My probable errors should be accurate to about 10 per cent, as the calculations depend on 36 sensibly independent data.

The difference between my estimate of M_P/m and Eddington's theoretical suggestion of $(136)^2/10 = 1849{\cdot}6$, is $3{\cdot}0_3$, or 6·3 times as large as my probable error. I can only conclude that this is very strong evidence against the value of M_P/m being exactly $(136)^2/10$.

I write this in memory of J. R. B.

W. N. BOND.

Department of Physics,
University of Reading,
Mar. 14.

[1] *Phil. Mag.*, December 1930.
[2] *Phys. Rev. Suppl.*, vol. 1, No. 1, pp. 48-57.

A New Band System of Copper Hydride.

A BAND system consisting of six band-heads has been found in the region λλ2900-2200. It is different in nature from the two systems previously known for the molecule. The bands are double-headed, indicating that their emitter consists of an odd number of electrons, and thus they have been attributed to the ionised copper hydride (CuH^+) molecule. The band structure has been analysed. It consists of nine branches, namely, six main branches and three satellites, and the branch lines obey the K-selection rule. From the intensity relations of the branch lines for low quantum values, it is found that $Q > R > P$. Thus the system has been assigned a $^2\Pi \longrightarrow {}^2\Sigma$ transition. The $^2\Pi$ level is inverted. From the vibrational quantum analysis, $\omega_0'' = 1874$ cm.$^{-1}$. This is in good agreement with the value as calculated from the relation given by Kratzer, namely, $\omega_0^2 = -4B_0^3/D_0$. The values of B_0'' and D_0'' are $3{\cdot}30$ cm.$^{-1}$ and $-4{\cdot}16 \times 10^{-5}$ respectively.

P. C. MAHANTI.

Applied Physics Laboratory,
Calcutta University,
Feb. 19.

Polarisation of the Raman Spectrum of Water.

THE Raman spectrum of water has been studied in great detail by a large number of workers, notably A. S. Ganesan and S. Venkateswaran and A. L. Meyer. So far as I am aware, however, no attempt seems to have been made to study the polarisation of the Raman bands. I have studied the Raman spectrum of pure water by the original method of Raman. The liquid, which was enclosed in a large bulb, had been carefully purified by repeated distillation *in vacuo*. The polarisation photographs of the liquid were taken with a fairly wide slit, due corrections in the exposures for the two directions of the nicol, for the polarisation introduced by the optical train in the glass spectrograph itself, having been made by a previous calibration of the instrument.

The intensities of the bands were estimated by a plate containing a series of graded exposures of the mercury spectrum. The following table indicates the results obtained :

Wave number shift (mean) excited by 4358·3 A.	Depolarisation factor.	Intensity.
3100	0·60	Medium.
3400	0·48	Strong.
3600	0·75	Weak.

From these observations I conclude that :

(1) The three different Raman bands excited by the same incident lines are differently polarised.

(2) The degree of polarisation of the different Raman bands (excited by the same line) seems to increase as the intensity of the band increases.

The 3·13μ band has been attributed to a polymer of H_2O. But whether the variation of the depolarisation factor is to be attributed to the variation in the geometric character of the oscillations involved, or has a definite bearing on the relative intensities of the bands themselves, is more than we can say at present.

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The Presidency College,
Chepanti, Madras.

Thermophilic Bacteria in Milk.

MUDGE and Thorwaldson [1] have advanced a new theory to account for the proliferation of the so-called thermophilic bacteria in milk during pasteurisation at 62·8° C. The fluctuations in numbers which occur at short intervals during pasteurisation are so sudden and violent as to require some further explanation than is supplied by mere proliferation, even if it is at its optimum. They suggest that the organisms exist in milk as dormant spores which, unless the milk is subjected to the action of certain physical and chemical stimuli such as heat, cold, or the action of alkalis, remain ungerminated.

Work which is in the process of completion in this laboratory has furnished evidence in support of this suggestion of Mudge and Thorwaldson, although it was arrived at by an entirely different route. During the investigation of a spore-forming organism isolated from commercial sterilised milk, it has been found that the germination of the spore, and subsequent spore formation, depends upon the effect of heat.

If after inoculation into milk the spores are heated, germination invariably occurs. If, however, the culture is not heated, germination is very much reduced and fails in the second generation. The original spores are gradually lost by a process of dilution during subsequent cultivation and a stable vegetative form of the organism is obtained.

If to a culture of heated spores (possessing the power to germinate) a small quantity of a living culture of the vegetative form be added, a number of these spores are so affected that they immediately lose the power of germination, and if they are allowed to remain in contact with the vegetative culture for 24 hours, this power is lost by all. If, however, to a culture of a number of spores, isolated by the Barber single cell technique, which cannot be induced to germinate by heating alone, a small quantity of a *killed* culture of the stable vegetative form of the organism be added, germination, followed by normal spore formation, takes place.

It appears that the stable vegetative form, which has been found to dissociate from the sporing form, bears an inhibiting factor which is heat labile. It therefore seems that the significance of heating lies in the destruction of this factor, and it may be that the dormancy of the spores of thermophilic bacteria in milk, which is destroyed by heating, is due to the presence of a similar inhibitory factor.

M. I. CHRISTIAN.

University of Reading,
National Institute for Research in Dairying,
Shinfield, Nr. Reading,
Feb. 5.

[1] *Milk Dealer*, December 1930, 57.

Two New Colour-types in Cats.

DURING the past year, we have obtained two cats, each of which is apparently a new colour-type. The first seems to be an albino. He was exhibited at a cat show in Paris in 1930 and came into our possession shortly afterwards.

Hitherto albinism in cats has been unknown. White cats do occur and are sometimes referred to as albinos, but their eyes are pigmented—often blue, sometimes yellow or green—and the white coat-colour is actually dominant white.

The white cat in our possession has eyes very like those of an albino rabbit. The iris is translucent white, and when the pupil is dilated the eyes look blood red. In appearance the cat is a perfect albino, but it is not yet known how his colour is transmitted. He appeared in a strain of Siamese, and it is of interest to note that the Siamese coloration is the nearest approach to albinism hitherto found amongst cats. Siamese in cats is almost certainly comparable to Himalayan in rabbits, and Himalayan is next to the lowest member of the series of allelomorphs extending from black to albino.

The second cat is a self-brown, very much the colour of ground coffee. He was previously owned by the late Mr. H. C. Brooke and was shown by him at the Crystal Palace as a self-red. Brown coat-colour occurs in many domestic animals, but also has not hitherto been recorded in cats. Yellow cats are fairly common. They are often referred to as orange, red, or marmalade—actually they are yellow with darker, orange-brown markings.

The self-brown cat in our possession was evidently considered to be such a 'red' without the lighter patches. His colour is, however, entirely different from anything found on a red—it is a true dark brown without markings. It is not yet known how his colour is transmitted, and nothing is known of his origin.

RUTH C. BAMBER (Mrs. Bisbee).
E. CATHERINE HERDMAN.

Zoology Department,
University of Liverpool,
Mar. 13.

Research in the Modern State.*

THERE are few documents which present a more comprehensive picture of the manifold ways in which scientific research is applied, not only to industrial problems but also to the service of our daily needs, than the annual reports of the Department of Scientific and Industrial Research. All the major needs of the population are touched by the activities of the Department—food and clothing, air and water supply, heating and lighting, communications and transport, housing and building—in each of these spheres science is making important contributions, and promoting not material developments alone but also the solution of many problems which menace the national development and health. There is no department of State in which the beneficial influence of the Department of Scientific and Industrial Research is not felt, and it is probable that no proportion of the national income is more profitably spent than the comparatively small sum of £711,200 (gross) or £536,746 (net) which represents the expenditure of this Department for the year ending Mar. 31, 1930.

The report of the Department for the period, Aug. 1, 1929–July 31, 1930, which has recently been published, includes the short report of the Committee of the Privy Council, signed by Lord Parmoor, with the report of the Advisory Council and summaries of the work carried out by the National Physical Laboratory (representing the largest single item of expenditure, £205,301 gross, or £100,418 net), and the Chemical Research Laboratory, by the twenty research associations which are in receipt of grants, and under the direction of the various research boards. Appendices deal with the research boards, committees, and establishments of the department, finance, publications, and developments during the period in the organisation of industrial research in other parts of the British Empire. The extent to which scientific knowledge is now woven into the fabric of modern life is well indicated by the list of some forty-five research boards and committees and of the twenty research associations, to the support of which grants amounting to £70,931 were contributed during the year. The personnel of these committees comprises many of the most distinguished scientific workers in Great Britain, and much of the voluntary service they thus render receives little public recognition. As in the year under report, the results of scientific work are seldom spectacular, and even when a fundamental discovery has been made, years may elapse before it becomes a benefit to mankind. The absence of spectacular results from the present report, in fact, renders it a more valuable document from which to assess the immense normal contribution such work makes to our common wants.

In the course of a short article it is impossible even to catalogue the wide range of subjects coming within the province of the Department, and a few examples only will be selected to illustrate the intimate relationship of its work and our daily life. Even to outline the work of the research associations would carry us beyond our limits, and it must be sufficient to refer to the investigations being carried out by the British Non-Ferrous Metals Research Association on the effect of frost on the bursting of water pipes, which is to include pipes made of lead, the new lead alloys, copper and iron so far as they are used in domestic installations; and by the Research Association of British Paint, Colour, and Varnish Manufacturers on the durability of films of paint or varnish, etc. The tests carried out have already made it possible to obtain much valuable information regarding the probable performance of paint materials in use. The British Cotton Industry Research Association has successfully introduced a new antiseptic, 'Shirlan', to protect cloths exported to warm damp climates, and warps stored under damp conditions at home from the deleterious effects of mildew development. The British Launderers' Research Association has studied the laundering of rayon, and directs attention to the caution needed in finishing, for example, ironing, such fabrics; whilst the Wool Industries Research Association has reported the unexpected discovery that when sulphur dioxide and alkali are present in particular proportions they assume a phase of exceptional activity. By taking advantage of this active range a new, effective, and cheaper process of bleaching has been developed.

The increasing use of electricity for domestic purposes is not unaccompanied by dangers. Thus, while the necessity for earthing as a means of avoiding the danger of shock or mitigating its effect is generally acknowledged, the means for obtaining a 'satisfactory' earth have not been described, and wide variations exist in practice, some of which are hazardous and others unnecessarily expensive. This question, and also the elimination of fatigue failure in the overhead lines now widely used for the transmission of power at high voltages, are occupying the attention of the British Electrical and Allied Industries Research Association. By work of this kind, the consumer benefits through obtaining a better article, and in some cases also a cheaper article. The standard of living is thus being gradually raised as a result of the application of discovery to production. Research on the electric lamp, for example, has enabled the consumer to-day to obtain more than four times the light his grandfather could obtain for the same money.

The work of the Fuel Research Board is of outstanding importance, whether for industrial or domestic purposes, and on this work a gross sum of £95,305 was expended. Some account of the investigations conducted by the Board has recently

* Department of Scientific and Industrial Research. Report for the Year 1929–30. (Cmd. 3789.) Pp. 224. (London: H.M. Stationery Office, 1931.) 3*s*. 6*d*. net.

appeared in NATURE (Mar. 7, p. 386), and the results of the study of low temperature carbonisation have led to the formation of a Low Temperature Coal Distillers' Association. This work is linked up with the investigation of the tar oils produced as by-products which is being carried out by the Chemical Research Laboratory, Teddington. The main object of the low temperature carbonisation process—the production of a satisfactory smokeless fuel—can only be achieved if the by-products can find a suitable market, and it is accordingly worthy of note that 'Bakelite' and 'Novalak' resins have been successfully prepared from phenolic fractions of this low temperature tar, whilst interesting results have also been obtained at Teddington in cracking, hydrogenation, and syntheses from the same tar.

A closely related problem is that of atmospheric pollution, and the investigations of the research committee dealing with this have now reached an advanced stage. Improved methods of obtaining information on atmospheric pollution are being elaborated, including methods for the determination of sulphur in the atmosphere, the approximate total sunlight received, and the lateral distribution of atmospheric impurity from a centre of pollution under different weather conditions.

The importance of preventing water pollution was particularly demonstrated during the dry summer of 1929, and has stimulated interest in the work of the Water Pollution Research Board. A comprehensive scientific survey of the Tees as a typical river flowing through an industrial centre has been undertaken, and already the general changes in the composition of the river water and in the fauna and flora of the river from source to mouth at different times of the year and under different conditions of rainfall and tide, have been ascertained. The very serious pollution occasioned by effluent from beet sugar factories has received special attention, and investigations carried out in co-operation with the industry have shown that there are practical methods by which such excessive pollution can be avoided. Another investigation in which the Chemical Research Laboratory is also participating is concerned with the difficulties caused by the corrosive action on iron mains and the plumbo-solvency of certain waters.

The work of the Food Investigation Board entailed a gross expenditure of £38,531, or £14,237 net, with a further £9736 on the extension of the Low Temperature Research Station at Cambridge —figures which seem infinitesimal in regard to the importance to the nation of the successful preservation, storage, and transport of fruit, vegetables, meat, and fish. The extension at Cambridge will accelerate the work on meat, in which important scientific and practical results have already been achieved in relation to freezing of gelatin gels and to the factors responsible for loss in 'bloom' or the freshly killed appearance of lamb. Work on the scientific basis of the curing of meat is providing a rational explanation of the customs of the curing industry, which are at present empirical and obscure.

The characteristic English breakfast has received special attention, for the programme of work has included large-scale investigations on the storage of frozen bacon and on the factors involved in control of the cold storage of eggs. During the year, construction of the new station at East Malling has advanced sufficiently to permit research on the storage of fruit on a semi-commercial scale, and a report has been published which should facilitate the elimination of wastage in fruit transport and storage, and another on the optimum temperatures and atmospheres for use in the gas storage of fruit, which has led to a remarkably successful method in one of the large commercial stores.

Research on the preservation of fish by cold, the smoking of fish, and the bacteriology of fish preservation has been commenced at the Surrey research station. This work has been supplemented by work carried out at sea in the steam drifter *City of Edinburgh* and by the Forest Products Research Laboratory, which has undertaken an investigation of the chemistry of wood smoke.

Much important work carried out by the Forest Products Research Board is concerned not merely with the development of the forestry resources of the Empire, but also with timber preservation and methods of preventing dry-rot or attack by the 'death-watch' beetle or other insect pests. Such work like that on the seasoning or creosoting of larch poles to prevent the serious wastage by longitudinal splitting is obviously related to the use of timber in building or constructional work, and in this field the Building Research Board is making a steady advance. Factors involved in weathering, the composition and properties of cement, the stresses and strength of constructional materials such as concrete, earth-pressure, and the fatigue of materials, have received systematic investigation. An experimental house has been used to correlate the heat requirements with weather conditions so as to obtain maximum efficiency from the point of view of the user.

The work of the Illumination Research Committee is also closely connected with housing problems, as is that of a joint committee of the Fuel and Building Research Boards on Heating and Ventilation. The former has directed investigations at the National Physical Laboratory on the effect of window size, colour, and reflection from walls and ceilings on the illumination of rooms, the effect of distribution and colour of various systems of lighting on clerical work, as well as investigations on street lighting and glare.

The latter represents only one of the ways in which the work of the Department impinges on the important field of transport. The establishment of a locomotive experimental station for tests and general research on locomotives, the testing of ship forms and propellers carried out in the William Froude National Tank, and the establishment of a second tank for research on ship design, resistance, and propulsion, etc., the aerodynamics research at the National Physical Laboratory, and the investigation of the Fuel Research Board on the

causes of fires on steamships in bunkers and cargo coal, are sufficient evidence of the important contributions made in every field of transport, without enumerating the metallurgical research or the important engineering investigations carried out at the National Physical Laboratory.

In another field of communications, the Radio Research Board is making contributions which affect the millions of homes where broadcasting is received, while dental research, the production of insecticides for the destruction of the cocoa moth, the production of new drugs, and the discovery of the efficiency of borax—boric acid mixtures for the fireproofing of fabrics—and investigations on the action of sunlight on cotton, which have revealed the deleterious effect of small traces of iron, are all that can be mentioned of the activities of the Fabrics Research Board.

Similar work is being carried out in Canada, Australia, New Zealand, South Africa, and in certain fields, notably in that of the transport of fruit and on the investigation of Empire timbers, much has already been done to secure co-operation between the mother country and the Dominions overseas. Even the above brief survey should make it sufficiently clear that the work of the Department of Scientific and Industrial Research is a vital factor in the prosperity of the British Empire, and upon its wise direction and active prosecution depend in large measure our prospects of restoring our industries to full vigour, exploiting to the full such natural advantages as we possess, and, by increased efficiency where we now possess no such advantages, recovering something of the position we formerly held amongst the industrial nations of the world.

Physical and Mental Development of Children.

In spite of the assiduity with which the growing child has been studied within recent years, it cannot be said that we know very much about him. But what we do know, and know with any degree of scientific certainty, is set forth in the Report of the Consultative Committee on the Primary School* recently issued. The Committee, indeed, has spared no pains in securing the most trustworthy information at present available. It has interviewed eighty-nine witnesses; it has read a staggering number of memoranda; it has examined with special care all evidence which can claim scientific validity. Hence it has treated with special respect the opinions of physiologists and psychologists. Indeed, much of what is said in the body of the Report about the development of the child is based on two memoranda which are printed in full in the appendix. The first is by Prof. H. A. Harris on the physical development of the child, and the second by Prof. Cyril Burt on the mental development of the child.

Prof. Burt's memorandum will be dealt with first. It may be said at once that it is wholly admirable. It sets forth with great clearness, and with no small measure of charm, all that is certainly known about the psychology of the child of primary school age—all that would receive the unqualified support of the author's fellow psychologists in Europe and America. It indicates the views that have survived; and these views show how far we have moved within the last thirty years.

Thirty years ago, the orthodox creed was largely based on biology. The belief of what happened in the mind was mixed up with a belief of what happened in the body and in its remote progenitors. It was believed that in the growing child certain instincts and interests and powers remained virtually dormant up to a given age, and then suddenly woke up and became insistently active. Their maturation was almost as sudden as their birth. Thus definite layers of mental life were laid down and consolidated, and, on top of these, new layers were superimposed. First came the mastery of the physical senses, then the control of the muscular system (including the muscles of speech), which give rise to walking, dancing, talking, and constructing things with the fingers. Then came the development of memory, and finally the emergence of a capacity to reason.

Mixed up with this stratification theory, as Prof. Burt calls it, is the recapitulation theory, which states that the development of the child tends to reproduce in rapid and abbreviated form the evolution of the race. He goes through the cave-dwelling period, the savage period, and the barbarian period. He is at various times in the hunting stage, the nomadic stage, the agricultural stage, the craft stage, and what not.

We no longer hold these views—not in their original form at any rate. The stratification theory is discredited by the fact that experiment has exploded the old doctrine of distinct faculties, such as memory and reason; and the recapitulation theory is discredited by the failure to find evidence for the transmission of personally acquired characters. There is no more reason to think that the son of a potter inherits the aptitudes and interests of a potter (apart, that is, from the influences of his immediate environment) than there is for believing that the son of a mathematician will know the differential calculus by the light of Nature. Indeed, these old beliefs have been shattered through their failure to fit in with the facts of the mental life which have been disclosed by direct observation and experiment. For the method of direct study is essentially the modern method.

This is an important point of methodology. The child's mind is studied, not by studying his body, his brain, or his pedigree, but by the simple and obvious method of studying the thing itself. The facts to be observed and explained are mental facts. Real progress in the study of mental development may be said to have begun when the psychologist resolutely turned a blind eye to the alluring theories of the physiologist or the

* "The Primary School." (London: H.M. Stationery Office, 1931.) 2s. 6d. net.

anthropologist, and began to study the mind as a mind. It was Binet who set the investigator on the right track. His instrument of research was neither a scalpel nor a microscope, but a mental test—a simple examination question, so devised, so applied, and so interpreted, as to become at once a means of discovery and a means of measurement. Indeed, all we know with certainty about the mode and rate of development of the child mind is a result of the direct method of mental testing.

This is abundantly evident from Prof. Burt's memorandum. He shows how, by the modern method, it is demonstrated that general intelligence grows with age, that the so-called faculties are all mixed up together from the very start, and that special intellectual interests and abilities develop, though they do not begin, at successive ages of school life. The new findings wholly fail to confirm the old theories. There is no ground for the old belief that memory is stronger at the junior school period than at any other; nor yet for the old belief that children cannot reason until they reach the adolescent stage. Children of all ages are found to reason well enough within the range of their understanding.

Prof. Harris's memorandum is equally good of its kind; but is different in kind. It has more of personal theory and conjecture; it pushes out further into the realm of the unexplored. For this very reason, some of his views, interesting and suggestive as they are, must be accepted with caution. He lays much stress upon successive periods of springing-up and of filling-out that occur in the course of a child's growth. The child mainly grows in height at one period and mainly grows in weight at another. There are, according to Dr. Harris, three of each period. The second springing-up period, for example, takes place during the ages of five, six, and seven years; and the second filling-out period during the ages of eight, nine, and ten. The curves of growth, however (one for height and one for weight), which he publishes in his memorandum, afford but slight evidence of these periods. Indeed, he admits that his inferences are drawn from clinical observations rather than from the curves of growth.

The existence of this rhythm is not denied; nor is the importance that Prof. Harris attaches to a recognition of this rhythm; but what is in doubt is whether it follows such simple laws as his classification suggests. A letter is at hand from a schoolmaster in Lancashire, who for many years made careful and regular measurements of his daughter's increase in height. For many years, beginning at the age of three, she grew at the rate of two inches a year—one inch in April and another inch in October—her stature being practically constant for the remaining months of the year. During the two growing months, she was mentally inert; and during the two months that respectively followed she often succumbed to the various illnesses incident to childhood. This, of course, is only one case; but other similar ones might be mentioned, which at least indicate that the rhythm is to a large extent individual and personal. If there is a wide wave of tendency over a long period, there are many ripples on the wave.

Prof. Harris shows clearly that sex differences appear all along the line, and not merely at adolescence. Indeed, it has long been an accepted fact that in the matter of physiological age, as judged by the eruption of teeth, the ossification of the wrist bones, and the onset of puberty, there is a difference between the two sexes which at the age of eleven amounts to about two years. Anatomically, a girl of eleven is at the same stage as a boy of thirteen. Here we find a clash of opinion between the physiologist and the psychologist. While the physiologist proclaims a wide disparity between the development of boys and the development of girls, the psychologist just as confidently proclaims their identity. He tells us that neither in the level nor in the rate of intellectual development is there any appreciable difference between boys and girls. There are emotional differences, and differences of interest; but no difference in general intellectual power. The truth, of course, is that each class of statements is valid in its own sphere. As boys and girls differ in muscular development, they should play apart; as they roughly agree in intellectual development, they may study together.

Each class of statement is valid in its own sphere; and Prof. Harris's valuable memorandum will be read with much interest and profit by all concerned with the nurture of the young. It is illustrated by excellent photographs; it is enlivened by wise and epigrammatic sayings; it is abundantly provocative of thought. It is only when he leaves his own territory and would base psychology on physiological facts that we join issue with him. He says, for example: "All growth and proliferation on the one hand and all differentiation for special function on the other will probably be found to be the ultimate basis of a rational psychology, whether it be labelled 'Gestalt' or not". As a pious belief we may let it remain. As a guide to psychological research, it seems to anyone who is familiar with the false clues of the past to stand on the same level of usefulness as the project of the Laputan philosopher to extract sunshine out of cucumbers. P. B. BALLARD.

Obituary.

DR. ENRICO SERENI.

THE sudden death of Enrico Sereni, at Naples on Mar. 1, ends prematurely, at the age of thirty years, a career full of scientific usefulness and promise. Sereni had been in charge since 1926 of the section of physiology at the Zoological Station at Naples, and so was well known to the many biologists who worked there. To his British physiological friends and colleagues he was better known from having spent a large part of 1924 in London at University College, and from having travelled with them to and from the International Congress

of Physiology in Boston in 1929. He valued his connexion with Great Britain, and his friends will miss his frequent and cheerful greetings.

Sereni took the degree of M.D. in 1922 with honours. While still a student he had been awarded three scholarships for research work which he performed in the laboratory of human physiology in Rome. After graduation, he obtained, in competition, a studentship from the Ministry of Education to work in Italy and abroad. This was how he came to London, though he supported himself here, frugally enough, for a longer period than the studentship allowed, by working early and late, assisting a medical friend, so leaving the days free for the laboratory. In 1923, he was appointed assistant in the Department of General Physiology in the University of Rome, and in 1925 *libero docente*. From 1925 he gave, every year, in the University of Naples, a course of lectures on physiology for students of medicine and science. In 1926 he was appointed to the position which he held when he died. Before entering the University, Sereni had volunteered, at the age of seventeen years, for military service, serving as a lieutenant and gaining the Croce di Guerra.

Sereni's researches extend over various fields of physiology. His most important work deals with anaphylaxis, which he studied from a general biological point of view on men, on various animals, and particularly on tissue cultures. He worked more recently on the humoral and nervous coordination in cephalopods and on the behaviour of unstriated muscle. A. V. H.

Mr. J. G. Millais.

Mr. J. G. Millais, who died on Mar. 24, the sixty-sixth anniversary of his birthday, was a man of many interests and talents. A traveller and a sportsman, who followed big game on the continent of Europe, in Africa, and in North America, an artist and a naturalist, who could write discursively about the ways of wild life or particularly upon specific themes, he unified all these interests in authorship. The variety of subjects of his published works is great, as the standard of his descriptions and accuracy is high, yet devotion to sport lay behind most of his writings.

Millais' travel books are always interesting and contain many acute natural history observations. His monographs, essential to the British naturalist, show a wonderful range of information. "The Natural History of British Surface Feeding Ducks" (1902) was rounded off by two volumes on "British Diving Ducks" (1913), and in the interval he wrote "The Natural History of British Game Birds" (1909). Amongst mammals, he opened with a standard work on "British Deer and their Horns" (1897) and proceeded to the most important of all his books, "The Mammals of Great Britain and Ireland", published between 1904 and 1906. The three enormous volumes of this monograph, awkward to handle because of their bulk and weight, contain the best complete account of their subject we possess. Latterly, Millais' interests concentrated upon the flower garden, and amongst his last publications are "Rhododendrons and their Hybrids", a series of three volumes running from 1917 to 1923, and "Magnolias" (1927).

Millais inherited artistic ability from his father, Sir John Millais, and illustrated in full or contributed to the illustration of his own books, but his finished drawings are inclined to be rather stiff and hard in tone, and lack the freedom of line and spontaneity which characterise the pencil sketches he often reproduced. J. R.

We regret to announce the following deaths:

Dr. J. Anderson, formerly fellow of the London School of Tropical Medicine, later professor of medicine in the University of Hong-kong and recently director of the division of medicine in the Henry Lister Institute at Shanghai, aged fifty-two years.

Prof. R. K. Butchart, professor of mathematics in Raffles College, Singapore, and formerly professor of physics in Wilson College, Bombay, on Mar. 30.

Prof. W. C. M'Intosh, F.R.S., emeritus professor of natural history in the University of St. Andrews, distinguished by his work in marine biology, especially the systematic study of British marine annelids, on April 1, aged ninety-four years.

Senator R. Nasini, professor of chemistry in the University of Pisa, on Mar. 29, aged seventy-five years.

Prof. Hugh Ryan, professor of chemistry in the University College of Dublin and Chief State Chemist to the Irish Free State, on Mar. 27, aged fifty-seven years.

News and Views.

The report of the Court of Inquiry into the loss of the airship *R101* over Beauvais on Oct. 5, 1930, has just been issued (Cmd. 3825. London: H.M. Stationery Office. 2*s*. 6*d*. net). It admits that an exact explanation of the immediate happenings leading to the disaster can never be given, owing to the lack of evidence, but by examining various hypotheses the Court has come to the unanimous conclusion that the one presented is the most plausible. This is, that there was a rapid loss of gas from one of the main forward gas bags, added to a heaviness from a gradual leakage of gas due to attrition of the bags, probably greater than was suspected. A heavy down air-current forced the nose down, and at the same time may have either caused or accelerated an existing tear in the outer envelope. The rush of air through this, again, may have either initiated or extended a split in the inner bag. It is known that the wind was variable enough to have buffeted the nose of the ship up and down, and the height coxswain, only just on duty and fresh to the 'feel' of the elevators, had possibly over-corrected an upward deflection when the downward one caught him. He then lost height to a dangerous extent while swinging the elevators to the other extreme position, but eventually succeeded in correcting the ship's altitude. The further loss of height following this appears to have been intentional in an endeavour to make a

slow landing when it was realised that a crash was inevitable.

THE other part of the report on the loss of *R101* is devoted to discussing the responsibility for the undertaking of the flight to India at that early stage in the ship's development. It is quite clear that although there were an exceptional number of novelties in design, there is no evidence of the failure of any of these having been either the cause of, or even contributory to, the disaster. On the other hand, the programme of flying trials as originally drawn up by the experts at Cardington had been curtailed. Since the addition of the extra bays, the ship had never flown in anything but exceptionally fine weather, and had never carried out speed trials. The air-worthiness certificate, without which the flight could not have been undertaken, was apparently issued by the Air Ministry before the report by the Air-worthiness of Airships panel, upon which it should have been based, was even written. It is abundantly clear that considerations of policy were allowed to overrule all others in deciding that the flight should take place when it did, although the blame lies with the system of controlling such work, rather than upon any particular individual.

ON Mar. 31, at 11.2 A.M. (5.2 P.M. G.M.T.), Managua, the capital of Nicaragua, was almost completely destroyed by a violent earthquake, many of the walls left standing after the shock and the fires that followed being thrown down by strong after-shocks on Mar. 31 at 9.15 P.M. and April 1 at 5.15 A.M. The principal shock lasted only a few seconds. Estimates of the number of persons killed range from 500 to 2000, out of a population of about 50,000. Though great earthquakes are rather frequent in the Central American republics, it is in Guatemala and Salvador that they are most serious. During the eighteenth and nineteenth centuries, out of 30 very destructive earthquakes, 14 occurred in Salvador, 10 in Guatemala, 4 in Costa Rica, 1 in Honduras, and 1 in Nicaragua. According to Montessus, who has made a detailed study of Central American earthquakes, the most important seismic centres in Nicaragua are those of Leon and Granada, which are respectively 54 miles north and 26 miles south-east of Managua. One of the few minor centres in the country lies close to Managua. The most interesting features of the recent earthquake are its brief duration, the comparative smallness of its area of damage, and its occurrence in an almost dormant seismic zone.

A GREAT advance has recently been made in the technique of radio-telephony which promises some surprising developments in the near future. The International Telephone and Telegraph Laboratories have shown that it is possible to utilise Hertzian waves, the frequency of which is more than a hundred times greater than the most rapid at present in use. The new method utilises wave-lengths of between 10 cm. and 100 cm. in length instead of the present 'short waves' which lie between 10 metres and 100 metres. The properties of the new 'micro-rays' are approximately the same as those of light rays. They can be reflected and refracted by devices of an optical nature and travel in straight lines. The curvature of the earth and the altitude of the sending and receiving stations are the determining factors for the distance of transmission. It is necessary that the two stations should be visible from one another. Hence high sites will be the most desirable in the neighbourhood of populous centres. There appears, however, to be no limit to the number of relay stations that can be used. A demonstration of the new system was given on Mar. 31 between officials and engineers on the cliffs at St. Margaret's Bay, near Dover, and Blanc Nez, in France. The speech vibrations were applied to a micro-radion tube in which oscillations of 1,600,000 kilocycles per second (about 17 cm.) were generated. The modulated waves were sent in a straight line by a parabolic reflector 10 feet in diameter to a similar reflector in France, where they were concentrated on the receiver. The demonstration was entirely successful and proved the practical character of the micro-ray method. The method provides a wave band nine times the width of that previously available. In addition, as the waves travel in straight lines and their distance range is restricted, a large number of stations can operate on the same wave-length and the present congestion of the ether will be relieved.

THE International Telephone and Telegraph Laboratories have also to be congratulated on a notable achievement in the field of facsimile telegraphy. By the new method, pages of type, handwriting, line drawings, and plans can be transmitted at the rate of two sheets a minute. In the case of typewritten sheets containing five hundred words, this corresponds to a speed of 60,000 words an hour. In the picture telegraphy at present in use between the Post Office and several continental cities, about twenty minutes is required for the transmission of a single picture. As in the case of other picture telegraphic systems, a device is used in the new method to scan the message in a series of fine parallel lines with a point of intense light. The light reflected from each elementary area of the sheet is collected and led to a photoelectric cell. This cell delivers to an amplifier a signal corresponding in amplitude to the tone value of the picture element, pure white giving a large signal and pure black a zero signal. At the receiving station a similar device is used, the message being replaced by a strip of photographic paper which is moved continuously forward with a speed equal to that of the message at the transmitting end. The beam of light is now obtained by an argon lamp which acts as a light valve. The motors operating the scanning heads are controlled by means of tuning-forks. A full description of the method is given in the *Electrician* for April 3. The method is particularly useful for telegraphing languages like Chinese, which have to be rewritten in some alphabetic language before being sent by the Morse code in ordinary telegraphy.

THE Marconi Company has received orders for the erection of a chain of wireless transmitting and receiving stations through the heart of Africa. The stations

have been ordered by the Administrations of Uganda, Kenya Colony, Tanganyika, Northern Rhodesia, Southern Rhodesia, and the Union of South Africa, and they will be used both for the operation of the new Cape to Cairo air route and, in many cases, for general communication. The apparatus to be installed will be for transmission and reception on medium and short wave-lengths. When these stations are completed the trans-African aviation service will be the most highly organised long-distance air route in the world, and at the same time internal and external communications will be greatly facilitated throughout the continent. The sites for the stations are to be in the proximity of Kampala (Uganda); Nairobi (Kenya Colony); Moshi, Dodoma, and Mbeya (Tanganyika); Mpika and Broken Hill (Northern Rhodesia); Salisbury and Bulawayo (Southern Rhodesia); Germiston, Victoria West, and Cape Town (Union of South Africa). The wave-lengths used for wireless communication between the aircraft and these stations will be 900 metres, and inter-aerodrome communication will take place on short waves. For general communications, special wave-lengths have been allotted to the stations at Mpika, Broken Hill, Bulawayo, Salisbury, Germiston, and Victoria West, which will be used for this purpose.

IN a dispatch from the Peking correspondent of the *Times* which appeared in the issue of Mar. 30, attention is directed to the manner in which, it is alleged, a Society for the Protection of Ancient Relics, formed some two or three years ago in Peking, is interpreting its functions. The scope of the society is wide, for it covers objects ranging from works of art to fossils. It is semi-official and has the approval of the Nanking Government. Its methods are said to be the subject of much criticism. Apparently the latest object of its attack is Sir Aurel Stein, whose expulsion from Chinese Turkestan, where he is now engaged in exploration, is said to be demanded on the grounds that while he was raising funds in the United States he spoke slightingly of the new China, and that his funds are too large for his purpose, which must have an ulterior and, it is presumed, political object. It will be remembered that Dr. Roy Chapman Andrews experienced obstruction on the return of the Fourth Central Asiatic Expedition from Mongolia, and in the following year the expedition had to be abandoned owing to the delay over the negotiations about the conditions on which the expedition would be allowed to proceed and the Chinese personnel to be attached to it. It is said to have been alleged at the time that Dr. Andrews's expedition was no more than a cover for a search for oil. It is scarcely necessary for us to defend Sir Aurel Stein from these charges, nor the further charge that it was his intention to smuggle out of Chinese Turkestan any antiquities that he might find. The declaration made by him before he entered the country, and forwarded to the authorities by the British Ambassador in Peking, is a sufficient guarantee of good faith, were one needed. Nor is it necessary to enter into the charge against the American expedition, even if there were any evidence before us.

THERE can be no question, however, that the ill-advised publicity given to the character of the material found by the American Central Asiatic Expedition—the dinosaurs' eggs—and the equally injudiciously advertised attempts to raise funds by their sale, aroused the suspicions of the Chinese and impressed upon the less well-informed that something of enormous value was being taken out of the country. It was in precisely similar circumstances that the recent legislation relating to antiquities in Egypt was passed. If the Peking Society is animated, not by a hatred of the 'foreign devil', but by a genuine desire to preserve China's antiquities for China, this is a perfectly legitimate aspiration, recognised as the right of nearly every civilised country, even England—or at least it will be in some degree when the new Ancient Monuments legislation is in force. If this desire is not genuine, as the *Times* correspondent suggests, then an attempt should be made to arrange a *modus vivendi*. It is admitted that, in addition to official personages, the society consists largely of the officials of universities, museums, libraries, research institutes, and the like. A great deal of archæological work has already been carried out in China by Europeans, and we have it on the authority of Prof. Elliot Smith in regard to the latest and greatest discovery of all, the Peking skull, that individual Chinese drawn from the classes which compose the society have co-operated wholeheartedly in organising the work of the geological survey which led up to the discovery of the skull, in the actual discovery, and in the work of preparation in the laboratory with Dr. Andersson, Dr. Davidson Black, Prof. Elliot Smith himself, and others of non-Chinese nationality, who have assisted them from time to time.

MR. BERTRAM THOMAS has been awarded the Founder's Medal of the Royal Geographical Society and also the Burton Memorial Medal of the Royal Asiatic Society, in recognition of his work of exploration in the Great Sandy Desert of Arabia. It is also announced that Mr. Thomas has accepted the invitation to deliver the triennial Burton Memorial Lecture before the Royal Asiatic Society on his return to England. At the close of the War, Mr. Thomas was a political officer in Mesopotamia and his knowledge of the country and his understanding of tribal Arab character proved of signal service to the administration under Sir Arnold Wilson in the troubled years which followed. After serving in the same capacity in Transjordania, he was selected to be the Financial Adviser and Vizier of the Sultan of Muscat and Oman, being the first Englishman to hold such an office, virtually that of Prime Minister. Both in the course of his official duties and in his leisure, Mr. Thomas has explored some thousand miles of the Oman coast in his patrol boat, while his relations with the turbulent tribes of the littoral have enabled him to penetrate country unknown to Europeans, adding considerably to our geographical, ethnological, and linguistic knowledge of Arabia. An account of his last journey appeared in the *Times* only a week or two ago. His first two journeys in Arabia, of which the scientific results were published in the *Geographical Journal*, the *Journal of the*

Royal Anthropological Institute, and other periodicals, have been pronounced by competent authority to be the most important and extensive piece of geographical exploration carried out since the War.

THE various organisations connected with research in the textile industries have now reached the stage where much of their work is suitable for direct application to the immediate problems of the industry itself. The recent Report of the Council of the Wool Industries Research Association (formerly known as the British Research Association for the Woollen and Worsted Industries) gives a concise summary of the application of the work of that Association to woollen and worsted spinning and to dyeing and finishing processes. The Association has, during the past year, continued fundamental research on biological, chemical, and physical problems. It has also devoted much time to the examination of the inherent characteristics of the wool fibre, its response to processing, and the possibilities of its utilisation in directions which are as yet undeveloped. The report records that in the course of electrical investigations, methods have been devised for the prevention of electrification during the processing of wool, and that the use of wool as an electrical insulator has now become an accomplished fact. It further adds that not inconsiderable quantities of worsted yarn have recently left Bradford to be employed for electrical insulation purposes in cable manufacture. There is much scope for this research association, and if its new method of financial support by means of a voluntary levy on the industry becomes really successful, its utility to the wool textile industry should be considerably enhanced.

THE *Journal* of the National Institute of Industrial Psychology, Vol. 5, No. 5, contains an account of "The Organisation of Works Transport", an investigation carried out by Messrs. L. I. Hunt, W. H. O'N. Manning, and G. H. Miles. The problem confronting the investigators was one of hand-trucking in a machine-producing works housed in an antiquated building. The whole transport system was carefully studied. The fluctuating demands of 38 departments and the irregular flow of production along 231 connecting routes were considered. Sources of delay were noted, and a comprehensive scheme of reorganisation initiated; this comprised the classifying of routes, and their co-ordination under a central transport office. A system of circuits, combining all routes, except those with the heaviest loads, enabled a scheduled service to the departments to be maintained. Very definite results followed the introduction of the scheme. The economy of labour amounted to 60 per cent, one man handling 50 instead of 20 loads; labour costs were reduced by 40 per cent, yet labourers' earnings rose; and an efficient, flexible transport system replaced the old cumbersome one. This experiment has been industrially successful; but its scientific value is considerably reduced by the number of variables that have been introduced. The arrangement for a bonus payable on individual output and working-time follows on in the Taylor-Gilbreth tradition and perpetuates the same fallacy. In spite of this, however, many interesting points emerge; and Mr. Hunt's exposition is admirably concise and lucid.

MR. S. MORRIS BOWER, of Langley Terrace, Oakes, Huddersfield, is asking for help in extending a statistical inquiry into the frequency of thunderstorms in the British Isles in winter, which was originated by Mr. C. J. P. Cave in 1916 and was concluded in March 1929, to a similar inquiry for the six months April to September. What is required is a note of the place, date, and time of occurrence of thunder, lightning, or hail, with the direction in which the lightning was seen. Additional details, such as the time of commencement of very heavy rain or hail, should such occur, and of the direction of movement of any well-developed storm, would be welcome. Thunderstorms sometimes move across the country along a definite 'front': that is to say, if crosses are marked upon a map showing where storms occurred at a particular hour, these form a nearly continuous chain; when similar information is shown for a later hour, a similar chain of crosses is normally shown, but displaced from the position that the first chain occupied. Phenomena of this kind are readily studied by professional meteorologists at the Meteorological Office with the aid of synoptic weather charts. But it is only on a small number of days in the year that anything of this kind is to be found on the synoptic charts. Numerous storms, more or less isolated, often occur both in winter and summer. They may travel or remain nearly stationary throughout their life history; in the latter case especially they often lie too far from any official reporting station for their occurrence to be noted officially. It is especially in regard to this class of storm that an organised inquiry is of value, and until such an inquiry has provided a reasonably complete statement of the facts, there is little prospect of being able to give a satisfactory general account of the thunderstorms of the British Isles.

THE arrangements for the British Chemical Plant Exhibition to be held on July 13–18 at the Central Hall, Westminster, in conjunction with the jubilee celebrations of the Society of Chemical Industry, regarding which a preliminary announcement was made in NATURE of Jan. 17, are making rapid progress. About forty firms have already booked space, and since these include most of the important firms in the British chemical plant industry, the success of the exhibition is assured. The exhibits will cover the whole range of the industry. The arrangements which the Chemical Engineering Group of the Society of Chemical Industry is making for the Section showing, on a co-operative basis, the work of the various research associations and of the Department of Scientific and Industrial Research are also well advanced. The scheme is being supported by the Department, which will be represented by the National Physical Laboratory, the Chemical Research Laboratory, the Fuel Research Board, the Forest Products Research Laboratory, and the Building Research Board. The research associations dealing with the following industries will co-operate: boots, shoes, and allied trades; cast iron;

leather; linen; non-ferrous metals; paint, colour, and varnish; rubber; wool. There will be three main groups, dealing respectively with (1) materials used in chemical engineering, such as metals, fabrics, etc.; (2) chemical plant and associated equipment, including that employed on fuel; and (3) testing apparatus and standardisation.

So long as mountain peaks remain unscaled by man there will be found hardy adventurers to attempt them, for the glory of achievement as well as for the valuable scientific data which well-organised expeditions afford. In 1924 there was the last Everest expedition, which ended so tragically with the death of Mr. G. L. Mallory and Mr. A. C. Irvine. Last year saw the attempt on Kanchenjunga led by Dr. Dyhrenfurth, when the climbers reached Jonsong Peak (24,344 ft.). Now we have a British expedition, consisting of Mr. F. S. Smythe (leader), Capt. E. St. J. Birnie, Dr. R. Greene, Mr. R. L. Holdsworth, and Mr. E. E. Shipton, which will attempt Mount Kamet (25,447 ft.). According to the *Times* of April 4, the party left Venice on that day for India. Mount Kamet is in the Gharwal District of the United Provinces and is in the Zaskar Range, a northern branch from the main Himalayan chain. The approach to Mount Kamet will take the expedition across the watershed separating the principal sources of the Ganges, to the glaciers above Gangotri, which is to the east of the main peak, and it is expected to obtain valuable topographical, physiological, botanical, and other data and useful climbing experience. There have been several attempts on Mount Kamet in the past, the last being in 1920, so the present expedition should have the advantage of knowledge of local conditions.

THE great heights of many of the blocks of buildings recently erected in America and picturesquely called skyscrapers has led to the development of high-speed lifts. In the *Westinghouse International* for the first quarter of 1931, a description of Carew's Tower, Cincinnati's largest structure, is given. It combines a 48-story office building, a 28-story hotel, a 25-story garage, and many retail shops. Three floors in the office building are reserved exclusively for doctors and dentists. Forty-one lifts are required, including six of the fastest in the world, to make life in this self-contained city possible. The express lifts move at a speed of 900 feet per minute, which is a little greater than ten miles per hour. The speed of the local lifts is 700 feet per minute. The hotel contains a thousand rooms and is served by nine lifts, six passenger and three service. There are three large motor-car lifts serving the parking garage. Their speed is altered by varying the applied voltage, thus eliminating mechanical gear. They can make a flight up the 25 floors in about half a minute. The stores use lifts moving at 450 feet per minute. At still slower speeds, dumbwaiters, sidewalk lifts, a 12·5-ton hydraulic lift, and an observatory-tower lift operate. At speeds of 500 feet and above it is practically impossible to read the numbers on the various floors. Lifts for speeds up to 1200 feet per minute are being designed, and at present there seems nothing to stop still higher buildings and still faster lifts from being constructed. A description of the lifts used to carry the students from one lecture room to another in the University of Pittsburgh, which is 40 stories high, is also given.

SEVERAL special problems have arisen in connexion with the supply of direct current to traction systems. Two solutions are in use and they are advancing in widely diverging directions. In America, the method of converting alternating current into direct current in the automatic substations is to use machinery of the rotating converter type. In Europe the use of mercury arc rectifiers is rapidly extending. In a paper read to the Institution of Electrical Engineers on Mar. 12, by J. W. Rissik and H. Rissik, the special requirements of traction operation were outlined and the present state of development of the ironclad rectifier for traction use, as reflected in its applications in converting substations on the Continent, was described. Since the War, the use of rectifiers in Germany has extended very rapidly. The whole of the Berlin city and suburban railway system is supplied by rectifiers in 47 substations, 31 being controlled from a distance. The German federal railways have adopted the rectifier as the standard equipment for traction substations. The development of rectifiers in America has been comparatively slow; the rectifiers manufactured there are generally designed in accordance with the latest European practice. In Great Britain the increased demand has stimulated manufacturers to compete with foreign firms by improving their designs. The authors believe that in the scheme of general railway electrification which will eventually be carried out in Great Britain, rectifiers will be used, if not exclusively, then very largely. They think that in the next decade Great Britain will be placed in a position comparable with that which now obtains in Germany.

WRITING on "Chemistry as a Career", in the *Alumnus Chronicle* of the University of St. Andrews, Prof. John Read remarks on the current tendency in certain secondary or public schools to carry specialisation too far with apt pupils. This tendency appears to be largely a response to the requirements of some of the universities in their entrance scholarship examinations. Hence many such pupils acquire little or no knowledge of biology, whilst others are deficient in English, modern languages, mathematics, and other fundamental subjects. Prof. Read wisely advocates that a pupil should be restrained from inordinate specialisation, until he has secured the necessary basis of a well-proportioned general education, and he supports the adoption of a broader test of intelligence and merit than that now imposed on scholarship candidates. In the same article, Prof. Read explains the complex nature of the chemical profession and surveys the prospects which confront entrants. He points out that chemistry provides a multitude of diverse professions, rather than a single homogeneous profession, and that in doing so it provides scope for all sorts and conditions of chemists. Just as it is difficult to legislate effectively for the com-

plex racial association of the British Empire, so the complex corporation of chemists is unable to safeguard the interests of the profession in a generally acceptable manner. Whilst specialisation at an early stage is undesirable, it is nevertheless essential later, and it is evident that at present there is no overproduction of chemical specialists of first-class ability. On the other hand, it is difficult to find openings in chemical industry for men of second-class attainments or for women chemists possessing the highest qualifications. Prof. Read pays a deserved tribute to the late Lord Melchett's policy in advancing the career of industrial science; in a scientifically organised chemical corporation with trained chemists in the highest administrative positions and on the board of control, the chemist is no longer the factory 'maid of all work'. Expansion of schools of organic research in the British universities in response to demands formulated under the shelter of the Dyestuffs Act has also opened attractive and useful scientific careers.

THE biological interests of the Galapagos Islands are so many that it is strange that no thorough exploration of their inhabitants had been carried out since Charles Darwin made them famous, until the islands were visited by the expedition, planned by L. M. Loomis, formerly director of the California Academy of Sciences, which remained in the field for more than seventeen months during 1905–6. An account of the work of the expedition, by Joseph R. Slevin, now appears as one of the *Occasional Papers* of the California Academy of Sciences, under the title "Log of the Schooner *Academy*". It is an interesting story. The study of the land tortoises, of which 266 specimens were collected, showed that, contrary to belief, they still inhabited all the islands in the archipelago from which they were formerly known (except Charles Island), and that they even existed on islands where they were never before observed. But many minor biological points attracted the attention of the explorers. The tameness of birds and lizards was remarkable: both would come to pick up crumbs dropped beside the observer; both, alas! were rewarded by being killed with a switch. The lack of sensitiveness possessed by lower animals was well shown when, on a lizard's tail being severed by a knife, the animal did not move until, seeing the wriggling severed portion, it turned about and grabbed it as if it were a foreign object. Land iguanas were common on Narborough Island and occurred over the whole area, even to the rim of the crater at an altitude of 5000 feet; and the wild goats on Hood Island, feral descendants of domestic stock, quenched their thirst by drinking sea water on the beach.

AT the meeting of the London Mathematical Society on Thursday, May 14, at Burlington House at 5 P.M., Prof. J. E. Lennard-Jones will deliver a lecture on "Quantum Mechanics of Atoms and Molecules". Members of other scientific societies who may be interested are invited to attend.

HIS MAJESTY THE KING has been pleased to approve the award of the Royal Medals of the Royal Geographical Society as follows: *Founder's Medal* to Mr. Bertram S. Thomas, for his geographical work in Arabia and successful crossing of the Ruba el Khali; *Patron's Medal* to Rear-Admiral Richard E. Byrd, U.S.N., for his expedition to the Antarctic, and his flights over both north and south poles.

THE first of a series of demonstrations of horticultural machinery is announced in the Mar. 26 issue of the Ministry of Agriculture's weekly publications. The trials took place recently at Pinhoe, Devon, on a mixed fruit plantation kept in a high state of cultivation. The implements used were the Simar Rototiller Nos. 3 and 5 and the 'Monotrack' motor cultivator, the Planet Junior (garden tractor), the Gravely motor cultivator, and the Auto-Culto motor cultivators, two types of the latter machine being used, one fitted with tines and the other with a 'one-way' plough. All implements, except the Simar 5 and the Auto-Culto motor with plough, carried out cultivation between strawberry rows, the distance between the rows being about 2 ft. 6 in. Later in the day all implements except the Auto-Culto plough worked among raspberry canes, the width cultivated being about the same (2 ft. 6 in.). The Auto-Culto ploughed on land from which broccoli crop had been taken. The demonstration, which was very well attended and carried out under favourable weather and soil conditions, proved entirely successful, all implements working successfully.

THE subject selected by the Exhibition Committee for this year's exhibition at the Royal Institute of British Architects is "The Architecture of Modern Transport". It will consist of photographs, drawings, and models of architectural and decorative subjects connected with modern transport, and is intended to illustrate the latest developments both in Europe and America. The types of work will include railway stations, signal-boxes, various types of railway coaches, docks, harbour works, canal power stations and locks, liners and yachts, bus and coach stations, garages and filling stations, trams, buses, charabancs and private cars, bridges and viaducts, pylons, traffic control stations, hangars and aerodromes, aeroplanes and airships, lifts and moving stairways. The exhibition will be formally opened by Mr. H. G. Wells on April 21, at 3 P.M., and it will remain open until May 22. Admission will be free.

ANOTHER of the well-known and valuable catalogues (No. 443) of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, has reached us. It gives the titles of, and in many instances useful bibliographic notes upon, upwards of 1500 works on botany, agriculture, forestry, fruit-culture, gardens and gardening, herbals, early medicine and surgery, tobacco, etc., and should be obtained by collectors.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued Catalogue No. 183 of some 695 second-hand books on gardening and botany, including materia medica, pharmacy, perfumery and scent, from the libraries of the late Mr. E. M. Holmes, curator of the Museum of the Pharmaceutical Society, and the

late Mr. W. Davis, collector for Messrs. Veitch. The same firm has also circulated a short handy list of useful books on gardening. Both catalogues may be had free of charge on application.

A CLASSIFIED list of second-hand instruments has recently been published by Messrs. C. Baker, 244 High Holborn, London, W.C.1. The list is divided into ten sections, comprising microscopes and cognate apparatus, surveying instruments, astronomical instruments, spectroscopes; projection apparatus, including lanterns, slides, and projection microscopes; field-glasses, chronometers, anemometers, thermometers, barometers, balances, hydrometers; various kinds of physical apparatus, such as polariscopes, voltmeters, and galvanometers; and photographic apparatus. Apparatus can also be had on approval or on hire.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A sugar-cane mycologist and a research assistant, each at the Agricultural Research Institute, Pusa, India, for research into mosaic and other diseases of sugar-cane —The High Commissioner for India (General Department), India House, Aldwych, W.C.2 (April 20). A lecturer in geography at the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth (April 25). A lecturer in metallurgy at the Bradford Technical College—The Principal, Technical College, Bradford (April 30). A lecturer in philosophy at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (May 2). A draughtsman under the Ministry of Agriculture and Fisheries—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (May 7). A chief research worker in the Nutrition Research Laboratories of the Indian Research Fund Association—The Secretary, Indian Research Fund Association, Simla, India (June 1). Teachers of woodwork under the Kent Education Committee—The Director of Education, Springfield, Maidstone. A handicraft teacher (wood and metal work) under the Norfolk Education Committee—The Secretary, County Education Office, Stracey Road, Norwich.

Our Astronomical Column.

Comets.—Prof. G. van Biesbroeck records, in *Pop. Astr.* for March, a remarkable increase of light in comet Schwassmann-Wachmann (1), which passed perihelion nearly six years ago, and is now more than seven units from the sun. In the middle of January, its magnitude was 17½, but on Feb. 11 it had risen to 12½, thus showing a hundred-fold increase in the light. There was a somewhat similar, but less intense, outburst in December 1929, the magnitude then rising from 17 to 13½. Both the outbursts were short-lived, the additional light fading after a few days. It would seem that the cause of the outbursts must be sought in the comet's nucleus, rather than in the sun; but its nature remains a mystery. A somewhat parallel case was presented by the two successive outbursts of light of Holmes's comet, at its first apparition in 1892. That comet was, however, much nearer to the sun, less than three units.

Prof. van Biesbroeck continued his observations of three other comets during February. Stearn's comet has now been observed for four years, and is distant from the sun 11½ units, establishing a record in that respect. Beyer's comet is still of magnitude 14½, and promises to be visible for several months more. Comet Tempel (2) has been observed for six months, but is now lost in the sun's rays.

Prof. Nakamura gives some more details, in Kwasan *Bulletin* 192, of the object that he discovered last November: it was called comet 1930 *g*, but it may be a minor planet; it looked quite sharp on some days, but on others had a nebulous appearance. Positions are given for Nov. 16, 17, and 18; plates were exposed on it until Nov. 28, but it faded rapidly, and no images have yet been detected after Nov. 18.

The search for Encke's comet has been fruitless; it must now be left to southern observers to pick it up after perihelion passage, which occurs on June 3. It will be too near the sun until then to make detection possible.

Distances of the Cepheid Variables.—Very wide use has been made of the principle, first discovered by Prof. H. Shapley and his assistants, that the period of variation of a Cepheid gives a measure of its absolute magnitude, and consequently of its distance. The distances of the globular clusters and of the spiral nebulæ are chiefly based on this method. The graduation of the scale of absolute magnitudes involves the finding of the distances of the nearer Cepheids; this is a difficult matter, as they are too distant to obtain accurate trigonometrical parallaxes. Estimates were made from their proper motions, but as these are small, it was known that the adopted values are subject to correction. *Ast. Jour.*, No. 951, contains a new discussion of their distances by B. P. Gerasimovic. He redetermines the proper motions with the aid of recent catalogues, and also makes some use of the radial velocities, using the radial motion due to galactic rotation in the same manner that Dr. J. S. Plaskett has done for the *B* and *O* stars. He finds that for stars with period 4-days, Shapley's absolute magnitudes need to be increased (that is, made fainter) by 0·9 magnitude, while for 8-day and 16-day periods the increases are 0·8 and 1·2 magnitudes. He adopts 1·0 magnitude in the mean as the average increase needed for the Shapley absolute magnitudes. This implies that distances found from the Shapley curve need to be reduced in the ratio 0·631 to 1, or about 5 to 8. R. E. Wilson had suggested 0·7 to 1, which is in fair accord; but the much more drastic reduction of Shapley's distances in the ratio of 0·13 to 1, suggested by Curtis, Kapteyn, and van Rhijn about ten years ago, is shown to be improbable.

Pluto.—A further article on Pluto by Prof. H. N. Russell appears both in the February number of the *Scientific American* and the February number of the *Journal* of the Royal Astronomical Society of Canada. It describes the barycentric orbit, deduced by Nicholson and Mayall as a simple method of allowing for the greater part of the action of the other planets upon it. Their period is 247·69 years, which is so close to 1½ times Neptune's period that it will need an interval of some 40,000 years to elapse before Pluto and Neptune are at their minimum distance from each other. The work of Nicholson and Mayall indicates that Pluto's mass is probably comparable with that of the earth. Prof. Russell notes that if Pluto's albedo is the same as that of the lunar maria, its diameter would be about equal to that of the earth.

Research Items.

Ancient Man in the Gipping-Orwell Valley.—The *Proceedings* of the Prehistoric Society of East Anglia for 1930, vol. 6, pt. 3, contains a study of the deeply buried deposits of the non-tidal valley of the Gipping above Ipswich and the tidal part of the valley of the Orwell below Ipswich. These deposits lie in deeply cut and steep-sided channels, filled apparently with glacial material buried beneath the deposits lying on the floor of the present valley. They are evidently of high antiquity. (I.) The Gipping Valley. (1) After the retreat of the ice which laid down the Upper Chalky Boulder Clay (third glacial epoch of East Anglia) and while climatic conditions were still severe, Aurignacian peoples were living in the valley. Afterwards 11 ft. of gravel was laid down, with an increase of cold conditions. It is possible that one bed represents the fourth glacial epoch of East Anglia, and that the flint implements it contains were swept down and redeposited over the slightly less old implements found beneath. (2) The Flood Plain Terrace. In ascending order are encountered (*a*) a Combe Capelle floor of Early Mousterian age, (*b*) Early Solutrean, fine flint blades in loam belonging to the third inter-glacial period below Flood Plain gravel. Mammalian bones, among them the mammoth, belong possibly to this horizon. (3) The gravel of the Flood Plain Terrace of post-Early-Solutrean age contains a large number of derivative flakes and implements, to be associated with the passing away of the fourth glacial epoch, the Boulder Clay of which contains implements of upper palæolithic type. (4) The beds above the Flood Plain Terrace. From the loamy peat deposit have been recovered a number of long, thin blades of flint probably of Magdalenian age. (II.) The tidal portion of the Orwell Valley. Overlying the basal gravel is a bed of compact peat, from which it is probable there came a skull comparable with the Tilbury skull and possibly contemporary with the Combe Capelle type of implement. Above the lower peat is a shingly gravel capped by peat and mud in alternate layers. From the base of the alluvium probably came implements exhibiting affinities with the Magdalenian. In both the Gipping and Orwell valleys the neolithic period is represented, both geologically and archæologically only in the superficial beds.

Song of the Skylark.—There have been many opinions expressed as to the length of time occupied by the song of a skylark. Opinions would have been fewer and more consistent had each observer taken the trouble to time more than a thousand songs, as Noble Rollin did before writing a short paper on the subject (*Scottish Naturalist*, 1931, p. 47). Variations in length occur according to the time of day, the month of the year, and the idiosyncrasy of the birds themselves, so that the range runs from 1 to 19 minutes. But the average length was only 2·22 minutes. A series of graphs illustrates time variation in successive songs, the average length of song for each month (ranging from 1½ minutes in July to 3 minutes in September), and the percentage occurrences of various song-lengths in different months.

Intelligence of a Raccoon.—Experimental tests made by Prof. Wm. McDougall with the object of discovering whether a raccoon was capable of foresight are recorded in a *Daily Science Bulletin* issued by Science Service, of Washington, D.C. The animal was trained to look in a box for food. Then a latch was put upon the box, pivoted on a screw so that a light push in the right direction would release the lid. The raccoon having unsuccessfully tried to raise the latched lid, in a few seconds opened the latch and secured the food. One by one, other latches were added, each new latch in the series holding the one attached previously, so that each had to be released in order before the next could be moved. Thus a complicated series of 24 latches was built up, extending all round the box. After the first few attempts, the raccoon never attempted to reach the food directly, but attacked the latches at once; and so efficient did she become that she was able to manipulate the series of 24 and open the box in a few seconds. When some of the series were left open, she would pass them by untouched, in order to proceed to the closed latches. Prof. McDougall, whose full report will appear in the *Journal of Comparative Psychology*, regards the behaviour of the raccoon as showing that its actions were governed by foresight of the result of the actions.

Bacteria in the Sea.—Miss Blodwen Lloyd in her paper "Bacteria of the Clyde Sea Area: a Quantitative Investigation" (*Journal of the Marine Biological Association of the United Kingdom*, **16**, 3; 1930) summarises her results of sampling three stations at regular intervals over a period of one year, together with further occasional samples from other localities. The stations chosen were at Loch Striven, Loch Long, and Greenock, representing areas respectively free from pollution, moderately free, and highly polluted. The apparatus used for vertical sampling is simple and the technique for the routine work follows as nearly as possible the procedure recommended by the American Society of Bacteriologists for standard examination of water, with some modifications. The incubation temperature was lower by some six to twelve degrees than that usually employed, in order to encourage the growth of true water bacteria and to discourage other bacteria which thrive at higher temperatures. The counts were made directly and the dilution method was not used. The largest number of bacteria was found in the surface waters, decreasing with increasing depth until, at the bottom, there was a slight increase. The numbers were remarkably constant throughout the year for all layers, with only slight evidence of rhythmic variations, except at the surface, where the numbers fluctuated considerably. In the daytime the bacteria at the surface are irregular in number; but in the lower levels there is a slight increase during darkness. Loch Striven and Loch Long are very free from pollution, but in Cumbrae Deep and in the estuary off Greenock the numbers are high, with a large proportion of what are presumably coliform bacteria.

Alcyonaria of the Faroes.—The Alcyonaria of the Faroes are for the first time described in detail by Dr. P. L. Kramp ("Zoology of the Faroes", edited by Ad. S. Jensen, W. Sundbeck, and Th. Mortensen. 1930. Vald: Pedersens). Six species of Alcyonaria are known from the Faroes, all mainly boreal, and from the deeper water, about 400-650 metres around the Faroe plateau, five more are added. The two littoral species *Alcyonium digitatum* and *Virgularia mirabilis* are very common, having their principal area of distribution south of the Faroes; but they are also found somewhat farther north. *Alcyonium* likes a hard bottom and *Virgularia* likes a soft bottom. No species with distinctly northern distribution has been found on the Faroe plateau. The gorgonacean, *Stenogorgia borealis*, was named, but not described, in 1915 by the late Prof. Jungersen in "Conspectus Faunæ Groenlandicæ". Dr. Kramp, who has examined all Prof. Jungersen's material, now describes this species in detail with good figures. It differs from

other species of the genus in the tentacles being always completely destitute of spicules; but it closely resembles them in many other ways and undoubtedly belongs to this genus.

Rafinesque's Types of Helices.—H. A. Pilsbry (*Proc. Acad. Nat. Sci.*, Philadelphia, **82**, pp. 321-326; 1930) discusses the types of Rafinesque's genera of Helices. Rafinesque published in 1818 a list of generic names, without descriptions or species, which was therefore of only historic interest. The terrestrial genera were *Limax*, *Helix*, and seven new genera which he described in two papers, one in 1819 and the other in 1831. Mr. Pilsbry considers each genus in turn, and indicates the species he considers should be taken as the type for those genera which are held to be valid. For the genus *Aplodon* with three nodose whorls no satisfactory explanation has hitherto been forthcoming, for, as Mr. Pilsbry points out, there is no shell in Kentucky (the area from which Rafinesque collected) which offers the slightest approach to the description. But if it be supposed that Rafinesque had a stray marine shell among his Kentucky collections, the case becomes clear, for the description applies perfectly to the common species *Modulus modulus* (L.) from Florida and the West Indies. Mr. Pilsbry is in no doubt as to the identity, and as *Aplodon* is prior to *Modulus*, he suggests that the generic name of the common marine shell be changed accordingly.

Fresh-water Diatoms.—The survey of fresh-water Bacillariales of Devonshire by G. T. Harris (*Trans.* of the Dev. Assoc. for the Advancement of Science, Lit., and Art, 1930) represents a large amount of work, extending over four or five years. The field is one to which little attention has been paid and it would be interesting to know how surveys of other counties would compare with Devonshire. Harris records 232 species from Devon, whilst West and Fritsch in the last edition of "Freshwater Algæ" say that about 250 species occur in the British area, which suggests that either Devon is extremely rich in species or else that the total number for Britain should be considerably higher. In connexion with this, it may be significant that Harris finds the majority of the species more or less indifferent to habitat, so that it is possible that the diatom floras of different parts of the country might show less variation than is found in the case of other groups of plants. As the number of species of diatoms is so large, the author is certainly wise, at this stage, to limit the records to well-defined species and not to multiply the number by including doubtful species or by taking into account varietal differences.

Significance of Relative Sexuality.—Max Hartmann gives an interesting survey of the possible influence of external and internal factors on sex determination in Thallophyta in *Die Naturwissenschaften*, Heft 1, 1931. The facts bring out clearly the bi-sexual potentialities of the sexual cells or gametes, but the fact that one sex always dominates, suggests that some realising factor is superposed, so that, regardless of external factors, any sexual cell has a definite tendency towards a particular sex. The realising factor may be unequally distributed at meiosis, a clear example of which is *Gonium pectorale*, in which the four-celled cœnobium is built up of two cells of male tendency and two of female. In this, and in the majority of cases, the sex appears to be fixed, though in some cases the sexual cells may occur in such close relationship to one another that it would be interesting to know what determines the behaviour. Examples of *Achlya americana* have been observed in which the antheridial tube originated from an oogonium, and also others in which an antheridial tube, after fertilising an oogonium, grew on and produced a terminal oogonium. Very interesting, from this point of view, is the work of Hartmann on *Ectocarpus siliculosus*, and of Jollos on *Dasycladus clavæformis*, where, by testing the gametes from different plants in various combinations, it was shown that not only could they be grouped as male or female, but these groups could be subdivided according to the intensity of the sexual tendency. Still further, if gametes of the same sex but of sufficiently different intensities were brought together, the gamete of weak intensity might actually behave as one of the opposite sex and copulation take place. These two algæ present a good illustration of the bi-sexual potentialities of sexual cells and of the fact that normally the dominant sex is determined by some internal factor; but if this 'realising' factor is weak, then an external factor, such as the proximity of another gamete of stronger sexual tendency, may actually determine the behaviour. So that we have here a typical example of relative sexuality.

Soil Sterilisation.—The value of soil sterilisation (or more strictly speaking, partial sterilisation) for the control of injurious insects and fungi and for effecting changes that lead to better cropping has proved so considerable that, at the invitation of the Ministry of Agriculture, Dr. W. F. Bewley has prepared a bulletin on the subject, entitled "Practical Soil Sterilisation". Growers of glasshouse produce no longer regard these operations as expensive luxuries and in market garden and propagation work they may also be carried out with advantage. Sterilisation can be effected either by steaming, baking, or treatment with chemicals such as cresylic acid or formaldehyde; but of these the steaming method is the most strongly recommended, treatment once in four years being sufficient. Baking is also reliable when the quantity of soil is relatively small. Chemical treatment, on the other hand, is less satisfactory, and must be carried out each year to be effective. Full working details, with costs, of the various methods are supplied and their relative merits discussed. Attention is also directed to the fact that care is needed in the manurial treatment after steaming, for the soil tends to become specially rich in nitrogen and will require the addition of phosphate and potash only to secure a proper balance. The use of stable manure may in such cases prove harmful. The bulletin, No. 22, which may be obtained direct from the Ministry of Agriculture, 10 Whitehall Place, S.W.1, price 1*s.* post free, should prove of great value to all those interested in glasshouse crops; but growers are advised to consult an expert before undertaking sterilising operations for the first time.

Raised Beaches of New Zealand.—The recent disastrous earthquake in New Zealand lends additional interest to an investigation by L. C. King of the raised beaches of the south-east coast of North Island (*Trans. and Proc. N.Z. Inst.*, Vol. 61, pp. 498-523; 1930). It is shown that the coast-line is one of emergence, except at Port Nicholson (a local down-warp) and Palliser Bay (a fault-angle depression). Along most of the coast-line studied, uplifted terraces of undoubted marine origin testify to the amount of comparatively recent uplift from place to place, and demonstrate that the movements were not uniform, but consisted of a series of interstage warpings and tiltings. The two main terraces suggest a general axis of tilting somewhere in Cook Strait. From Terawhiti to Black Rocks, the higher of these rises from 250 ft. to 950 ft., and the lower from 125 ft. to

700 ft. The platforms are carved in hard greywacke. A lower beach at 25-35 ft. indicates that one of the latest movements of the coast appears to have been a general uplift of approximately 30 ft. along almost the whole length described. The paper is well illustrated and includes a useful critique for the discrimination between marine and alluvial terraces.

Diffraction of Electrons in Gases.—Many diffraction experiments have now been performed in which electrons or atoms are made to exhibit undulatory properties in interaction with periodic structures. The *Proceedings of the Royal Society* for March contains accounts of two sets of experiments which furnish what is practically the electron analogy of the formation of haloes by clouds of fine particles of water, that is, diffraction by an obstacle the dimensions of which are comparable with the wave-lengths of the electrons. In the one case, studied by E. C. Bullard and H. W. Massey, the obstacles were the individual atoms in argon, in the gaseous phase, and in the other, studied by F. L. Arnot, atoms in mercury vapour. In both cases the apparatus was quite simple in principle; a beam of electrons was projected with definite speed into the gas or vapour at low pressure, and the electrons, which were scattered from a small volume into a Faraday cylinder without loss of energy, were measured for various orientations of the projecting and collecting systems. The curves showing the variation of the current scattered, with angle of scattering, exhibit series of maxima and minima, which change in position as the energy, or wave-length, of the electrons is changed. The full theory of this type of scattering has not yet been developed, a fundamental difficulty occurring from the fact that the wave-lengths of the electrons alter as they are accelerated or retarded in the fields of the scattering particles, but the qualitative course of the effect is what would be anticipated, and, in the case of argon, there is fair agreement between the results which have been obtained and those of Ramsauer for the effective cross-section of the atom for slow electrons of various speeds.

Gas Analysis Apparatus.—The Bureau of Standards *Journal of Research* for January contains a paper by M. Shepherd in which an improved volumetric apparatus is described for the analysis of gases by combustion and absorption methods, with details of manipulation. The apparatus is of the Orsat type, that is, the series of pipettes is connected to the burette; but the adjustment and control of pressure balances have been greatly improved. The combustion and absorption pipettes have been redesigned, and a new type of mounting permits the easy removal and replacement of any part. It is suitable for rapid technical analysis. Very complete details of construction and use are given.

Chemistry of Disinfection.—In a paper on the chemistry of disinfection, in the February number of the *Journal of Physical Chemistry*, W. D. Bancroft and G. H. Richter, from ultramicroscopical observations on the colloidal changes in living cells and bacteria, conclude that antisepsis in bacteria is merely a state of narcosis depending upon the reversible coagulation of the cell colloids. Disinfection is brought about by the irreversible coagulation of the cell colloids. The observations have shown that other means—action of heat, light, distilled water, or mechanical agitation—which produce coagulation also produce antisepsis or disinfection. The mechanism of disinfection consists of two phases: (1) the adsorption of the drug and (2) coagulation of the cell colloids; and the phenomena of stimulation are associated with the decreasing stability of the cell colloids in the initial stages of coagulation. Drug tolerance is similarly attributed to fractional coagulation, with adsorption of the drug by the coagulum and simultaneous increased stability owing to dilution of the sol. Antiseptics and disinfectants, like narcotics, can thus act in two ways, either directly coagulating the colloids, as in the case of phenol, or by interference with the normal cell functions so that accumulated toxic products produce the coagulation. Arsenic derivatives appear to act in the latter indirect way.

Diphenyl and its Derivatives.—The *Journal of the American Chemical Society* for January contains a paper by Clark and Pickett on the X-ray investigation of diphenyl and some of its active and inactive derivatives. It is known that substitution of certain groups in the 2, 2′, 6, 6′ positions in diphenyl gives rise to compounds which may be resolved into stereoisomers, and it is thought that the presence of sufficiently large groups prevents the free rotation of the two rings and hence two active forms of such a compound exist. The examination of such compounds by X-rays should throw much light on their structure. So far as the investigations have gone—and it is emphasised that accurate measurements of intensities are still required before certainty can be reached—they indicate that the two benzene rings in diphenyl are in prolongation of each other rather than doubled over each other, and this is also the configuration accepted by most organic chemists. The rings are probably puckered, not flat, a conclusion also reached by Hengstenberg and Mark. The width of the molecule is probably 5·6, the actual thickness less than 4·1, and the length greater than 9·5. The carboxyl groups in diphenic acid probably exert forces upon each other which result in a doubling up of the molecule, a supposition which is in agreement with the ease of formation of an anhydride of this acid. The thickness of the molecule is constantly 4·3 for the derivatives of diphenyl. The width is 7·9 for hexachlorodiphenyl, and the length 10·75. The values for dimesityl and its diamino derivative indicate a tilt of the rings.

Barley Proteins.—A contribution to this subject from the Tuborg Laboratories, Copenhagen, by G. Hofman-Bang appears in the February issue of the *Journal* of the Institute of Brewing (**37**, 72; 1931). It was found that the proportion of insoluble proteins (glutelin) varies according to the variety of barley, but that, for one particular variety, it is constant and independent of the soil conditions. The salt-soluble proteins decrease and the alcohol-soluble proteins (hordein) increase with increase in the total protein content of the barley, though after drying there is an increase of both hordein and salt-soluble proteins and a decrease in glutelin. A conversion of salt-soluble protein into glutelin occurs, without, however, a change in hordein content, on storage of the barley. At 20° C. with samples containing 11 per cent or less of moisture this change is very slight; but the rate of reaction increases with increase of either temperature or moisture-content. These results are of considerable importance in their relation to the changes undergone by barley during malting, but they are also of great interest in that they substantially confirm, for Danish barleys, the relationships between the individual proteins already established by Bishop in Great Britain. Some work has also been carried out on the influence of various practical malting conditions on these relationships, and it has been shown that in the presence of large proportions of carbon dioxide germ-growth is checked and an accumulation of salt-soluble proteins in the malt is promoted.

Pyrethrum as an Insecticide and its Cultivation in England.

By J. C. F. FRYER and C. T. GIMINGHAM, Plant Pathological Laboratory, Ministry of Agriculture.

THE insecticidal properties of the flowers of certain species of pyrethrum (*Chrysanthemum*) have been known for a long period, the very high toxicity of the active principles to insects and their harmlessness to man and warm-blooded animals forming an almost unique combination of qualities. It is, however, within the last decade only that the chief advances towards a detailed knowledge of these plants have been made, and the marked interest aroused in the subject recently makes it appropriate to direct attention to the present position of investigations undertaken in Great Britain.

Three species of pyrethrum, *Chrysanthemum cinerariæfolium* Trev., *C. coccineum* Willd., and *C. marschalli* Ascher (*roseum* Bieb.), possess insecticidal properties. Of these, the first named is much the most important; its flowers constitute the great bulk of the pyrethrum of commerce, and the work to be referred to has been confined almost exclusively to this species. The plant is a native of the Mediterranean coast region, and is widely cultivated there and in Japan *; it is now also grown commercially for home consumption in Switzerland, France, and North Africa.

Experiments on the cultivation of pyrethrum in England were started in 1925 by the Plant Pathological Laboratory of the Ministry of Agriculture,[1] small plots being laid down at some sixteen centres on a variety of different types of soil. In co-operation with the Insecticides and Fungicides Department of Rothamsted Experimental Station, samples of the produce from many of these plots during the years 1926–29 were tested by a biological method and later examined chemically (see below), and, without going into details, it may be said that the result of these experiments has demonstrated that pyrethrum can be grown and harvested successfully under English conditions, that the average yield of dried flowers is of the same order as that obtained elsewhere, and that the insecticidal efficiency of the product is not less than that of imported samples.[2] The plants proved quite hardy and successfully withstood the fairly severe winters of 1927–29; a plot at Harpenden, planted in 1925, is still in good condition and gave its highest yield of flowers in 1930. These experiments, however, were on too small a scale to give data on which an opinion could be formed as to the economic possibilities of growing pyrethrum in England, and arrangements were therefore made to plant up several larger areas of ½ to 1 acre, for which detailed costings could be kept. Four of these bigger plots yielded their first harvest of flowers in 1930, and another should come into bearing this year. It will be necessary to continue these investigations for several years before the desired information is obtained, but the first year's figures are, on the whole, not discouraging, though in one case the grower considered the crop too troublesome and has decided to discontinue the experiment. The produce from all four plots was of high quality; two gave a yield which is about the average for a first-year crop, the yield from the third was rather below the average, and from the fourth was very much higher. Costs of planting and cultivation are much greater in the first year than later, but reckoning the produce at the current price of imported flowers (at present rather low), expenses were about covered in the case of the fourth plot. These plots should continue to crop for at least another four years, during which the expenses of cultivation will be greatly reduced. Thus, although the results so far obtained do not warrant confidence as to ultimate success, they certainly justify the continuation of the experiments. Cutting the flowers by hand is probably the most serious item of expense, and labour costs will be considerably reduced if a mechanical means of harvesting can be devised.

Laboratory investigations have proceeded concurrently with the field experiments. The brilliant investigations of Staudinger and Ruzicka [3] elucidated the composition of the active principles of pyrethrum and showed that these were two esters of complicated structure, to which the names pyrethrin I. and pyrethrin II. were given. A method for the determination of these substances was also suggested by Staudinger and Harder.[4] Following up these researches, analytical methods, involving the use of only small amounts of material, were worked out at Rothamsted, and a number of samples were examined both biologically and chemically. A close correlation was found between the percentage of pyrethrins in a series of samples and the observed insecticidal efficiency under standard conditions.[5]

Another point to which special attention has been given is the relationship between the stage of development of the flower and the pyrethrin content. It is an established convention in the trade that pyrethrum flowers picked before they are fully open ('half opened') possess greater insecticidal value than the fully opened flowers, and higher prices are given for the former.† Biological experiments carried out under standard conditions have, however, shown that the toxicities of extracts of equal weights of pyrethrum flowers at different stages of development do not differ significantly,[2] and a detailed investigation by Dr. F. Tattersfield (not yet published) of the pyrethrin content of flowers taken week by week over the flowering period, in which the large mass of data obtained is dealt with statistically, shows that the percentage of pyrethrins present increases up to the stage at which the flowers are fully open. Gnadinger and Corl,[6] in America, using a different analytical method, have also found that the pyrethrin content of the flowers increases with maturity. The point is of great practical importance, since the yield both of flowers and of active principles which can be harvested per unit area increases markedly with increasing maturity of the flowers.

Evidence has accumulated in the past two years that many samples of pyrethrum grown in England contain a higher percentage of pyrethrins than is generally found in imported consignments. Figures of 1·5–2·0 per cent are not uncommon, whereas imported samples commonly contain not more than 0·5 per cent. Further, analysis of the flowers of individual plants have shown wide variations in pyrethrin content, and the possibility of evolving improved strains is under consideration.

Pyrethrum insecticides were formerly confined very largely to powders obtained by grinding the dried flowers, but in recent years preparations for use as horticultural spray fluids have been on the market in America, and kerosene extracts of the flowers have been widely sold as fly sprays. As was pointed out by Staudinger and Ruzicka, the pyrethrins undergo hydrolysis with alkalis, and

* Japan now provides about 70 per cent of the world's supply of pyrethrum. For details of the history and present position of pyrethrum-growing in Japan and the methods of cultivation adopted, see an article by the British Vice-Consul at Seoul in *Bull. Imp. Inst.*, Oct. 1930, p. 300.

† This opinion had been challenged by Swiss, French, and American workers many years ago, but without affecting the custom of the trade.

preparations containing soap, such as the French 'savon pyrèthre', are liable to gradual deterioration; petroleum extracts with a non-alkaline emulsifier are, however, stable for considerable periods. A formula for the preparation of a spray fluid of the latter type has been published by Tutin,[7] and proprietary products of a similar kind were placed on the English market last year.

Walton [8] has obtained very promising results with sprays of this type for the control of the raspberry beetle, a serious pest of raspberries and loganberries; and preliminary experiments with these fluids against red spider and against the apple capsid bug, both important pests of fruit and difficult to control, have also been successful. Although different kinds of insects vary somewhat in the degree of resistance that they offer to the effects of pyrethrum, a great many important pests are killed by preparations containing 0·0025 to 0·005 per cent of pyrethrins, that is, approximately the equivalent of 0·5 to 1·0 per cent of flowers. The pyrethrins appear to act upon insects as nerve poisons, and they are undoubtedly among the most powerful insecticides known; the range of their usefulness has by no means yet been fully explored.

[1] J. C. F. Fryer and R. Stenton, *Min. Agric.*, **33**, 916; 1927.
[2] J. C. F. Fryer, F. Tattersfield, and C. T. Gimingham, *Ann. App. Biol.*, **15**, 423; 1928.
[3] *Helv. Chim. Act.*, **7**, 177; 1924.
[4] *Ann. Acad. Sci. Fennicæ*, A, **29**, No. 18; 1927.
[5] (*a*) F. Tattersfield, R. P. Hobson, and C. T. Gimingham, *J. Agric. Sci.*, **19**, 266; 1929.
(*b*) F. Tattersfield and R. P. Hobson, *J. Agric. Sci.*, **19**, 434; 1929.
(*c*) J. T. Martin and F. Tattersfield, *J. Agric. Sci.*, **21**, 115; 1931.
[6] *J. Amer. Chem. Soc.*, **51**, 3054; 1929: **52**, 680; 1930.
[7] F. Tutin, *Long Ashton Res. Stat. Rept.*, p. 96; 1928: p. 93; 1929.
[8] C. L. Walton, *J. Pom. and Hortic. Sci.*, **8**, 173, 309; 1930.

Geology in Great Britain.

THE "Summary of Progress" of the Geological Survey of Great Britain for 1929 is issued in three parts, of which the first is devoted to an account of the routine work during the year under review, while the others contain papers on subjects of special interest. Part 1 [1] embodies the annual reports of the Geological Survey Board and of the Director. Sixty-six maps were published during 1929, with eight memoirs, which, with the exception of that dealing with Moreton in Marsh (see below), have already been noticed in our columns (NATURE, Aug. 16, 1930, p. 258). The memoirs in the press at the close of the year have since appeared and are reviewed below.

The most important event in the progress of the Survey during 1929 was the beginning of operations for the building of a new museum, library, and offices on a site in Exhibition Road, South Kensington, midway between the Natural History Museum and the Science Museum. The Geological Museum will have direct connexion with each of these by means of passages open to the public. The work now in progress will take at least three years to complete. New offices have been occupied in Edinburgh and a scheme for the erection of an additional building is under consideration. Field work has for some years been concentrated on the revision of the coalfields. In Yorkshire, Lancashire, and Northumberland this is still actively in progress; elsewhere the surveys are approaching completion, though the maps and memoirs have still to be published. Reports on six districts in England and four in Scotland, and on the palæontological, petrological, and chemical work in progress, contain many records of current interest.

In Part 2 [2] the results of a magnetic survey of part of north Leicestershire are recorded and discussed by A. F. Hallimond. A valuable petrological study of the hornfelses from Kenidjack, Cornwall, is provided by C. E. Tilley and Sir John Flett. It is thought that the original dolerite intrusions of the area were intensely weathered and leached, and afterwards sheared and thermally metamorphosed with the production of cordierite-anthophyllite rocks and cummingtonite rocks. In view of the occurrence of similar rocks elsewhere in puzzling circumstances, this paper is of much more than local importance. H. G. Dines and F. H. Edmunds show conclusively that it is unsafe to base stratigraphical deductions on mechanical analyses of the formations of the Lower Greensand. Four other papers record noteworthy stratigraphical and palæontological observations.

Part 3 [3] contains an account of magnetic work on the Swynnerton Dyke, also by A. F. Hallimond. Sir John Flett describes a teschenite, 224 feet thick, encountered in a boring at Easter Dalmeny, west of Edinburgh, and devotes special attention to the variation of mineral composition and specific gravity with depth. The discussion of differentiation is particularly illuminating and should be seen by all petrologists. Bernard Smith contributes a useful study of the origin of the St. Bees-Whitehaven Gap. Important palæontological investigations are recorded in R. Crookall's account of *Palæoxyris* and related genera, and in W. S. Bisat's paper on the goniatite and nautiloid fauna of the Middle Coal Measures of England and Wales. The accurate determination of hitherto confused species makes possible a notable advance in the correlation of the English and German Coal Measures. Other papers deal with the Pliocene of Hertfordshire and a boring in the Lower Oil-shale Group of Burntisland.

Few memoirs in recent years have approached that dealing with north Ayrshire,[4] in the wide variety, general interest, and scientific importance of the topics discussed. The area is characteristic of much of the Central Valley of Scotland, and includes a long succession of sediments from the Downtonian to the New Red Sandstone, and a remarkable number of igneous episodes of different ages. Lava suites occur in the Lower Old Red Sandstone, Calciferous Sandstone, Millstone Grit, and New Red Sandstone (? Permian). In addition, beds of volcanic ash occur at intervals in the Limestone Coal and Upper Limestone Groups, and there are many north-west dykes that can confidently be referred to the Tertiary. A remarkable range of petrographic types is represented, and petrologists abroad, as well as at home, will find the memoir a rich storehouse of highly significant records, analyses, and associations. A summary of the geology and an account of previous researches are given in the first two chapters. The chief rock groups, sedimentary and igneous, are ably dealt with in successive chapters. Special attention is directed to the fauna of the Carboniferous and the flora of the Coal Measures. A detailed account of the glaciation of the district follows and includes a description of fossiliferous beds of Pleistocene age found beneath the boulder clay of certain areas. A special feature of the memoir is the chapter on the soils and agriculture of north Ayrshire. It should be noted that in addition to the beautiful one-inch maps (Solid and Drift editions) published in 1928, a soil-texture map on the same scale is also available. The latter was issued in 1929 and was prepared under the supervision of the late Prof. R. A. Berry.

The new memoir on the Alnwick district [5] deals with the country stretching from the Cheviot foothills to the coast between Warkworth and Embleton, and includes some of the chief beauty-spots of North-

umberland. The rocks are mostly of Lower Carboniferous age and the diversity of sediments affords many interesting problems. Of special interest is the famous Shilbottle coal, the most valuable Lower Carboniferous seam in the north of England. Chapters are devoted to the Whin Sill, glacial, and post-glacial deposits, and economic geology. Details of borings and sinkings made in recent years are given in an appendix, and there is a useful glossary of the local and mining terms of north Northumberland.

The Maryport memoir [6] covers part of the West Cumberland coalfield and is the first systematic account of a difficult and intricate region. Most attention is given to the Productive Coal Measures, their correlation with the seams in other parts of the field, the complicated faulting of the strata, and the structural features of the adjoining concealed coalfield. The whole district has been heavily glaciated; exposures are few; and detailed mapping has been largely dependent on mining information. The remaining chapters deal with the Skiddaw Slates, the Carboniferous Limestone, the Whitehaven Sandstone series, the New Red Sandstone, glacial and recent deposits, and the economic geology of the district.

The memoir [7] describing Sheet 77 deals with a region of great industrial importance, extending from Blackstone Edge Moors to Dewsbury, and embracing Huddersfield, Halifax, Batley, Brighouse, the southern part of Bradford, and some of the suburbs of Leeds. The region lies on the easterly dip-slopes of the Pennines, and, apart from the superficial deposits, the rocks all belong to the Millstone Grits and the Lower and Middle Coal Measures. The geology of these formations is fully discussed, and there are chapters on structure, glacial deposits, local fossils, and economic geology, special attention being devoted to the goniatite zones and to the occurrence of marine bands in the coal measures. Records of borings, a list of quarries, and a list of geological photographs (of which prints and lantern slides can be supplied) are given as appendices.

The district represented on Sheet 217 is an attractive residential and agricultural area in the Cotteswolds ranging from Cheltenham to Chipping Campden.[8] Roughly, about half the region is in the Severn basin and about half in the Thames basin. Apart from the superficial formations, which are here of great variety and interest, and the concealed Palæozoic floor, the rocks belong to the Lower and Middle Jurassic. Since the days of Murchison (who described the geology in 1834) the area has provided an attractive field for many active workers, including the late S. S. Buckman and the author of the memoir. Mr. Richardson has demonstrated, for the first time, the relationships of the Estuarine deposits of southern Northamptonshire and northern Oxfordshire to the marine Inferior Oolite of the Cotteswolds. The memoir is an admirable guide to the geology of a classical and much-visited region.

The next two memoirs belong to the county series in which the sources of underground water are recorded. The Worcestershire volume [9] provides an excellent short account of the geology and structure of the county, and is illustrated with a clear map and several sections. The chief regional water undertakings are covered, and the supplies of the rural and urban areas are described in detail. Special attention is given to the waters of Malvern and Droitwich, and a comprehensive series of water analyses is provided by the county analyst, Mr. C. C. Duncan. The Gloucestershire memoir [10] is of unusual interest because of the great variety of rocks that occur in this variegated and delightful county. As usual in this series, an admirable general introduction to the geology is provided, with maps and sections. Detailed accounts of the water supplies of Bristol, Gloucester, and Cheltenham are given. The saline waters of Cheltenham originate in the Lower Lias, while the chalybeate springs issue from a superficial gravel in which there is an admixture of peaty matter. Other rural and urban district supplies are described with a wealth of detail, and numerous analyses and full bibliographies are added. Twenty-four memoirs on the underground water supplies of counties have been published to date.

[1] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1929. Part 1. Pp. iv+100. 2*s*. net.
[2] *Ibid*. Part 2. Pp. iv+80+3 plates. 2*s*. net.
[3] *Ibid*. Part 3. Pp. iv+89+8 plates. 2*s*. 6*d*. net.
[4] Geology of North Ayrshire (Explanation of One-inch Sheet 22, Scotland). By J. E. Richey, E. M. Anderson, and A. G. MacGregor, with contributions from E. B. Bailey, G. V. Wilson, G. A. Burnett, and V. A. Eyles; Palæontological Chapters by the late G. W. Lee and R. Crookall; and an account of the Soils and Agriculture by the late Prof. R. A. Berry, E. M. Melville, and C. Louden, of the West of Scotland Agricultural College. Pp. viii+398+10 plates. 10*s*. net.
[5] The Geology of the Alnwick District (Explanation of Sheet 6). By R. G. Carruthers, G. A. Burnett, and W. Anderson, with contributions by C. H. Dinham and the late J. Maden. Pp. vii+138+4 plates. 3*s*. net.
[6] The Geology of the Maryport District (Explanation of Sheet 22). By T. Eastwood. Pp. viii+137+3 plates. 3*s*. net.
[7] The Geology of the Country around Huddersfield and Halifax (Explanation of Sheet 77). By D. A. Wray, J. V. Stephens, W. N. Edwards, and C. E. N. Bromehead. Pp. vi+221+5 plates. 4*s*. 6*d*. net.
[8] The Country around Moreton in Marsh (Explanation of Sheet 217). By L. Richardson, with contributions by A. E. Trueman, D. M. Williams, R. C. Gaut, and H. G. Dines. Pp. vi+162+6 plates. 4*s*. 6*d*. net.
[9] Wells and Springs of Worcestershire. By L. Richardson, with contributions by Cecil Cooke Duncan and B. Brotherton. Pp. vi+219+1 plate. 4*s*. net.
[10] Wells and Springs of Gloucestershire. By L. Richardson. Pp. vi+292+1 plate. 5*s*. net.
(London: H.M. Stationery Office.)

University and Educational Intelligence.

ABERDEEN.—The honorary degree of LL.D. was conferred upon the following, among others, at the graduation held on April 1: Sir Leonard Hill, Sir Frank Smith, Prof. C. R. Marshall, and Sir J. Arthur Thomson.

CAMBRIDGE.—The Appointments Committee of the Faculty of Economics and Politics will shortly proceed to appoint a University lecturer in statistics, the duties to begin on Oct. 1. Candidates are requested to communicate with the Registrary of the University not later than May 1.

The General Board has made the following grants from the Worts Fund: £100 to the Zoological Station at Naples; £45 to Miss W. Lamb, of Newnham College, for the continuation of her excavations at Thermi; £45 to Dr. E. B. Worthington, of Gonville and Caius College, towards the expenses of the Cambridge Expedition to the East African Lakes; £45 to Dr. L. S. B. Leakey, of St. John's College, for archæological, palæontological, and geological investigations in East Africa; £45 to G. Bateson, of St. John's College, for anthropological work in New Guinea; £30 to R. T. Wade, of Clare College, towards his expenses in connexion with visits to museums in Europe to study fossil fish; £20 to P. W. Richards, of Trinity College, towards the expenses of a botanical expedition to the Sierra Nevada; £15 to I. H. Cox, of Magdalene College, for geological exploration in Baffin Land.

It is proposed to confer the degree of Sc.D. *honoris causa* upon Prof. J. S. Haldane, honorary professor and director of the Mining Research Laboratory in the University of Birmingham.

EDINBURGH.—At the meeting of the University Court on Mar. 23, a letter was read from Sir Alexander

Rodger, formerly Inspector-General of Forests, India, intimating that he desired to present a prize for the best student in forestry graduating in 1931, 1932, and 1933. The Court gratefully accepted this gift.

The intimation of a gift to the University from an anonymous donor of £5000 towards the cost of furnishing the new Masson Hall, directs attention to a movement that is on foot to remove the present hall from George Square to a new site at West Mains Road, where it will be capable of accommodating about one hundred resident students in addition to the staff. Plans have been prepared and the building will be proceeded with as soon as the necessary funds are available. The estimated cost of the new building is £50,000.

Prof. James C. Brash has been appointed by the curators to the chair of anatomy in the University, to succeed Prof. Arthur Robinson, who is resigning at the end of the current academic year.

LONDON.—Miss G. K. Stanley has been appointed, as from Aug. 1, to the university readership in mathematics tenable at Westfield College.

It has been resolved to institute a university chair of experimental pathology tenable at the Cancer Hospital (Free).

The Petrie Medal for distinguished work in archæology has been awarded to Sir Arthur Evans.

APPLICATIONS for Beit junior memorial fellowships for medical research can now be received. They should be sent at latest during May to Prof. T. R. Elliott, Beit Memorial Fellowships for Medical Research, University College Hospital Medical School, University Street, W.C.1.

A SPECIAL course of seven lectures on "Internal Combustion Engines and Lubrication" will be given by different specialists at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3, on Mondays and Thursdays from April 13 to May 4. The course has been specially arranged for those engaged in the technical branches of the petroleum industry.

A LIMITED number of agricultural scholarships for students who propose to take up posts as agricultural organisers, teachers or lecturers in agriculture, etc., are being offered by the Ministry of Agriculture and Fisheries. Form No. A.472/T.G. and particulars can be had from the Secretary of the Ministry, 10 Whitehall Place, S.W.1. Completed forms are returnable by, at latest, June 15. The Ministry also invites applications for some research scholarships in agriculture and veterinary science. Applications must be received not later than June 15 on Form 900/T.G., which, with a copy of the conditions attached to the scholarships, may be obtained from the Secretary of the Ministry.

NOTICE is given by the Institution of Electrical Engineers that the triennial award of the Coopers Hill War Memorial prize and medal will this year be made for a paper on one or other of the following subjects:—The use of electricity in public works; hydro-electric power developments; electrification of railways; electricity in agriculture; electricity in mines; long-distance telephony (excluding wireless); long-distance telegraphy (excluding wireless); overhead lines in rural districts; extra high-voltage underground cables and their protection; Empire wireless communications. The competing essays, which must be written specially for the occasion, must reach the Secretary of the Institution of Electrical Engineers, Savoy Place, W.C.2, by Oct. 1 next at latest.

Birthdays and Research Centres.

April 14, 1867.—Prof. J. C. McLENNAN, F.R.S., professor of physics and director of the Physical Laboratory, University of Toronto.

In collaboration with one group of associates, I am determining the spin moments of the nuclei of several types of atoms with the object of gaining information of a definite character regarding the structure of such nuclei. With another group, studies are being made of the optical and electrical properties of metals at the lowest temperatures with the object of elucidating the phenomenon of superconductivity. With a third group, problems in spectroscopy are under investigation, involving not only gases but also solids and liquids. I am also directing a special investigation on the heating effects produced by very short radio waves, another on the products obtainable with mixtures of certain gases subjected to irradiation by high speed electrons, and still another on auroral phenomena.

April 17, 1863.—Prof. GEORGE GRANT MACCURDY, curator of the anthropological collection at Yale University and director of the American School of Prehistoric Research.

I am at present engaged on (1) a small volume to be called "The Coming of Man"; (2) Director's Report, *Bulletin* No. 7, the American School of Prehistoric Research, for 1930; (3) article on archæology and prehistory for a new encyclopædia.

Societies and Academies.

LONDON.

Optical Society, Feb. 12.—T. Smith: Modern optical glass as exemplified by the list of the Parsons Optical Glass Co., dated September 1926. The optical positions ($\mu\ \nu$) of the glass types catalogued by the Parsons Optical Glass Company and the relations between the dispersions for several segments of the visible spectrum are exhibited graphically. A knowledge of the refractive indices of any glass for three wave-lengths is sufficient to specify the index for the whole of the visible spectrum, and a knowledge of two indices is almost sufficient. In particular, the partial dispersive ratios are almost functions (nearly linear functions) of ν only. This implies that there are no glasses suitable for making apochromatic telescope objectives of large relative aperture. The graphs show that the general standard of accuracy of the measured indices is high. A new graphical method of interpolating refractive indices for glass is obtained.—J. Guild: On the fixed points of a colorimetric system. The paper discusses the significance of the constants which enter into the specification of colour on the trichromatic system, and suggests certain fundamental considerations of a metrological character which ought to govern the choice of such constants in a standard reference system. Various proposals which have been put forward from time to time are discussed in the light of these considerations, and the basis of the system which has been adopted at the National Physical Laboratory is explained.

Royal Meteorological Society, Feb. 18.—L. J. Sutton: Note on haboobs. This note is a revision and extension of a paper which appeared in the Society's *Journal* in 1925 on the severe dust storms which occur in the north and central Sudan, chiefly during the rainy seasons. The statistics, which are drawn mainly from the records of Khartoum, include

frequency of occurrence, direction, diurnal variation, and average velocity. Most of the haboobs appear to be due to a current of relatively cold air undercutting warm air, probably in many cases connected with the diurnal variation of temperature, which in the summer causes a depression to form during the daytime over the hot arid region between Khartoum and the Nubian Desert.—**S. Chapman** and **Miss M. Hardman**: The lunar atmospheric tide at Ocean Island. The lunar atmospheric tide at Ocean Island, in the Pacific, has been determined from hourly data extending, with gaps, from 1904 to 1912, or the equivalent of about five years' continuous data. The annual mean semiamplitude of the tide is found to be 71 microbars, and maximum pressure occurs at about 20 minutes after lunar transit.—**A. C. Best**: Horizontal temperature differences over small distances. The temperature differences over two intervals of 25 feet and 50 feet at a height of 4 feet above the ground were recorded for nearly three months. It was found that during the daytime the air was not homogeneous. The temperature fluctuated rapidly at any one spot, the amplitude being as much as 1·5° F. under conditions of low wind velocity. This non-homogeneity decreased as the wind increased. There is some evidence that the state of the sky also affects the amplitude of the temperature fluctuations. At night the fluctuations became much slower and temperature differences up to 1·5° F. persisted for periods up to 30 minutes, usually under conditions of low wind velocity. The daytime periods and the night periods were usually connected by a short period of one or two hours, when the air at 4 feet was very homogeneous with regard to temperature.—**E. Ll. Davies**: A portable temperature gradient indicator. The method consists essentially of measuring the differences in resistance of two platinum elements exposed at different heights above the ground. The advantages and disadvantages of three types of housing for resistance elements are given in detail. With the electrically aspirated housing a good galvanometer (sensitivity about 2 mm. of scale per microampere), differences of temperature to within 0·1° F. are measurable.

Physical Society, Feb. 20.—**G. G. Sherratt** and **J. H. Awberry**: On the velocity of sound waves in a tube. The apparent velocity of sound in a tube of diameter 2 cm. has been measured at temperatures up to 400° C. and with frequencies of from 3000 to 14,000~. The reduction in velocity below the free-air value is discussed, and the suggestion is put forward that this reduction, for a single tube and gas, depends on the wave-length rather than on the frequency. The theoretical expression found by Helmholtz and Kirchhoff for the reduction in velocity does not appear to be valid. The method used by Dixon and by Partington and Shilling for correcting for the influence of the tube receives support.—**P. S. H. Henry**: The tube effect in sound-velocity measurements. The modifications in Kirchhoff's formula required to take account of the finite thermal conductivity of the tube, slip between the gas and the walls, temperature-discontinuity between the gas and the walls, and absorption of energy by the walls are calculated and found to be negligible. The effect of roughness of the walls is discussed, and the conclusion is drawn that the large tube-effects often found in practice are due to irregular motion of the gas.—**W. A. Wood**: A note on the elimination of the β wave-length from the characteristic radiation of iron. The method is based upon the selective absorption produced by a thin film of pure manganese which is obtained in the required form by electro-deposition upon aluminium foil.

Geological Society, Mar. 4.—**W. A. Macfadyen**: The geology of British Somaliland. Some 100,000 square kilometres were mapped geologically for the first time, on the scale of 1 : 250,000. The larger part consists of a great plateau sloping very gently to the south-south-east, fronted by a relatively low-lying area of broken surface-features and faulted strata. Terrace gravels occur up to an altitude of 594 metres near Dagah Shabell, where they are best developed, and the river system of that district is a fine example of superimposed drainage. Raised beaches are found in the Berbera district at levels of 8 metres, about 85 metres, and 200 metres; none is earlier than Pleistocene. In the coast district, particularly south of Bulhar and along the Jibuti border in the west, are basalts and lavas, with the dissected volcano of Elmis; all are probably of Pliocene age and later. The fragmentary Dubar Series, approximately of Burdigalian age, is restricted to the coastal district. The Daban Series, 2300 metres thick and resting conformably on the gypsum, occurs locally in the Guban country. The south-eastern half of the country is covered by Eocene strata. Over the eastern part of the plateau outcrop the richly fossiliferous Middle Eocene limestones and marls, 230 metres thick. The Eocene rests on Cretaceous Nubian Sandstone, up to about 200 metres thick in parts of the Guban, where it includes the Shabell Beds, 830 metres of grits and red clays. Jurassic strata in faulted outcrops occur only north of the plateau, except in the north-east. A measured section 910 metres thick, showing the complete developments near Bihendula, is found from the ammonite fauna to be mainly of Kimmeridgian age; only the uppermost 150 metres is later, while the basal 80 metres is earlier.

Mineralogical Society, Mar. 17.—**A. J. P. Martin**: On a new method of detecting pyro-electricity. On changing the temperature of certain crystals, electric poles of opposite sign are developed at the two ends. In these experiments the temperature change is produced by cooling in liquid air and the electric charge is detected in the following way. The crystal is suspended by a long thin glass fibre near to the copper plate, which may be moved near to, or away from, the crystal, both of them being immersed in the liquid air. The charge on the crystal induces an equal and opposite charge on the plate, and the attraction between the two, causes the crystal to move nearer the plate. This method is specially suited to very small crystals or to those which are decomposed on heating.—**D. R. Grantham** and **F. Oates**: On the Mbosi meteoric iron, Tanganyika Territory. A wedge-shaped mass of meteoric iron measuring 10 ft. × 4 ft. × 3 ft. and estimated to weigh 12-15 tons was found late in 1930 near Mbosi, between Lakes Tanganyika and Nyasa. It is a medium octahedrite containing 8·69 per cent of nickel.—**S. R. Nockolds**: On the Dhoon (Isle of Man) granite: a study of contamination. The Dhoon granite forms a small boss-like mass intruded into the Lonan Flags. Two main types are present, one of which is slightly earlier in date than the other. The difference between the two types is mainly textural. The main type may be termed biotite-granodiorite-porphyry, whilst the other is a biotite-granodiorite. Both types are abnormal in that the biotite occurs in clots and in association with zoisite, ilmenite (usually with a border of granular sphene), sphene itself, and, more rarely, epidote, clinozoisite, and garnet. These clots represent the last remnants of a regionally metamorphosed basic igneous rock which has been absorbed by the original granitic magma. It is concluded that the original magma was of alkali-granite type and similar to the

quartz-porphyry dikes which are associated with the mass. All the evidence points to an extensive interchange of oxides between the original magma and the basic igneous rock. Further, it is shown that the peculiar albitisation of the felspars in the 'granite' of both types is indirectly dependent on the contamination.—**A. G. MacGregor**: On clouded felspars as a result of thermal metamorphism. A special type of cloudiness in plagioclase due to the development of minute inclusions is shown to be the result of contact thermal metamorphism acting after consolidation of the igneous rock. The effects have been observed in various contact metamorphosed lavas in Scotland. Similar cloudiness is observed in the Scourie Dyke, the 'hyperites' of Sweden, malchite of Melibocus, and many other rocks. The possibility of similar clouding being produced as a deuteric effect at a late stage in consolidation is considered.—**C. N. Fenner**: On the residual liquids of crystallising magmas. Discussion of the character of the residues left by the crystallisation of magmas. A short summary is given of outstanding points of evidence that should be taken into consideration in forming an opinion on the broad problems of differentiation.

EDINBURGH.

Royal Society, Feb. 2.—Sir E. Sharpey Schafer: Observations on the relative rate growth of the nails of the right and left hands, on seasonal variations in the rate, and on the influence of cutaneous nerves upon it. The rate of growth of the finger-nails was faster in summer than in winter, and faster on the right hand than on the left. A notable exception was presented by the thumb-nails, which grew faster on the left hand than on the right, both in summer and winter. The slowest rate of growth occurred in the nail of the little finger of the left side. The cutaneous nerves of this finger had been severed and, with the exception of those which subserve pain, had not shown any functional recovery. It is therefore possible that a trophic influence is exercised through the cutaneous nerves upon the growth of the nail, the possibility being supported by the fact that the little finger nail on the left or denervated side not only exhibited a slower rate of growth, but also is distinguished from the corresponding nail on the normal side in being more flattened in form, rougher on the surface, and more brittle in texture.—**F. J. W. Whipple**: A note on the secular changes of rock temperature on the Calton Hill. The temperature of the rock forming the Calton Hill at Edinburgh has been studied since 1837. The long series of observations was analysed recently by Mr. R. W. Wrigley, who concluded that the fluctuations which he had discovered had their origin in the interior of the earth, and sought to correlate them with irregularities in the earth's rotation. There are difficulties in accepting this interpretation of the observations. It is maintained that the fluctuations of temperature are probably propagated downwards from the surface. A possible explanation is that there was less sunshine at Edinburgh in the latter half of the nineteenth century than in recent years. There are, however, no comparable sunshine records by which this hypothesis can be tested.

PARIS.

Academy of Sciences, Feb. 23.—Ch. Fabry and H. Buisson: The absorption of radiations in the lower atmosphere and the estimation of ozone. From measurements of the optical density of the lower atmosphere the proportion of ozone by volume is deduced to be $2{\cdot}2 \times 10^{-8}$. The higher atmosphere is much richer in ozone.—**Louis Roy**: The comparison of the effects of diffraction in reflecting and refracting telescopes.—**V. Lalan**: Contribution to the study of the curve of pursuit.—**Paul Delens**: The congruences of curves.—**Georges Giraud**: Certain problems concerning systems of equations of the elliptic type.—**Georges Durand** and **Gaston Rabaté**: Two conceptions of the limit ensemble and an infinite collection of point ensembles.—**Georges Valiron**: Remarks on the theorem of Borel in the theory of meromorph functions.—**J. Haag**: The realisation of mechanisms of pure rolling. Remarks on a recent paper by F. E. Myard.—**d'Ocagne**: Remarks on the preceding paper.—**R. Tremblot**: The study of gaseous currents by means of interference.—**Ch. Volet**: The application of the method of least squares to the calculation of the orbits of double stars.—**L. Dubar**: The influence of the thermal treatment on the characteristics of copper oxide rectifiers. When the current is in the direction copper to oxide, it is little affected by thermal treatment, but in the reverse direction, oxide to copper, thermal treatment produces large variations in the current. In the case given, the current can be varied from 0·05 ampere to 10 amperes under the same voltage, according to the thermal treatment.—**P. Fourmarier**: The existence of an abnormal magnetic flux. Critical discussion of the views of W. Mitkevich: the author considers that the experiments of Mitkevich are insufficient to establish the existence of a normal magnetic flux.—**R. de Mallemann** and **P. Gabiano**: The variation of the specific magnetic rotatory power in the passage from the liquid state to the gaseous state. The variation of the magnetic rotatory power in the change of state may be calculated with a good approximation starting from the factor $\phi(n) = \left(\frac{n^2+2}{3}\right)$ of Lorentz: any other factor, such as that of Gladstone, is markedly out of agreement with experiment.—**G. Bruhat**: The absorption of aqueous solutions of tartaric acid. The author's experimental results, and the later figures of Lucas and Schwob, are in contradiction with the classical hypothesis of the existence in solutions of two different forms of tartaric acid.—**G. Reboul** and **J. Sambussy**: The passage of the continuous (electric) current in acetone. A description of experiments carried out with the view of finding out the cause of the contradictory results obtained by H. Garrigue and by P. Lafond. The difference was traced to the effect of light on the acetone.—**M. Battegay** and **L. Denivelle**: The aryl chlorosulphinates and the aryl sulphites. By the interaction of sodium phenate and thionyl chloride, in addition to phenyl sulphite, the chloride $C_6H_5.O.SOCl$ has been isolated.—**Paul Lemoine**: The geological and hydrogeological results of a boring at the National Natural History Museum.—**Jean Lacoste**: Tectonic observations on the southern Riff (Moulay Bou-Chta region).—**Mme. Mara Lechtova-Trnka**: The presence of an ascomycete in a tubercle of *Astragalus alopecuroïdes*. The name *Ascorhiza Leguminosarum* is suggested for this mould, which appears to be new. It has been found in the tubercles of three other Leguminosæ.—**Pierre Dangeard**: The sensibility of *Laminaria* to external actions and iodovolatilisation.—**G. Nicolas** and **Mlle. Aggéry**: A new example of the important rôle of bacteria in phytopathology.—**Emile Saillard**: The fixity of composition of plants, according to Liebig, and the sugar beet produced by selection. The quantity of mineral bases contained in the entire plant per 100 kgm. of sugar in the root, or per 100 kgm. of dry material, is not constant; it diminishes as the richness of the roots in sugar increases. The sugar beet, produced by selection, has not the fixity of composition indicated by Liebig.—**Jean Roy**: The existence of parthenogenesis in a species of Copepod,

Elaphoidella bidens.—Georges Morin and Jean Boucomont: Modifications of chronaxy in experimental rickets of the rat.—Louis Lapicque: Remarks on the preceding communication.—G. Ramon, R. Legroux, and M. Schoen: The dissociation of the diphtheric anatoxin-antitoxin complex and the recuperation of the anatoxin.—A. Demolon and G. Barbier: Fermentations in a heterogeneous and discontinuous medium. The medium was brick clay or a quartz sand moistened with a suitable nutritive liquid; the organisms, yeast, *B. coli*, and a mobile urobacillus. The phenomena of diffusion and migration take place in quartz sand when there is 6-8 per cent of water present, but this is not the case with a siliceous clay medium.—H. Jacotot: Researches on vaccination against bovine plague: the preparation of the antigen by dehydration of the virulent splenic pulp.

Official Publications Received.

BRITISH.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1349 (Ae. 481—Ae. Techl. 519): On rendering Airflow visible by means of Hot Wires. By H. C. H. Townend. Pp. 5+4 plates. (London: H.M. Stationery Office.) 9*d*. net.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 12: A Study of Comparative Results for Lea, Single Thread and Ballistic Tests on Yarns from Standard Indian Cottons. By Dr. A. James Turner and V. Venkataraman. Pp. ii+27. 8 annas. Technological Bulletin, Series B, No. 13: The Determination and Variation of Twist in Ring-Spun Cotton Yarns. By D. F. Kapadia and Dr. A. James Turner. Pp. iv+25. 8 annas. (Bombay.)

Report of the Rugby School Natural History Society for the Year 1930. (Sixty-fourth Issue.) Pp. 43+2 plates. (Rugby.)

Empire Fibres for Marine Cordage: African Sisal, New Zealand Hemp and Indian Sunn. Report of Investigations conducted by the Imperial Institute. Pp. 34. (London: John Murray.) 1*s*.

Silvicultural Research Manual for Use in India. Vol. 1: General. (The Experimental Manual.) By H. G. Champion. Pp. xii+181+25 plates. (Calcutta: Government of India Central Publication Branch.) 8.2 rupees; 13*s*. 9*d*.

Department of Scientific and Industrial Research. Building Research Abstracts. Vol. 4 (New Series), No. 2, February. Abstracts Nos. 215-396. Pp. 39-69. (London: H.M. Stationery Office.) 9*d*. net.

Transactions of the Mining and Geological Institute of India. Vol. 25, Part 3, December 1930. Pp. 185-305+plates 4-19. (Calcutta.) 4 rupees.

The Research Scheme of the Institute of Brewing, 1931. Pp. 19. (London.)

University of Leeds: Clothworkers' Department. Report of the Work done under the Research Scheme established in 1928 with the aid of a Special Grant from the Worshipful Company of Clothworkers, Session 1929-30. Pp. 18+2 plates. (Leeds.)

Wool Industries Research Association. Report of the Council, 1930-31. Pp. 34. (Leeds.)

Ministry of Health. Ninth Report of the Advisory Committee on the Welfare of the Blind to the Minister of Health, 1930. Pp. 24. (London: H.M. Stationery Office.) 6*d*. net.

Proceedings of the Royal Society of Edinburgh, Session 1930-1931. Vol. 51, Part 1, No. 1: On the Pregnancy Rate in the Lactating Mouse and the Effect of Suckling on the Duration of Pregnancy. By L. Mirskaia and F. A. E. Crew. Pp. 7. 6*d*. Vol. 51, Part 1, No. 2: Observations on the Relative Rate of Growth of the Nails of the Right and Left Hands respectively; on Seasonal Variations in the Rate, and on the Influence of Nerve-section upon It. By Sir E. Sharpey-Schafer. Pp. 8-13. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

FOREIGN.

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 47: The Glacial Geology of Connecticut. By Prof. Richard Foster Flint. Pp. 294+64 plates. (Hartford, Conn.) 2 dollars.

The Tôhoku Mathematical Journal. Vol. 33, Nos. 3-4, January. Pp. 181-365. (Sendai: Tôhoku Imperial University.)

R. Osservatorio Astrofisico di Catania. Annuario 1931. Pp. iii+37. (Catania.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1651: The Corn Earworm as an Enemy of Field Corn in the Eastern States. By W. J. Phillips and George W. Barber. Pp. ii+18. (Washington, D.C.: Government Printing Office.) 5 cents.

Occasional Papers of the California Academy of Sciences. 17: Log of the Schooner *Academy* on a Voyage of Scientific Research to the Galapagos Islands, 1905-1906. By Joseph R. Slevin. Pp. 162+17 plates. (San Francisco.) 3 dollars.

Intâiul Congres National al Naturalistilor din România (Premier Congrès National des Naturalistes de Roûmanie) ținut la Cluj dela 18 până la 21 Aprilie 1928 (tenu à Cluj du 18 au 21 avril 1928). Dare de seamă a lucrărilor publicată de (Compte rendu des séances publié par) Al. Borza și (et) E. Pop. Pp. viii+518+17 planșe. (Cluj: Editura (Edité par) Societatea de Științe.) 30 lei.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 66: The International Wing Model measured in the Wind Tunnels of Japan. By the Wind Tunnel Committee specially appointed by the Aeronautical Council of Japan. Pp. 307-440. (Tôkyô: Koseikai Publishing House.) 1.03 yen.

Państwowa Rada Ochrony Przyrody. Nr. 28: Sprawozdanie z działalności Państwowej Rady Ochrony Przyrody w roku 1930. Napisał Prof. Dr. Władysław Szafer. Pp. 19. Wydawnictwo Okręgowego Komitetu Ochrony Przyrody na Wielkopolskę i Pomorze. Zeszyt 2. Pp. 60. Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Treść rocznika 10-go. Pp. iv+309+16 tab. (Kraków: Państwowa Rada Ochrony Przyrody.)

U.S. Department of Commerce: Coast and Geodetic Survey. Seria No. 498: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Vieques, P. R., in 1923 and 1924. By W. N. McFarland. Pp. ii+94+5 plates. (Washington, D.C.: Government Printing Office.) 40 cents.

U.S. Department of Agriculture. Farmers' Bulletin No. 1655: The Control of Moths in Upholstered Furniture. By E. A. Back and R. T. Cotton. Pp. ii+33. 10 cents. Technical Bulletin No. 231: A Revision of the American Species of Empoasca known to occur North of Mexico. By Dwight M. DeLong. Pp. 60. 15 cents. (Washington, D.C.: Government Printing Office.)

University of Illinois Engineering Experiment Station. Bulletin No. 215: The Column Analogy; Analysis of Elastic Arches and Frames by the General Formula for Flexure. By Prof. Hardy Cross. Pp. 75. 40 cents. Bulletin No. 219: Treatment of Water for Ice Manufacture; a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Utilities Research Commission. By Prof. Dana Burks, Jr. Pp. 112. 60 cents. Bulletin No. 220: Tests of a Mikado-Type Locomotive equipped with Nicholson Thermic Syphons; a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Illinois Central Railroad Company and the Locomotive Firebox Company. By Prof. Edward C. Schmidt, Prof. Everett G. Young and Herman J. Schraeder. Pp. 99. 55 cents. (Urbana, Ill.)

CATALOGUES.

Classified List of Second-hand Scientific Instruments. No. 99, April. Pp. 58. (London: C. Baker.)

Catalogue of Scientific Journals and Transactions of Learned Societ es. (Catalogue No. 1.) Pp. 12. (London: Oppenheim and Co. (Rare Books) Ltd.)

Diary of Societies.

FRIDAY, APRIL 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—L. H. Thomas: A Criticism of Current Theories of Stellar Structure, and a Suggestion.—H. Roth: The Density Distribution in Capella.—Dr. H. Jeffreys: On the Cause of Oscillatory Movement in Seismograms.—S. F. Grace: Tidal Oscillations in Rotating Rectangular Basins of Uniform Depth.—G. Shajn: On the Behaviour of Certain Simple Multiplets in Stellar Spectra.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.—Exhibits, including *Opisthoporus* and *Lymnœa stagnalis* (L.).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—Dr. A. E. Dunstan: The Present Position of the Thermal Decomposition of the Lower Hydrocarbons.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—H. Roe and others: Discussion on Aerial Ropeways.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Annual Meeting.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (Annual General Meeting) (at Mayfair Café, Cardiff), at 7.15.—Prof. W. J. Jones: Chairman's Address.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. Russell: Difficulties in Power Transmission by Belt and how to overcome them.

SATURDAY, APRIL 11.

GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square, W.C.1), at 2.30.—Sir Richard Gregory, Bart.: Comets and Shooting Stars (Lecture).

MONDAY, APRIL 13.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. D. M. McIntyre: The Jewish Apocalyptic and its Bearing on the New Testament.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—P. Lake: Island Arcs and Mountain Building.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Debate: The Final Report of the Royal Commission on Transport.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Annual General Meeting.

CERAMIC SOCIETY (Pottery Section) (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—W. Podmore: Pottery Engineering—its Failures and Possible Improvements.—A. S. W. Odelberg: The Durability of Bone China Hotel Ware.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. Grey: Modern Flats.

ROYAL SOCIETY OF ARTS, at 8.—Dr. N. A. U. Piercy: The Present Position in Aeronautics (Howard Lectures) (1).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—J. W. Walters: Studies in the Free Air Cooling of Hot Gases in Mains.—F. L. Bassett: Some Factors affecting the Corrosion of Buried Steel.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University).—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cheltenham).—H. T. Young: Modern Lighting (Lecture).

TUESDAY, APRIL 14.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. W. E. Le Gros Clark: The Brain of *Microcebus murinus*.—M. Burton: The Interpretation of the Embryonic and Post-larval Characters of certain Tetraxonid Sponges, with Observations on Post-larval Growth-stages in some Species.—Dr. R. Bigalke: Note on the Egg of the Nile Crocodile (*Crocodylus niloticus*).—D. L. Bryce: Report on the Rotifera: Mr. Omer Cooper's Investigations of the Abyssinian Freshwaters (Dr. Hugh Scott Expedition).—I. Filipjev: Report on Freshwater Nematoda: Mr. Omer Cooper's Investigation of the Abyssinian Freshwaters (Hugh Scott Expedition).—Col. A. E. Hamerton: Report on the Deaths occurring in the Society's Gardens during the Year 1930.
INSTITUTION OF CIVIL ENGINEERS, at 6.—R. W. Mountain: The 132-Kilovolt Transmission-System of the Central Scotland Electricity Scheme.—C. S. Berry, H. P. Gaze, and C. E. H. Verity: The Deptford West Power-Station of the London Power Company, Limited.
INSTITUTE OF MARINE ENGINEERS, at 6.—F. A. Pudney: The Caprotti-Bauer-Wach Marine Installation.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—L. S. Crutch: Long-Distance Telephony To-day.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce, Birmingham), at 6.30.—At 7.—F. R. O'Shaughnessy: Some Modern Methods of Sewage Disposal.—Dr. H. E. Lockwood and Dr. R. S. Hayes: A New Method of Testing Agar and Gelatine Jellies.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow) (Annual General Meeting), at 7.30.—B. Leggett: The Medical and Surgical Applications of Electricity.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—W. E. Watson Baker and others: Discussion on Microscope Design, with special reference to Advances since 1914.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. F. A. Willcox and J. D. Farmer: A Comparison of Refrigeration Systems.

WEDNESDAY, APRIL 15.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. J. D. Rolleston: J. B. Bouillaud (1796-1881): a Pioneer in Cardiology and Neurology.
ROYAL METEOROLOGICAL SOCIETY, at 5.—W. D. Flower: An Analysis of the Cold Front over Egypt on Mar. 7, 1929.—W. H. Pick: A Note on the Relationship between Fog and Relative Humidity.—H. Jameson: Temperature Observations on Adam's Peak, Ceylon.—*To be taken as read*:—S. P. Wiltshire: The Correlation of Weather Conditions with Outbreaks of Potato Blight.
ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—L. La Cour: Improvements in Everyday Technique in Plant Cytology.—Prof. A. G. Hornyold: On the Preparation of Eel Scales.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Prince Henry's Room, Fleet Street), at 5.30.—Col. R. E. B. Crompton: The First Installation of House to House Supply in the United Kingdom.—G. A. Orrok: The Pearl Street Station: The First Steam Power Station in America.—Prof. J. K. Finch: The Civil Engineering Achievements of John B. Jervis.
INSTITUTE OF FUEL (Annual General Meeting) (at Chemical Society), at 6.—A. Marsh: Smoke Problem: A Consideration of some of its Economic Aspects and the Difficulties of its Solution.
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30—F. C. Ball: Some Considerations on the Economic Design of Small Reinforced-Concrete Girder Bridges for Highway Use.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—D. B. Hoseason: The Cooling of Electrical Machines.
ROYAL SOCIETY OF ARTS, at 8.—D. R. Wilson: Industrial Lighting.
ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—S. Wernick: Experiments in Cadmium Plating.
SOCIETY OF GLASS TECHNOLOGY (at Sheffield).—Annual General Meeting.

THURSDAY, APRIL 16.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
CHILD-STUDY ASSOCIATION (at 90 Buckingham Palace Road), at 6.—Dr. J. N. Glaister: Does the Developing Mind Recapitulate Ancestral History?
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—R. M. Charley: Recent Progress in Large Transformers.—W. E. M. Ayres: The Application of the Induction Voltage Regulator.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. A. H. Davis: Aircraft Noise.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.
BRITISH INSTITUTE OF RADIOLOGY, at 8.30.—Dr. H. S. Souttar: The Ideal Distribution of Radon Seeds.—W. E. Schall: A Two-Valve Transformer Unit for Diagnosis and Therapy.—Dr. A. Orliansky: Uniformly Impressed Reduced Prints from Contrasty Negatives.—Dr. L. A. Rowden: A Technique of Radiographic Pelvimetry.

FRIDAY, APRIL 17.

BRITISH INSTITUTE OF RADIOLOGY (at North Middlesex Hospital, Edmonton), at 11 A.M.—At 5.—Meeting of Medical Members.
ELECTRICAL ASSOCIATION FOR WOMEN (at Park Lane Hotel), at 11.30 A.M.—Annual General Meeting.—At 3.—Report from Branches, etc.
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—A. J. Maddock: The Generation of Current Pulses of Rectangular Wave-form.—R. A. Fereday: An Improved Method for the Comparison of Small Magnetic Susceptibilities.—Dr. E. G. Richardson: Edge Tones.
NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (Annual General Meeting) (at Royal Society), at 5.
ROYAL SANITARY INSTITUTE (at Guildhall, Poole), at 5.—E. J. Goodacre and others: Discussion on Some Aspects of Municipal Sanitation.—Alderman J. C. Julyan and others: Discussion on Prospect and Retrospect.—Dr. G. Chesney and others: Discussion on Diphtheria Immunisation at Work.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—C. D. Gibb: Post-War Land Turbine Development.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—J. Foster King: Corrosion of Oil Tankers.
COKE OVEN MANAGERS' ASSOCIATION (Midland Section) (at Sheffield University), at 6.30.—Prof. R. V. Wheeler: Rational Analysis of Coal.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—H. E. Potts: The Patent Law relative to the Chemist and Technologist.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. W. Hill and G. F. Shotter: Current-Transformer Summations.
INSTITUTE OF FUEL (East Midlands Section) (at University College, Nottingham), at 7.—H. L. Pirie: Theory and Practice of the Gasification of Coal in Producers.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Demonstration of Modern Scientific Instruments and Apparatus of Special Interest.
INSTITUTE OF METALS (Sheffield Section) (in Non-Ferrous Section of Applied Science Department, University of Sheffield), at 7.30.—R. Genders: Extrusion.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. E. Gray: The Transmission of Gas.—T. G. Martin: The Building Requirements of Lifts.
INSTITUTE OF BREWING (Yorkshire and North-Eastern Section) (at Queen's Hotel, Leeds).—Annual Meeting.

PUBLIC LECTURE.

TUESDAY, APRIL 14.

GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeeding Lectures on April 15, 16, and 17.)

DISCUSSION.

APRIL 17 AND 18.

GENERAL DISCUSSION ON PHOTOCHEMICAL PROCESSES.

FARADAY SOCIETY (in Department of Chemistry, Liverpool University).

Friday, April 17, at 10 A.M.—Molecular Spectra in Relation to Photochemical Change.
Introductory Paper. Prof. R. Mecke.
Ultra-violet Absorption Spectra of Acetylene and Formaldehyde. Dr. G. Herzberg.
The Absorption Spectra and the Optical Dissociation of the Hydrides of the Oxygen Group. C. F. Goodeve and N. O. Stein.
The Photochemical Properties of the Carbonyl Group. F. W. Kirkbride and R. G. W. Norrish.

Friday, April 17, at 2.30.—Photochemical Kinetics in Gaseous Systems.
Introductory Paper. Prof. M. Bodenstein.
The Reaction between H_2 and O_2 under the Influence of Photochemically-produced H Atoms. The Relation of its Mechanism with that of the Explosive Gas Reaction at High Temperatures. Dr. W. Frankenburger.
The Photochemical Union of Hydrogen and Chlorine at Low Pressures. J. B. Bateman and H. C. Craggs.
The Photosensitised Decomposition of Nitrogen Trichloride by Chlorine, and the Induction Period of the Hydrogen-Chlorine Reaction. J. G. A. Griffiths and R. G. W. Norrish.
The Photosensitised Formation of Hydrogen Peroxide in the System Hydrogen-Oxygen-Chlorine. R. G. W. Norrish.
The Photochemistry of Mixtures of Chlorine Oxygen and Carbon Monoxide. Prof. G. K. Rollefson.
The Mechanism of the Photo-Oxidation of Gaseous Alkyl Halides. J. R. Bates and R. Spence.
A Comparison of the Efficiency of Photochemical Reactions and Similar Reactions Produced by Gaseous Ions. G. R. Gedye.

Saturday, April 18, at 10 A.M.—Photochemical Change in Liquid and Solid Systems.
Introductory Paper. Prof. A. Berthoud.
The Photochemical Temperature Coefficient. D. W. G. Style.
The Acceleration of the Electrolytic Deposition of Hydrogen and Oxygen by Light of Short Wave Length. Dr. F. P. Bowden.
The Photochemical Decomposition of Chlorine Dioxide in Carbon Tetrachloride Solution. Y. Nagai and C. F. Goodeve.
The Photochemical Oxidation of Potassium Oxalate by Iodine in Aqueous Solution. Prof. A. J. Allmand and K. W. Young.
A Comparative Study of the Photographic Process under Different Experimental Conditions. Prof. J. Eggert.
The Latent Photographic Image. New Methods of Investigation and Results. Prof. F. Weigert.
Sensitisations of the First and Second Type. Prof. F. Weigert.

Saturday, April 18, at 2.30.—Photosynthesis.
Introductory Paper. Prof. E. C. C. Baly.
The Application of the Einstein Law to Photochemical Processes in Living Cells. Prof. O. Warburg.
The Measurement of the Physiologically Active (Erytheme forming) Ultra Violet by means of the Photochemical Formation of Dyestuffs from the Leuco-Compounds of Triphenyl Methane Dyes. Edith Weyde and W. Frankenburger.