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CONTENTS.

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A Parliamentary Science Committee.

THE Association of Scientific Workers has a number of achievements to its credit, but none more pregnant with possibilities for advancing the interests of science and scientific workers than its success in getting together during the last Parliamentary session more than seventy members of the House of Commons to form the nucleus of a Parliamentary Science Committee upon which it is hoped to build a body representative of both legislative houses and of all political parties. That the nucleus is so large, although less than one-third of the members of the Commons have so far been approached, is encouraging evidence of the growing desire of members of Parliament to be informed of the progress of science and the possibility of its more intensive application to the problems with which they are confronted. It was in this belief that Major Church, general secretary of the Association of Scientific Workers, and now happily once more a member of Parliament, approached them. The result justifies his belief. It is to be hoped that it will also convince scientific workers of the importance of supporting the candidature and otherwise assisting in the return to Parliament of persons who are, by virtue of their training, experience, and associations, in a position to voice their aims and aspirations faithfully and to know and evaluate the contributions which science has to make to society as a whole.

The functions of the Parliamentary Science Committee will be to accumulate and distribute to its members such information concerning the activities of scientific workers, whether engaged in industry, research, or higher educational institutions, which have bearing on Bills before Parliament at the time or on imperial problems of current interest. Periodical meetings will be held in a committee room at the Houses of Parliament, and, when desired and whenever possible, these meetings will be addressed by acknowledged leaders of scientific thought on subjects of particular interest to the Committee. For this purpose the Association of Scientific Workers has offered to act as the liaison body between the Parliamentary Committee and prominent workers in the main branches of scientific activity. That it will be able to act adequately in that capacity obviously depends on the enthusiasm of its members and the co-operation of other bodies, notably the British Science Guild and the British Association for the Advancement of Science. For some years past the British Science Guild has had a small standing Parliamentary

Committee through which it was able to bring matters bearing upon the relations between the State and science to the notice of the Government. The British Association seventy-five years ago formed a similar committee, and this committee remained in existence until 1866.

An interesting account of the activities of the first Parliamentary Science Committee is given in Mr. O. J. R. Howarth's review of the work of the British Association from 1831 to 1921. The project was first discussed at a meeting of the Council in 1850, when it was proposed to form a committee of "members of the British Association who are also members of the legislature". To quote Mr. Howarth:

"The first idea seems to have been that any person combining these two qualifications should *ipso facto* belong to the committee; but the obvious possibilities of complications arising from such a practice led the General Committee to limit the new body to selected members of both Houses of Parliament who belonged to the Association."

The committee was formed in 1854 and at first acted as the medium of communication between the Council of the Association and government authorities. Apparently Lord Wrottesley, who was also president of the Royal Society, was its first chairman—no mean asset—and it was probably due to his efforts that the representations made by the Association to the government gained in effectiveness.

During its twelve years' existence this Parliamentary Committee appears to have brought a number of very important matters to the notice of government and achieved no inconsiderable measure of success. In 1854 it stimulated the Board of Trade "to improve conditions and facilities for navigation, and for accumulating marine meteorological data on a large scale": it made representations on the principles governing the award of Civil List pensions in relation to scientific workers, and the allocation of accommodation for scientific societies in Burlington House in order to bring such societies into closer juxtaposition. The following year it produced a document dealing with the measures which should "be adopted by the Government or Parliament to improve the position of science or its cultivators in this country" (including reforms at those universities "which do not at present exact a certain proficiency in physical science as a condition preliminary to obtaining a degree" and the creation of a Board of Science). In 1857 it asked for the publication of the results of the trials of steamships employed in the public service, and the sending of an annual expedition to the Niger. A request for increased accommodation and staff for the Meteorological Department of the Board of Trade, an application for an expedition to be sent to the Mackenzie River (northern Canada) and for the dispatch of an expedition under Livingstone to the Zambezi River, were made in 1858. That year also, although apparently without official support from the Association, the Parliamentary Committee referred to the "proposed severance from the British Museum of its Natural History Collections" as calculated to inflict a deep injury to science.

In 1859, Admiral Fitzroy was authorised to proceed in bringing to a practical issue the recommendations made to the scientific department of the Board of Trade on the subject of telegraphic communication between seaports of the British Isles. The same year the Parliamentary Committee was successful in obtaining government support for the dispatch of another African expedition, that under Speke and Grant, for the exploration of Victoria Nyanza and Uganda. Most noteworthy and fruitful in results was the action taken by the Parliamentary Committee in 1865 in arranging for Sharpey, Miller, Huxley, and Tyndall to give evidence, during the select committee stage of the Public Schools Bill, on the extent to which physical science might be introduced into the curriculum of the great public schools. "The bill did not pass," says Mr. Howarth, "but public interest was to some extent awakened, and it is recorded that voluntary efforts were made by masters at certain schools to add instruction in natural science to the classical course, while 'some of the boys at Harrow . . . formed themselves into a voluntary association for the pursuit of science'."

In spite of the varied nature of its interests and the obvious success which attended its efforts to secure greater recognition for science, this first Parliamentary Science Committee did not survive the death of its chairman, Lord Wrottesley, in 1867. This by no means implies that the Association ceased to bring pressure to bear on government to further the Association's aims. It continued to do so, and not without effect, but it is doubtful whether members of the legislature maintained the same lively interest in the recommendations of the parliament of science. This lack of interest may have been of immediate advantage to science. On the other hand, the removal of the subject from the sphere of Parliamentary controversy almost inevitably had the effect of diminishing public interest, just at a time when science was dependent

on a quickened public interest for the consolidation of the position it had occupied in face of the opposition of the protagonists of the classics and dogmatic theology, the representatives of which were still strongly entrenched in Parliament.

The revival of the Parliamentary Science Committee immediately provokes speculation regarding its possible interpretation of its functions. There is certainly no dearth of material to engage its attention. The present government, like the last, gives it plenty of scope for the exercise of its powers of destructive criticism. This government, in spite of the lip-service paid to science by the party it represents, has shown not the least disposition to give scientific workers effective representation on the important development committees it has set up. Neither the advisory committee which Mr. Thomas has appointed for considering industrial development in Britain, nor the committee he has appointed for considering colonial development, is calculated to inspire scientific workers with confidence in their capacity to appreciate the contributions which science can make to either problem. The same criticism, but with even greater emphasis, can be levelled against the constitution of the Royal Commission on the Civil Service, promised by Mr. Baldwin and appointed by Mr. MacDonald. The committee recently set up to consider the preservation and creation of National Parks contains no naturalist, a stupid omission. Lord Passfield, in reconstituting the Empire Marketing Board consequent upon the change of government, has not appointed an accredited representative of science either on the main body or, what is still more surprising and unsatisfactory, on its Research Grants Committee. Mr. Clynes presumably expects the Licensing Committee which he has appointed to report on the alcoholic drink question to consider the effect of alcohol on the body and mind. Drinking to excess is manifestly harmful, but it does not necessarily follow that drinking in moderation is not beneficial. The appointment of a physiologist with expert knowledge of the effect of alcohol on our metabolism might have lent authority to the final pronouncements of the committee.

It is to be hoped, however, that the Parliamentary Science Committee will not be expected to spend its time framing and passing resolutions protesting against this or that act of government. The tendency on the part of governments to overlook the need for science to be represented on government committees of various kinds set up for considering problems, to the solution of which scientific workers can make valuable contributions, is largely due to the fact that scientific workers themselves have not pointed out what contributions they have to make to the subjects under consideration. Where they have brought pressure upon the government, as in the case of the revision of the Patent Laws, the government has proved amenable.

Scientific workers should make use of the Parliamentary Science Committee to bring to the notice of members of Parliament what science has done, is doing, and can do, and what they expect governments to do to encourage scientific research. The encouragement of scientific research is not a matter about which the electorate can be stirred to any great enthusiasm. Science is essentially a non-controversial subject: Parliament rarely discusses, and Ministers rarely refer to, the activities of the research workers attached to the departments for which they are responsible. Expenditure on research is rarely challenged. This absence of publicity is neither to the advantage of scientific workers nor to the progress of scientific research.

It is high time that members of Parliament were better acquainted with the work of departments to which they vote fairly large sums of public moneys yearly. They should know something about the activities of the Medical Research Council, the Empire Marketing Board, the Development Commission, the Department of Scientific and Industrial Research, the University Grants Committee, and the research departments attached to the three fighting services. These bodies are responsible for the encouragement of research over fields covering the industrial and social life of our peoples at home and overseas. Much of the work done and in commission has a definite bearing upon matters before the Imperial Parliament. Members of Parliament do not yet appreciate this fact, not because they are obscurantists or unwilling to be instructed, but because no systematic efforts have been made to instruct them. Most of the above-named departments issue periodical reports, and these are supplied gratis to any member of Parliament who troubles to ask for them. That few do so is the fault of scientific workers rather than that of our legislators. Scientific workers have not yet succeeded in organising themselves into a professional body possessing political significance by reason of its representative character. Such an organisation is necessary if the Parliamentary Science Committee is to become a really effective body.

Petroleum Geology.

(1) *Earth Flexures; their Geometry and their Representation and Analysis in Geological Section, with special reference to the Problem of Oil Finding.* By H. G. Busk. (Cambridge Geological Series.) Pp. vii + 106. (Cambridge: At the University Press, 1929.) 12*s.* 6*d.* net.

(2) *The Geology of Petroleum and Natural Gas.* By Prof. E. R. Lilley. Pp. x + 524. (London: Chapman and Hall, Ltd., 1928.) 30*s.* net.

(3) *Analytical Principles of the Production of Oil, Gas and Water from Wells: a Treatise based upon a System of Fluid Mechanics particularly adapted to the Study of the Performance of Natural Reservoirs.* By Dr. Stanley C. Herold. With a Foreword by Cyrus F. Tolman and a Final Summary by Ernest K. Parks. Pp. xi + 659. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1928.) 35*s.* net.

(1) IF it be a geological axiom that outcrop evidence is not necessarily indicative of subsurface structure, which is admittedly true in many cases, that where comparatively soft rocks are involved the divorce between the two may be so great as to render one an unreliable guide to the other, then it is easy to find many flaws in Mr. Busk's thesis. We cannot help feeling that rather special cases have been chosen as the basis of the hypotheses, constructions, and proofs composing this geometrical geology; that were the methods faithfully applied to the rocks of Trinidad, Venezuela, or southern California, for example, where surface data are often misleading or scanty, in contrast to the almost overwhelming evidence of the naked rocks of Burma, Egypt, and Persia chosen as the basis of discussion, some grotesque interpretations of underground conditions could result; certainly the limits of error in locating oil-pools involved could scarcely be said to be narrowed in such circumstances. On the other hand, there is something to be said for the purely geometrical treatment of folding, especially for those to whom the third dimension is elusive, even if it only teaches precision in thought and expression. In these matters geology has need of all the mathematics it can legitimately absorb, though we may be devoutly thankful that the science can never be reduced to a string of uninspiring formulæ: even inexactitude is a blessing sometimes.

The theme of this work is that exactitude of graphical expression of earth flexures is attained by employing tangential circular arcs having normals to measured surface dips of the rocks as radii; in other words, that geometrical conics should displace methods in which curves are reduced to straight lines at right angles to the normals of known dips, a procedure which was expounded some years ago by Sir Thomas Holland and has been widely followed in professional work in the Eurasian oilfields.

Anything is better than sketch-sections or those terrible essays in 'geological artistry' which are the delight of certain draughtsmen to be found all the world over. At all events, given the conditions visualised by the author of this book, there is a good case for following his precepts. To whatever extent we may differ from him in his Euclidean attempt to bring law and order into subsurface geological studies, we have to admire the sincerity of his appeal for greater precision, as we heartily endorse it, and at the same time welcome this work on account of its refreshing originality. But we close the book with a reflection, possibly a faint sigh of relief, that even Mr. Busk's masterly translation of earth flexures into geometry has not been able to deprive the former of the glamour of that glorious uncertainty which is the very lodestone of the science.

(2) How different is Prof. Lilley's book. Had we read it before "Earth Flexures", possibly the contrast would not have been so vivid. Compilation and recapitulation are two words which should long ago have been allowed to pass out of the petroleum technologist's vocabulary, especially if he aspire to authorship. Yet in this latest geology of petroleum, it is not easy to find much to which one or the other does not apply. Those who are familiar with the literature will also recognise many old friends, some of them indeed well-tried, among the many illustrations scattered throughout the book.

However, as the avowed purpose of the author is to provide individuals who cannot keep pace with the mass of technical publications with "a single volume in which they may find brief statements of the principles of the science and examples illustrative of the application of those principles", we can scarcely blame him for sticking to his last. In one respect his treatment of the subject is superior to many former attempts of others: instead of discussing the geology of the important oilfields of the world country by country, he takes as his basis the different structural conditions under which oil can and does occur, and selects as illustrative examples those fields which are relevant. The

selection on the whole is good, though, as might be expected, American fields figure rather to the exclusion of foreign developments which in some cases could provide even better illustration than those chosen.

The last chapter on exploration of new areas breaks away from monotony of description and reviews possibilities ranging from the significance of surface-indications of oil to the pros and cons of geophysical prospecting and, be it noted, the 'limitation of geologic activity'; here was a chance for the author to let his imagination guide his pen, but it was not taken. That, we believe, is the whole trouble with works of this description: the compiler is so buried in the mass of material at his disposal, so deluged with facts and theories which must find a place in a text-book, that there is little or no opportunity for personal expression, for just that touch of ego and occasional glimpse of imagination which animate even the most ponderous subject. This leads us to another recent volume.

(3) Few will deny that "a treatise based upon a system of fluid mechanics particularly adapted to the study of the performance of natural reservoirs" is, on the face of it, a weighty subject for discourse. In Dr. Herold's work it takes a heavy book of well over six hundred pages to deal with this most important branch of oil and gas production, and it is doubtful if one of those pages is superfluous. We have here undoubtedly the most valuable and original contribution to our knowledge of the fundamental principles underlying the production of fluids from wells.

The thesis is developed gradually from an exposition of those laws of physics and properties of matter which are relevant to the conception of fluid reservoirs and of the behaviour of such fluids under varying natural conditions. The author contends that there are three great classes of reservoirs to one of which every oil, gas, and water well must belong. Control of the fluids involved is thus vested in three factors, hydraulic, volumetric, and capillary. The detailed mathematical and physical analyses of each of these controls constitute the essential part of this treatise; such analyses proceed uniformly by consideration of ideal performance and its primary and secondary functions.

The work as a whole is necessarily one of reference, and as such will serve as a standard for a long time to come. The temptation to swamp his hypotheses and proofs in a whirlpool of higher mathematics has been nobly resisted by the author, who has, in point of fact, shown considerable restraint in this connexion. This does not imply that his ideas lack precision or that pure description has been allowed to displace theorem; on the contrary, the necessary functions are always clearly stated, and where mathematical expression is due, it is not stinted; at the same time, it is never abstruse.

This book is full of originality tempered with a well-curbed imagination. It will, of course, find its deserved niche on every production engineer's bookshelf; it should also be noticed by all concerned with the teaching or application of the principles of fluid mechanics; none should lay it down, however, without reading the preface, which gives us a pleasing insight into the mind of a modest and erudite man, and also Mr. Parks's summary of the author's analysis, especially as his conceptions affect the oil and gas industry.

What is Sociology?

An Introduction to the Study of Society: an Outline of Primary Factors and Fundamental Institutions. By Prof. Frank Hamilton Hankins. Pp. xiv + 760. (New York: The Macmillan Co., 1928.) 17*s.* net.

PROF. HANKINS holds the chair of sociology at Smith College. He has written a book which suggests two questions. Is the task which he has undertaken one which falls to the sociologist as such to accomplish? Is he following the best method to achieve the purpose which he has in view? The title and sub-title of the book give some idea of its scope. It includes discussions of the origin of man, the races of man, the physiographic, biological, psychological, and cultural factors in social life, the evolution of material culture, myth, magic, religion, and science, marriage and the family, and ends with an examination of social organisation and integration. It may be said at once that this is an exceedingly competent production. The author has patiently mastered a huge mass of material; he exhibits good judgment and width of mind. The exposition is orderly and lucid. The book is what it purports to be—a scientific study of the background of social life.

The book is intended to serve as a text-book for a general introductory course. Assuming such a course to be desirable, a matter which deserves discussion, does it properly fall to the department of sociology to undertake it and to the head of the department to supply the text-book? This is not a mere question of academic organisation. At

present there is no general agreement as to what constitutes the province of sociology, and the work assigned to, and undertaken by, these departments may affect the whole future of sociology. When we find them engaged upon these synthetic tasks, we recognise the old tradition that sociology is in some sense a super-science. We realise also the weaknesses of this definition. However necessary the task, however admirably carried out, as in this case, it is not possible to find in synthetic work of this kind the sphere for a special science. In practice, it generally comes to retailing at second hand the results of various social sciences. Matters are not substantially improved by supposing that the true function of sociology is to be found in the interpretation and correlation of these other studies. There is ample scope here—but this work cannot be deliberately undertaken and made the subject of everyday research. We must wait upon the appearance of the exceptional man, usually a notable contributor to some existing social science, who oversteps its frontiers and forges links with cognate studies.

Thus we come to the well-worn discussion as to whether there is any special field which can be said to be that of sociology. We can begin by agreeing that, if sociology is a science, social philosophy and social ethics, however deeply concerned any sociologist worthy of the name is bound to be with this range of problems, lie without its field. At that point disagreements appear. But opinion seems to be hardening in the direction of admitting that there are two quite distinct fields of investigation, either of which might claim the title of sociology. The first includes an apparently somewhat ill-defined group of data which do not fall within the fields of political science or of economics, however widely the latter may be extended under the guise of social economics. These data relate to the family, social organisation, and modes of living. They are as susceptible of quantitative treatment as are economic data. The second is less obvious. But there is a good case for the view that human relations and interactions provide a special field of study. There is something common to economics, political science, and the other existing social sciences which is missed by each of them. This something is the interaction of human beings, whatever the cause, result, and content of these relations may be. Existing social sciences deal mostly with the content of relationships. The mechanism of interaction, which is common to them all, escapes scientific study. Little progress, however, has yet been made in this direction.

There are perhaps other possibilities. The matter cannot be discussed here. It is relevant for one reason only. Nothing is more certain than that there is no place in the academic organisation of teaching and research for departments which only deal at second hand with the results obtained elsewhere, however loudly they may claim to be concerned with 'interpretations' and 'syntheses'. If sociology is to survive, to say nothing of progressing, general agreement must be reached regarding its special field, and on this account we may regret, however much we may admire his work itself, that Prof. Hankins should seem, because he does his work as a sociologist in a sociological department, to be putting back the clock.

The second broad question suggested by the book deserves some consideration. The book is intended to serve as the basis of a general introductory course for students in their sophomore or even in their freshman year. Such courses are becoming common in the United States. Teachers in American universities are perplexed by the lack of background shown by their students and are endeavouring to fill it in. They adopt the method of direct attack. But is this the best way to do it—at least under our conditions? It may very well be that different social and intellectual traditions and atmospheres demand different educational methods and that the Americans diagnose their own problems correctly when they design such courses. To us in Great Britain it may seem that there is danger that these courses will fail to achieve the two chief aims of education, to light up the imagination and to teach people to think. The imagination may be dulled rather than fired by the absorption of masses of varied knowledge, and there can be little stimulus to think when, owing to the vast range of the subjects touched upon, the boundaries of the known are never reached and there is no time for the making of generalisations step by step after an adequate examination of the data.

If we in Great Britain can be said to adopt any method at all, it is an indirect one. We hope that specialist students, taught to think in their own field and intellectually alive, because they have somewhere come up against the boundaries of knowledge, will extend their interests and broaden their outlook. But at its best this works only with good students. Surely something more could be done deliberately for the mass of our students without reversing our methods. If the specialist student of a pure science could be encouraged to take an interest in its history on one hand and in the

philosophical criticism of its assumptions on the other, he would be progressing out of specialism into humanism. But deliberate planning is necessary, and this is lacking. We may not altogether like the American plan, but we have no organised alternative to offer.

Elementary Botany.

(1) *A Textbook of General Botany.* By Gilbert M. Smith, James B. Overton, Edward M. Gilbert, Rollin H. Denniston, George S. Bryan, and Charles E. Allen. Revised edition. Pp. x + 539. (New York : The Macmillan Co., 1928.) 16*s.* net.

(2) *A Laboratory Manual of General Botany.* By Emma L. Fisk and Ruth M. Addoms. Pp. ix + 103. (New York : The Macmillan Co., 1928.) 4*s.* 6*d.*

(1) THE growing tendency towards co-operation is shown by the increasing number of works that are published under joint authorship, but it is unusual to find an elementary text in which so many authors have collaborated as that before us. It is therefore with some curiosity that we peruse this experiment in multiple collaboration, for which all six authors would appear to have been collectively and severally responsible. If on one hand we are reminded of the proverbial benefits accruing from a multitude of council, on the other we recall that the broth of wisdom may suffer in homogeneity from too many compositors.

The plan of the book exhibits an especial emphasis upon the plant groups, the treatment of which occupies some 230 pages of text. By describing a larger number of types of cryptogams than are commonly exemplified in works of this standard, the reader gains a more adequate concept of the groups represented. This, however, is accomplished at the expense of the other and, from an educational point of view, probably more valuable aspects of the subject.

The families of flowering plants are treated only as part of the chapter on floral types, which contains descriptions of nineteen selected families of phanerogams. The descriptions are, however, so superficial that the reader who relied on these alone for guidance might justifiably assume that the fruits of all Ranunculaceæ were achenes, that all Cruciferous flowers possessed six stamens, and that in all Leguminosæ a single free stamen is present.

Some of the physiological matter is simply if all too briefly presented, but the explanation of the principles of diffusion of water vapour and other gases from the chlorenchyma leaves much to be desired. When we turn from the text to the figures we find even more evidence of insufficient care and thought. No subject is perhaps more commonly misunderstood by elementary students than the phenomenon of secondary thickening, which authors should therefore treat with meticulous accuracy and clarity. Here, not only is the description meagre, but also the figure which is intended to elucidate this portion of the text shows a longitudinal section of a root in which the youngest portion near the apex contains only secondary wood of the third year, whilst the second-year wood and the first-year wood are confined to the older regions ; an error that is fundamental and not one of mere inaccuracy of lettering. Again, the figure of the elm twig entirely ignores the essential feature of the branching in this species. These are merely a few of the many shortcomings that a perusal of these pages reveals.

The concept of an elementary text depends for its success not merely upon the accuracy of the information conveyed, or upon the amount of knowledge which it imparts, but also upon the educational aim which that knowledge serves and the subjective judgment of the authors in its selection. It would be manifestly unfair to regard the present work as evidence against the value of co-operation, but having regard to the fact that this is a " revised edition ", it is impossible not to surmise that the text would have been clearer and the errors fewer if the individual responsibility had been greater.

(2) The laboratory manual serves as a guide to the practical work which it is suggested should accompany the use of the text-book just considered. The work is divided into thirty-six exercises, of which eighteen are occupied with the study of types, five with the angiosperms, and the remaining thirteen with anatomy, morphology, and physiology. The undue emphasis upon the study of plant groups is again indicated by these proportions. The inadequacy of the anatomical work suggested is sufficiently exemplified by the treatment of secondary wood, where the only drawing which the student is asked for is a ' diagram ' of a cross-section. There is no exercise in the use of microchemical tests, neither are instructions given for the use of stains and reagents for the differentiation of tissues, whilst the practical work on respiration consists of sketching a demonstration apparatus, and experiments on transpiration are ignored.

One cannot but deplore the increasing number of elementary texts that add nothing helpful either in substance or in method to botanical teaching and, at least in their own provenance, may replace texts that are real aids to the student in his difficulties. E. J. S.

Marriage.

Ideal Marriage : its Physiology and Technique. By Dr. Th. H. Van de Velde. Translated by Stella Browne. Pp. xxvi + 323 + 8 plates. (London : William Heinemann (Medical Books), Ltd., 1928.) 25*s.* net.

THIS compact book, written by the some-time director of the gynæcological clinic at Haarlem, a psychologist, and a connoisseur of human nature, gives, as its sub-title indicates, an introduction into the art of conducting an ideal marriage. It approaches its subject from the physiological side mainly, but it is based on an essentially sound sociological conception of matrimony.

Nowadays, when the institution of marriage is being the subject of much discussion and some reform—revolutionary as in Russia, somewhat hysterical as in the United States, and perhaps almost too slow as in Great Britain—this book will be of interest not only to those who read it as a practical guide, but also to students of human society and human nature.

In the first part, after a succinct but comprehensive introduction discussing the real nature of marriage, the author gives a detailed analysis of the physiology of reproduction. The second part deals with more specific questions of anatomy and function. The third part is an outspoken, but in no way pornographic, analysis of technique in marital relations. In the last part, Dr. Van de Velde gives advice as to the mental and physical hygiene of the personal relations between married people.

The book raises, of course, the question how far it is possible to deal scientifically with what might be called the most subtle and most intimate technique of human relations. The present work gives us the reflections, conclusions, and the philosophy of a man with wide experience, with a great deal of common sense, and a capacity for plain but clean speaking, and it justifies itself as a manual of conduct, if not as a scientific disquisition. Treated as a document, it is really valuable for the sociologist, the student of human culture and of the human mind.

This brings us to the second question : such a book could obviously not be sold in the open bookselling market ; the publishers have limited its sale strictly to the medical profession. This certainly is not in any way justifiable : there should be some provision by which a man of science, whether he be a biologist interested in reproduction, or a psychologist studying problems of sex, or a sociologist, should have as easy an access to such a book as the average medical practitioner. The neglect and even scorn of science and of scientific status, so characteristic of public opinion and official attitude in Great Britain, is exemplified nowhere so clearly as in the silly and irksome discrimination which is given to the 'medical and legal professions' and neglects completely the researcher and the academic teacher ; and gives him no place above the man in the street or the seeker after pornography. B. M.

Our Bookshelf.

Anatomy and the Problem of Behaviour. By G. E. Coghill. (Lectures delivered at University College, London.) Pp. xii + 113. (Cambridge : At the University Press, 1929.) 7*s.* 6*d.* net.

THE anatomy into which behaviour does not enter, at least unconsciously, is generally regarded as an academic study incapable of formulating general conclusions and therefore sterile. The anatomical method which has proved most valuable in the hands of British investigators is that which seeks to establish a comparative correlation between structure and function. It is therefore hard to understand why the same method which has proved so suggestive in comparative anatomy has not been pursued more vigorously by embryologists, in order to elucidate the meaning of neurological structures, since this method is even more accessible to professed zoologists than to human anatomists in England. Dr. Coghill, the author of these three lectures, is a member of the Wistar Institute of Anatomy and Biology at Philadelphia ; but the lectures were delivered in London. He has made a parallel study of the development of behaviour and of the nervous system of *Amblystoma* with signal success for his purpose.

We should expect behaviour to develop consistently with the order of development of the nervous system. The demonstration that it does so is therefore of less general interest than, for example, Dr. Coghill's observation that the muscles which move the gills of *Amblystoma* act at first with the trunk muscles although they are under the nervous control of different centres. The reason assigned is that until appropriate sensory connexions are established for local reflexes, the motor pathway to the trunk actuates the gill nerves and their muscles. There is thus evidence for the existence of an early, more generalised anatomical pattern which acquires discreteness anatomically and physiologically. "The development of behaviour primarily through the extension of the total pattern rather than through the projection of primarily isolated parts to become integrated secondarily, means that the maintenance of the integrity of the individual as a whole is the elementary function of the nervous system." However complex the organisation, conduction alone cannot fully account for the rôle of the nervous system. Its own growth is one of the conditions of

its functioning, and this is not dependent upon exercise or intensified function in those parts of the nervous system in which it occurs, as was supposed by those who wrote before adequate data concerning the correlations between the growth processes and behaviour became available. Such is the argument in brief outline. It will be seen that it depends not only upon accurate observation of behaviour but also on trustworthy evidence concerning the anatomical mechanisms involved. The behaviour is the easier to observe. Are we sure that the histology which is so fast becoming a convention is beyond reproach?

Die Entstehung der Kontinente und Ozeane. Von Prof. Dr. Alfred Wegener. (Die Wissenschaft, herausgegeben von Prof. Dr. Wilhelm Westphal, Band 66.) Vierte umgearbeitete Auflage. Pp. x+231. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.) 10 gold marks.

The fourth edition of Wegener's "Entstehung der Kontinente und Ozeane" is greatly enlarged and improved. For example, of the previous illustrations 12 are omitted, but the total number is increased from 44 to 63. The author naturally directs attention to the widespread new support to his hypothesis, especially among meteorologists and physicists, and its adoption by some geologists such as Argand, Staub, and Matley. He mentions some recent criticisms, as in the symposium arranged by the American Institute of Petroleum Geologists, but fails to meet the arguments there put forward.

The new edition directs attention to the seismic work on the rate of earthquake waves under the Pacific. In an appendix in support of the view that longitude determinations prove the westward drift of America, though the author reduces his estimate for the annual increase in the distance between Washington and Paris to a third of a metre, he claims this amount on the basis of longitude observations in the years 1913 and 1927. These results, however, are inconsistent with those given by longitude determinations between Washington and Greenwich in 1913 and 1926. According to Sir Frank Dyson, they show a total decrease in the distance of 30 ft. instead of the reported annual increase of one foot. The author does not notice some of the later work in criticism of the longitude determinations upon which he claimed the rapid westward drift of Greenland. One of the new illustrations deals with the mode of formation of the island festoons of the western Pacific, but it does not seem to represent the actual geological conditions.

The one serious defect in the new edition is the omission of the index, which is especially inconvenient owing to the rearrangement of the book, and the consequent trouble to those who wish to see what modifications have been made in sections of the discussion that specially interest them.

The Journal of the Institute of Metals, Vol. 41. Edited by G. Shaw Scott. Pp. xii+825+42 plates. (London: Institute of Metals, 1929.) 31*s.* 6*d.* net.

In the course of its twenty-one years of existence the Institute of Metals has rendered great services to the science of metallurgy, and has been the means of encouraging research into many metallurgical problems. Its latest volume contains a number of valuable papers. Sir Oliver Lodge's May lecture will be read with interest, consisting as it does of personal reminiscences of scientific discovery in connexion with the electrical and magnetic properties of metals, with suggestive speculations as to the nature of their underlying causes. Good work is being done in Great Britain in the difficult but important field of the establishment of equilibrium diagrams for alloy systems, and the systems magnesium-zinc and cadmium-gold have been added to those which have been studied in the light of modern ideas as to equilibrium in solids, whilst the volume also includes a further study of the age-hardening of certain aluminium alloys, a phenomenon of technical importance which has now been shown to be much more general than had been supposed.

The international character of the Institute is illustrated by a paper on eutectics by Prof. Saldau of Leningrad, and there are several communications dealing with matters of practical and industrial interest. A report which is of value to physicists as well as to metallurgists is that by Miss Elam on the results so far obtained in the study of alloys by means of X-rays. This is a most useful compilation, which will save much labour in searching for references. The abstracts, which form a large portion of the volume, are another valuable feature.

Practical Color Photography. By E. J. Wall. Pp. vii+280. (London: Chapman and Hall, Ltd., 1929.) 15*s.* net.

Amateur Cinematography. By Capt. Owen Wheeler. Pp. xi+135. (London: Sir Isaac Pitman and Sons, Ltd.; Henry Greenwood and Co., Ltd., 1929.) 6*s.* net.

Heraclitus: or the Future of the Films. By Ernest Betts. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2*s.* 6*d.* net.

There are some subjects nicely compounded of general and particular interest, such, for example, as photography. In this, too, where amateurs frequently excel, not a few professionals fail from the artistic point of view. The three recent books on this art referred to above merit attention. Mr. Wall evinces a mastery of his subject, though it lacks presentation in a pleasing form; the trees hide the forest. His reference to juxtaposition of colours in preference to superposition is deserving of attention. Capt. Wheeler provides a most attractive book, and it is amusing to read his and Mr. Betts's references to the 'some-day' appearance of the talkie film. Capt. Wheeler regards it as "long distant"; Mr. Betts hopes it will be long distant; it has arrived, however, rather prematurely. Mr. Betts's subject is, *par excellence*, the future of the film, and with it he pictures the combination of television for political propaganda. "Elections may yet be won on good looks rather than fine words, and no doubt we shall be quite as well off." P. L. M.

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.*]

Electrical Excitation and the Possible Structure of the Plasmatic Membrane.

BANCROFT'S observation that the oil in oil-water emulsions tends to become the continuous phase in the presence of calcium salts and the discontinuous phase in the presence of sodium salts was developed by Clowes (*Jour. Biol. Chem.*, vol. 24, p. xiv; 1916) into a physical explanation of the phenomenon of the action of antagonistic ions on the permeability of cell membranes.

Bancroft showed that when the molar concentration ratio of sodium to calcium was about 98 : 2 there was an equalisation of the surface tensions of the two phases: when the ratio is greater, the surface tension of the oil phase is the greater, and it becomes the disperse phase; and, conversely, it becomes the continuous phase when the [Na] : [Ca] ratio is smaller.

Those salts which promote the dispersion of oil in water (sodium, etc.) also bring about an increase in the permeability of cell membranes, and this permeability effect is antagonised by the presence of salts which promote dispersion of water in oil; moreover, Clowes showed that the ratio of concentrations of various mixtures of salts at the inversion point of oil-water emulsions is the same as that at which their antagonistic action on cell permeability is most pronounced. These facts suggested that the plasmatic membrane might be an oil-water emulsion. In its water-in-oil state it would be impermeable to ions, etc., but permeable to lipoid-soluble substances, as Overton and others have found in certain cases with cell membranes. On inversion to the oil-in-water state these permeability relations would be reversed; this reversed condition is largely observed.

The object of this present preliminary communication is to direct attention to the striking similarity between the electrical excitability of such emulsions and of living tissues.

Two stock emulsions were prepared by grinding together the following ingredients: (1) 'Sodium emulsion', olive oil 50 c.c., water 25 c.c., oleic acid 1 c.c., NaOH 0·08 gm.; (2) 'Calcium emulsion', exactly similar except that 3·0 gm. CaO were used instead of 0·08 gm. soda.

The specific conductivities of a series of mixtures of these two emulsions were as follows:

Na emulsion .	10	8·4	7·2	6·3	5·5	0·0
Ca emulsion .	0	1·6	2·8	3·7	4·5	10·0
Spec. Res. in ohms × 100 .	20·5	18·4	inf.	inf.	inf.	inf.

Clearly those mixtures containing less than 28 parts per 100 of the calcium emulsion stock are freely permeable to ions and are thus of the oil-in-water type.

The mixture of 2·8 parts of calcium stock to 7·2 parts of sodium stock was then placed in the conductivity cell with electrodes 2·5 mm. apart and was stimulated by application of an alternating current of 200 volts, 50 cycles, for 2 seconds. The resistance at once fell from the initial value of more than 50 megohms (inf.) to 240,000 ohms, and continued to fall for about 10 minutes after the stimulus, attaining the minimum value of 195,000 ohms.

From this point the resistance began to increase, and in about 4 hours it had recovered to the value of one megohm, and 17 hours later it was again infinite.

Living tissues also possess a very high resistance which may fall to as little as 2 per cent of its original value when the tissue is subjected to a suitable electric stimulus (Dixon and Bennet-Clark, *Proc. Roy. Dublin Soc.*, vol. 18, No. 29; 1927; and *Notes from Bot. Sch. Trin. Coll. Dublin*, **4**, p. 33). The minimum value of the resistance of a tissue after stimulation is also attained some minutes after the stimulus, and from this the resistance also starts to rise again.

This remarkable behaviour of the oil-water emulsions on stimulation represents the closest parallel yet found in an artificial system to that found in the living protoplasmic membranes.

This change of conductivity of an emulsion is only brought about by relatively small stimuli when its composition is such that it is close to its inversion point.

That the effect of the stimulating current is to invert the emulsion is clearly seen when thin films of emulsion are watched under a microscope at the moment of stimulation. Immediately the stimulating current is started the water drops distributed through the oil instantaneously run together, and water areas filled with oil drops appear where previously separate drops of water were dispersed. The phenomenon is more clearly seen when the water is coloured with phenol-phthalëin.

One explanation of the phenomenon which suggests itself is that the running together of the water drops is due to a reduction of their surface tension, and, as this becomes less than that of the oil phase, inversion of the emulsion takes place.

Such a decrease of surface tension will almost certainly take place if a current of sufficient voltage is applied across the emulsion, as ions and soap micellæ will be banked against the impermeable sides of the water drops, and this increase in concentration will cause a change of surface tension.

Such an increase in the concentration of ions at impermeable membranes in the tissue to a certain limiting value is the condition postulated by Nernst and Hill for the excitation of nerve and muscle.

From this postulate have been deduced the relationships between voltage and frequency of the liminal alternating current, and between voltage and duration of the liminal direct current which will excite a given tissue. These relationships have been verified experimentally in nerve and muscle (see Keith Lucas, *J. Physiol.*, **40**, p. 225; 1910).

The hypothesis that the limiting layer of the plasmatic membrane is an oil-water emulsion at its inversion point would explain how this rise in concentration of ions at the membranes actually brings about excitation. The additional hypothesis is included that the membranes in question are the surfaces of the water drops of the emulsion.

Experiments on emulsions, shortly to be published, show that the relation between the voltage applied to a given emulsion and the response evoked (that is, the change in resistance) is of the same type as that obtained from living tissues; in the former case there is a simple physical explanation of the quantitative results which may possibly also apply to the living tissue.

Moreover, it is also shown that the minimum D.C. voltage required to bring about a change in the resistance of an emulsion is related to the time for which it is applied in the same way as that deduced for the conditions postulated above. In one experiment where the simple relation, $i\sqrt{t}$ = constant, was tested,

the values obtained were 226, 245, 249, and 237; when i is expressed in volts and t in hundredths of a second.

It has also been shown that addition of sodium salts increases the sensitivity, and it seems clear that this effect is produced by bringing the emulsion closer to the inversion point. In these circumstances the required increase in concentration of ions for excitation will be less.

In summary and conclusion, it may be said that the hypothesis that the plasmatic layer of the living cell is a water-in-oil emulsion close to its inversion point correlates and gives relatively simple physical explanations to the following diverse phenomena:

Effects of antagonistic ions and narcotics on permeability.

Effects of electric currents on permeability.

The Nernst theory of excitation.

The effect of calcium on excitability of nerve and muscle.

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Photosensitised Decomposition of Ozone.

DURING the last twelve months we have been working on the photodecomposition of ozone sensitised for visible and long-wave ultra-violet light by the addition of chlorine. A detailed analysis of the somewhat complex pressure changes which occur on insolating or on cutting off the light from a mixture of these gases kept at constant volume, combined with quantum efficiency measurements under various conditions, caused us to suspect the formation, during the course of the reaction, of small amounts of an intermediate compound, and this view has been strikingly confirmed by some recent observations.

The first was that the transmission for the mercury 365 $\mu\mu$ line of an ozone-chlorine mixture containing low concentrations of chlorine increases appreciably during the early stages of the reaction.

The second was that, using sulphuric-acid dried gases, a distinct mist is formed in the gaseous mixture on insolation. Further experiments have shown that this mist is less pronounced under more stringent conditions of drying, and that the resulting trace of liquid, when dissolved in water, (*a*) gives a positive chloride reaction with silver nitrate solution after boiling with ferrous sulphate and sulphuric acid (both the original solution and the reagents were free from chloride), and (*b*) gives potassium perchlorate, recognised by its characteristic crystalline form, on treatment with a drop of concentrated potassium chloride solution, and also gives a positive crystalline perchlorate reaction with brucine.

Finally, we have shown that, if chlorine dioxide, dried by phosphorus pentoxide, is mixed with dry ozone, a red liquid is produced. On admitting moist air, an immediate mist is observed and the liquid is hydrolysed with formation of chloric and perchloric acids.

These observations are consistent with the view that, during the reaction, the following processes take place: (i) Production of Cl atoms by light; (ii) formation of ClO_3 groups by union of Cl atoms and O_3 molecules; (iii) a short chain reaction, probably terminated by adsorption of intermediate atoms or groups on the walls; (iv) union of a certain number of ClO_3 groups to form the chlorine hexoxide of Bodenstein, Harteck, and Padelt (1925), this immediately hydrating in presence of traces of moisture to form chloric and perchloric acids; (v) formation from Cl atoms and O_2 molecules of ClO_2 molecules, these reacting with O_3 molecules to give ClO_3 groups and O_2 molecules.

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An Absolute Method of Measuring High Frequency Currents.

UNTIL recently the measurement of currents at radio-frequencies has depended on the assumption that the instruments used did not alter their calibration with frequency, and every endeavour was made to satisfy this condition. The method largely adopted comprised the use of sufficiently thin conductors so that freedom from skin effect could be obtained. While this naturally limited the magnitude of the currents which could be employed satisfactorily, transformer and condenser methods have been used by D. W. Dye and P. R. Coursey respectively at medium radio-frequencies, for the conversion of large currents into those which could more conveniently be measured directly. More recently, E. B. Moullin has developed an instrument the operation of which depends upon the attraction of two parallel wires carrying the same current. While this instrument would appear to be satisfactory as an absolute method of measurement, it has been considered desirable to develop another method based upon a different principle in order to place the very important subject of radio-frequency current measurement on secure foundations.

Before his departure for America in April last, Mr. R. M. Wilmotte had developed at the National Physical Laboratory a method of current measurement the principle of which is similar to his method for measuring the high frequency resistance of standard inductive coils (R. M. Wilmotte, "On the Construction of a Standard High-frequency Inductive Resistance and its Measurements by Thermal Measurement", *Proc. Roy. Soc.*, vol. 109, pp. 508-522; 1925). The coils were made of mercury in glass, and the expansion of the mercury when a known radio-frequency current was passed through it for a known time could be compared with a similar expansion produced by direct current. The method for measuring current is the inverse of this. An unknown current is passed through a known resistance made of mercury, and it is then required to find the direct current which produces the same expansion of the mercury. The simplest form of resistance which can be accurately calculated at any frequency is a straight circular conductor surrounded by a concentric metal shield. In order to keep the cooling constants as steady as possible, this shield is kept in contact with ice. The column of mercury is connected to a capillary tube in which the rate of expansion of the mercury can be observed.

As previous experience had shown, the time taken for the mercury to reach a steady thermal state is too long for practical use, and it is preferable to make the measurement by observing the time, with a stop-watch, which the mercury column takes in expanding through a given length of the capillary tube. In order to secure accuracy and consistency in the readings, a number of precautions have to be taken in the construction and use of the apparatus. For example, it is desirable that the glass tube containing the mercury column should have as thin walls as possible in order that the glass may be sensibly at the same temperature as the mercury. It has also been found necessary to dry the air between the glass and the

copper screen so that no water should condense on the glass and thus alter its cooling constants.

In order to eliminate end effects, the current is led into the mercury through a special steel rod of the same diameter as the mercury column. This rod is made of non-magnetic steel with a ratio of resistivity to permeability of nearly the same value as for mercury at 0° C. In this manner the distortion of the lines of flow of the current at radio-frequencies is made inappreciable.

At the outlet end a similar arrangement is adopted, except that the steel rod is provided with a very fine capillary in order to allow the mercury to pass from the main column to the glass capillary upon which the observations of expansion are made.

Observations made with the first experimental apparatus have shown that it is possible to measure a direct current of 10 amperes consistently to a few parts in a thousand. The variation in the calibration from day to day has also been found to be considerably less than 1 per cent, and with a more suitably constructed instrument it is probable that this variation can be appreciably reduced. With the view of linking up with the low current thermal instruments which have hitherto been employed, an instrument suitable for currents of the order of 1 ampere has been designed, but certain constructional difficulties have still to be overcome.

This work is being conducted as part of the programme of the Radio Research Board established under the Department of Scientific and Industrial Research.

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The Fine Structure of X-ray Absorption Edges.

IT is well known that the edges of X-ray absorption spectra are very often accompanied by secondary edges on the short wave-length side. For this phenomenon the following explanation has been proposed (D. Coster, *Zs. f. Phys.*, **25**, 83; 1924: A. Sommerfeld, "Atombau", fourth German edition, p. 326; 1924). Whereas the main edge in the case of the K-absorption line corresponds to the transition of the K-electron just to the outside of the atom, the secondary edges should correspond to a simultaneous transition of a K-electron and an outer electron by one single absorption act.

This hypothesis has been examined experimentally by D. Coster and J. H. van der Tuuk (NATURE, **117**, 586; 1926). The K-absorption line of argon was chosen because in this case there was no complication due to chemical bonds to be feared, and the experiments are easily performed by filling the spectrograph with argon of varying pressure. Though one rather weak secondary edge just near the main edge was found, which seems to be connected with transitions to different optical orbits outside the atom, no edge corresponding to a simultaneous transition of a K-electron with one or more outer electrons could be detected.

In a beautiful investigation of the absorption spectrum of iron by Lindsay and Voorhees (G. A. Lindsay and H. R. Voorhees, *Phil. Mag.*, **6**, 910; 1928. See also B. B. Ray, *Zs. f. Phys.*, **55**, 119; 1929), however, several secondary edges, some at considerable distances from the main edge, were observed. Some of these edges are explained as being due to simultaneous transitions of a K- and an M-electron, and in view of the experimental facts this seems to be the only satisfactory explanation available. In the light of the experiments on the argon edge, we must therefore conclude that such double electronic transitions are much less probable in the case of complete outer electronic shells (argon) than when one of the outer electronic shells is incomplete (iron). Recently also R. Swinne (*Phys. Zs.*, **30**, 523; 1929) has directed attention to the fact that in the case of complete outer electronic shells, fine structures are not readily observed. In agreement with this view is the fact that extremely beautiful fine structures corresponding to rather large energy differences were observed by Nishina (Y. Nishina, *Phil. Mag.*, **49**, 521; 1925) in the case of the L-spectrum of the rare earth metals and by Fricke (H. Fricke, *Phys. Rev.*, **16**, 202; 1920) for the K-spectrum of the elements in the neighbourhood of the iron group.

To test this view, K-absorption spectra were taken from metallic copper and metallic zinc. In the normal zinc atom, the M-shell is complete and the bivalency of zinc warrants that this is still the case in compounds and in the solid metallic state. Though

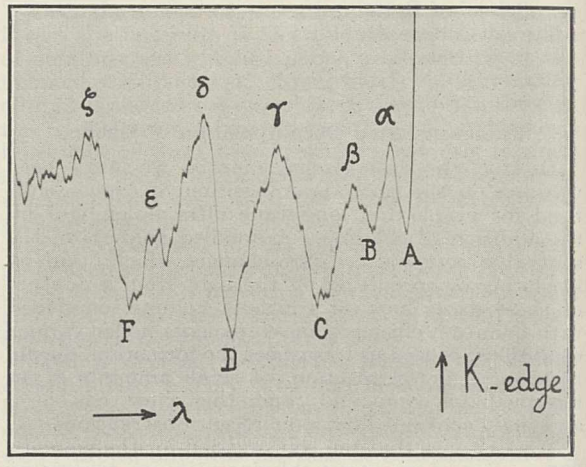

FIG. 1.

in the normal copper atom the M-shell is also complete, this is certainly not the case in the bivalent copper compounds and probably not in the solid metallic state. Indeed, there appeared to be a great difference between copper and zinc as regards their absorption X-ray spectrum. Whereas with copper a very complicated fine structure is easily obtained, until now we have not succeeded in obtaining the same for zinc, though the main edge in this case was clearly pronounced.

The photometer curve taken with the Moll photometer shows the complicated structure of the K-absorption edge of metallic copper. On the long wave-length side of the K-edge the blackening was too great to be registered on the same plate. On the short wave-length side a great number of alternating black and white lines are clearly seen; the former are denoted by Greek, the latter by Latin letters (the letter E between F and D has been erroneously omitted in the figure). Their positions relatively to the main K-edge are:

	$\Delta\frac{\nu}{R}$		$\Delta\frac{\nu}{R}$
A	1·7	α	2·5
B	3·6	β	4·7
C	6·9	γ	8·9
D	12·4	δ	13·1
E	15·5	ϵ	16·3
F	17·9	ζ	20·0

These energy differences might be connected with the energies which are required to remove a M-electron

from the copper atom from which one K-electron is already missing. These energies correspond to the M-levels for the next element (zinc), for which the following values are known: M_{I} 10·1; M_{II}, M_{III} 6·8; M_{IV}, M_{V} 0·9.

A detailed exact explanation of the observed fine structure is made very difficult by the inaccuracy of the latter numbers and the complexity of the phenomenon in question. Experiments have been started with a spectrograph of much higher dispersion in order to try to settle the unsolved problems.

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The Comma Butterfly in England.

IT may be of interest to put on record the fact that on Sept. 21 I saw a quite fresh-looking specimen of the Comma butterfly (*Polygonia c-album*) feeding at *Sedum spectrabile* in my garden here. My wife and I watched it together for ten minutes—several Tortoiseshells and Red Admirals were feeding also. The Comma butterfly, according to South's "British Butterflies" (published by Warne), p. 65, is "now almost entirely confined to Herefordshire, Worcestershire, and Monmouthshire". I have taken it at Chepstow years ago when I was a keen butterfly collector, but have not met with it in England since, though I have often seen it on the Continent in Corsica, Dauphiny, etc. I should doubt if a specimen of the Comma has been recorded in London for a hundred years. F. SHERWILL DAWE.

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Chiswick, W.4, Sept. 21.

DR. DAWE'S observation serves to direct attention to a matter that is of considerable interest to students of the Lepidoptera of the British Isles in connexion with the distribution of *Polygonia c-album*. It is not an isolated one, for in 1928 a single example of the same species was noted in a garden at Twickenham, which is near Chiswick. The two records, however, provide an additional interest in the suggestion they contain that this butterfly may have established itself somewhere in the vicinity. Old records show that at the commencement of the nineteenth century the Comma was, if not actually common, at least widely distributed in England and to be met with in most counties. Its numbers gradually dwindled, however, until, towards the end of the century, it had disappeared from all the southern and eastern counties. By about 1905 it was no longer to be found, with any certainty, outside the area comprised roughly by Monmouthshire, Worcestershire, and Herefordshire, and seemed still to be rather on the wane. Records of its occurrence during the War years are somewhat scarce, but it was recorded from Eastbourne (1915), Kent (1916—last seen in 1899), Shropshire (abundant, 1917 and 1918), and Cheshire (1918). The Kentish and Eastbourne records are interesting as, taken in conjunction with others given below, they seem to suggest that the butterfly had in fact been maintaining itself somewhere in the south-east corner of England in spite of its apparent absence.

The tendency to spread in a northerly direction, that is indicated by the Shropshire and Cheshire records, appears to have given place about 1919 to a southerly and easterly trend, which is best shown chronologically as follows: 1919, Wiltshire, Essex; 1920, Somersetshire (last seen 1892); 1921, Gloucestershire, Warwick, Cotswolds, Berkshire; 1922, Devonshire, Hampshire, Buckinghamshire, Berkshire, Hertfordshire, Staffordshire; 1923, Warwickshire, Staffordshire, Buckinghamshire, Bedfordshire, Somerset, Wiltshire; 1924, Dorset, Hampshire, Sussex (Eastbourne); 1925, Berkshire, Buckinghamshire, Hertfordshire, Bedfordshire, Hampshire, Essex; 1926, Oxfordshire, Dorset, Hampshire, Sussex (Eastbourne); 1927, North Staffordshire, Nottinghamshire, Berkshire, Hertfordshire, Wiltshire, Dorset, Hampshire, Sussex; 1928, Dorset, Isle of Wight, Portsmouth, Twickenham; 1929, Devonshire, Dorset, Hampshire (abundant in New Forest), Sussex (East and West), Surrey (Walton-on-Thames), South Buckinghamshire.

The above records are taken from *The Entomologist*; no doubt supplementary data exist elsewhere. They appear to indicate fairly definitely a radial dispersal of the very attractive butterfly under discussion that commenced sometime between 1910 and 1915, and had the Wye Valley as its centre. Dispersal was primarily in a northern and north-eastern direction, afterwards mainly eastern and southern, the isolated records from Essex (1919) and Eastbourne (1924 and 1926), as already suggested, not forming part of the main phenomenon. In the present year the butterfly has undoubtedly reached the south coast throughout Dorset, Hampshire, and the greater part of Sussex, but on the other hand records from the counties through which it has passed within the last ten years are entirely lacking. Negative evidence of this kind is admittedly untrustworthy, and it would be most interesting to know whether the butterfly is in fact absent from these counties now or merely so well established in them that collectors have ceased to direct attention to its presence.

It may, of course, be argued that the facts recorded above are as readily to be explained by a sudden general increase in population among very small and hitherto overlooked colonies scattered throughout the area under consideration, as upon the hypothesis of a migration from the Wye Valley area, but the evidence in my opinion favours the latter view. In either case, however, no suggestions have been made that would account for it. The principal food-plants of the caterpillar are, in order of preference, hop, nettle, and currant, none of which appears to occur now any more generally or plentifully than formerly.

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Oct. 9.

Electrical Phenomena of Crystals floating on a Saturated Aqueous Solution.

AT the end of 1926 a student under my charge named M. Simizu found that crystals of acetanilide formed a regular arrangement on the surface of the saturated aqueous solution of acetanilide. He had filtered the crystals produced by boiling aniline and acetic acid (J. B. Cohen, "Practical Organic Chemistry", p. 151, 1920), and discovered this after leaving the filtrate for two days.

I have since then undertaken the following experiments. On bringing a glass rod near the crystals these floating crystals were all attracted to the end of the rod; that is to say, they had *free* electric charges. The charge was positive, because they were attracted strongly by a sulphur rod rubbed against wool and were repelled by a glass rod rubbed against silk. The solution was weakly acidic to litmus paper.

Dissolving acetanilide, purified by frequent recrystallisation, in ordinary distilled water, acidifying it

with acetic acid, and finally cooling it, I found that small crystals appeared on the surface of the solution. These formed a regular arrangement more striking than those described above and reminded me of the famous experiment of Meyer's floating magnets; for example, when seven crystals were present, they arranged themselves in a right hexagon, one of them placing itself in the centre.

The crystals thus had a fair amount of *free* charge, the charge being positive. When they were small (for example, 0·8 mm.), the crystals thus crystallised out of the saturated solution would separate themselves from each other by mutual repulsion. When, however, the crystals were larger, they would not separate if they were once brought into contact. Moreover, they would attract one another and come into contact though they were separated by a small distance from one another. This is due to the capillary effect.

According to Perrin's explanation of the phenomena of electrical endosmose (Perrin, *J. Chim. phys.*, **2**, 601; 1904), crystals of naphthalene and other compounds acquire positive charges by the adsorption of hydrogen ions in acidified water. When they are in alkaline solution, by the adsorption of hydroxyl ions they acquire negative charges. In the case of acetanilide also, a layer of the ions is produced on the surface of the crystals by selective adsorption, and at the same time a diffusion layer of the ions with the opposite charge is also produced outside of the former layer. If the latter layer of ions can slip in the electric field, it is clear that the crystals move towards one direction in the field.

It was ascertained that the crystals of acetanilide deposited from the pure aqueous solution have negative charges. Using the same apparatus as was adopted by Perrin when he examined electro-endosmose, and putting a porous diaphragm made with melted acetanilide between the cathode chamber and anode chamber, ordinary distilled water saturated with acetanilide was poured into these two chambers and a D.C. source of 120 volts was applied. Then it was observed that the solution of the cathode chamber rose, while the level fell when the polarity of the electrodes was reversed. From this it is clear that the wall of acetanilide is charged negatively.

When some acetanilide was put into distilled water, heated until the solution became saturated, and cooled, the first crystals produced were polygonal plates, and had a free charge of negative sign. When acetic acid was added to this solution, the crystals that had negative charges acquired positive charges, for they were easily attracted by a sulphur rod rubbed with wool.

In experiments in other solvents than water, for example, chloroform, benzene, toluene, and water containing ethyl alcohol, no charged crystals were found.

The origin of the large quantity of *free* charge on the crystals and the electrical phenomena of crystals other than acetanilide are under investigation.

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High-frequency Discharge in Organic Vapours.

WHILE studying the rectification effect in some organic vapours, when ionised by electrodeless discharge, striations unlike the general type obtained by McCallum and Perry (NATURE, Jan. 12, p. 48) were observed to fill the whole tube. The diameter of the tube was different at different parts, varying from 0·5 cm. to 2·5 cm., but there was observed no essential difference in the pattern anywhere excepting their increased luminosity in the narrower portion.

The pattern appeared like a helix, with five or six rings per centimetre and would rotate rapidly about its axis. All these rings are not parallel to one another, and during their rotation they get inclined owing to the non-uniformity of the field in its proximity. They present a wave-like appearance, as has been observed by K. A. MacKinnon and J. K. Robertson (NATURE, July 13, p. 55). It has also been observed in some cases that on prolonged working, the striations separated themselves into groups, presenting the appearance of nodes and antinodes in Kundt's tube phenomena. This happens only when the slip electrodes which are the seat of damped oscillations are brought close together.

Striations in the vapours were observed at a lower wave-length than in the case of air; and also at the same wave-length they would come out quicker in

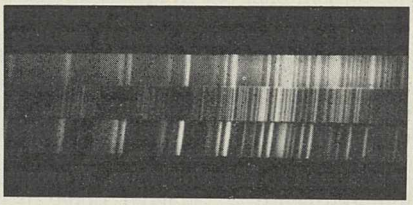

FIG. 1.

vapours than in air, as is expected from the non-ionising collision and absorption of energy in the case of heavy molecules (J. J. Thomson, *Phil. Mag.*, July 1929).

The glow of the striations may be made to extend beyond the electrodes, whether an internal or external electrode is used, provided there is a chance of stray capacity effect. This is very clearly shown when an earthed tin-foil is wrapped over the tube at any remote part of it.

Incidentally, it was also observed that these vapours when ionised give rise to band spectra. The accompanying photograph (Fig. 1) shows such an effect when propyl bromide was used, but we are not yet sure of the emitter of these bands. Investigations in this laboratory are being carried on to study the band spectra of some simple molecules when ionised by this method of electrodeless discharge.

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Dr. Augustus Waller and Patents.

IN the "Calendar of Patent Records", page 562, NATURE, Oct. 5, it is stated that Dr. Augustus Waller patented, in 1852, a means for measuring the quantity of alcohol in liquors; "but" (quoting from the paragraph in NATURE) "his most important invention—the cardiograph . . . was not patented".

The Dr. Augustus Waller who is reported to have obtained this patent, and who in 1852 was engaged on his neurological researches, was the father of Dr. Augustus Désiré Waller, who first observed and recorded the human electrocardiogram.

The patent may well have been the result of some hobby of his spare time, but neither my grandfather nor my father patented any results of the researches through which they are now remembered by physiologists.

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Sexual Behaviour in Birds.

By Dr. F. H. A. MARSHALL, F.R.S.

IN recent years the intensive observation of birds living in a state of Nature has led to the development of a branch of study which is not only full of interest to the outdoor naturalist, but may be as strictly scientific as the work of the museum specialist or the laboratory observer. The pioneer in this movement was undoubtedly Gilbert White, about whose book on "The Natural History of Selborne" it has been said that, together with Bewick's "History of British Birds", it has been the main contributory cause of that widely spread interest in ornithology which has been so apparent in Great Britain since the beginning of the last century.[1]

White's observations on bird behaviour, unique though they were at the time that they were recorded, were nevertheless scanty, and we have to pass over nearly a hundred years before the general interest in bird-watching received a new stimulus from the close and detailed studies of W. H. Hudson, whose virtue it was to combine great literary merit and scientific exactitude with an intense sympathy for the animals observed. Of more importance than Hudson's work, as showing a wider biological outlook and a greater scientific precision, are the recorded observations of Eliot Howard [2] and Edmund Selous,[3] both of whom have concerned themselves with the sexual behaviour of birds and its physiological and evolutionary significance. Mention must also be made of the work of Julian Huxley,[4] whose studies on courtship phenomena have not yet received the full recognition they deserve.

Selous's most important scientific work is probably that dealing with sexual selection and the extension of that principle to birds which are decorated in both sexes and display mutual courtship—a principle to which he applies the term inter-sexual selection. This phenomenon may be seen to a greater or less extent in grebes, divers, shags, guillemots, oyster-catchers, and avocets, besides various other birds, and has been observed independently by Huxley. In some species the usual parts played by the sexes are definitely reversed, as shown by Huxley for the great crested grebe. Eliot Howard's investigations likewise deal mostly with breeding phenomena, and in particular with the territory theory which he has put forward and supported with a wealth of detailed observation to explain the meaning of the complete change of habit shown by many passerine birds and some others when they take up their breeding quarters. But it is to Howard's more recent but related work on the phases of the reproductive cycle and their physiological significance that I desire to refer chiefly in this article. The recorded observations are upon the outward behaviour of birds during the breeding season, yet, as the author himself emphasises, each phase of activity must be correlated with internal changes in the bird's sexual state, without a knowledge of which the behaviour of the individual cannot be adequately explained. For birds the necessary data for a full interpretation do not at present exist, for the subject has scarcely begun to be investigated. Nevertheless, a consideration of what is known in this connexion concerning the changes undergone by the reproductive organs of other animals may point the way to further work and provide some clue to the interpretations which will some day be forthcoming.

In the spring, in response to some stimulus which is partly internal and partly external, buntings and various other birds which form flocks in the winter, assume isolated positions or territories which later become their breeding quarters and from which they exclude other birds of their own species. In the same way warblers and other migratory birds, soon after their arrival from southern lands, acquire territories, and these they continue to hold until the young are able to look after themselves and the breeding season is over.[5] Howard has shown that the territories are first occupied by the male birds alone and are held by them against other comers for some days or weeks before the arrival of the females. The latter leave the flock, which is thereby broken up in response to some sudden impulse, and commence to wander until attracted by the song of the males with which they afterwards mate. In the case of migratory birds also, the females commonly arrive after the males.

Mating is not at first followed by sexual intercourse, but there is in the female a period of preparation which Howard compares with the proœstrum of the mammalian female, and this period is often very prolonged. In buntings the proœstrum is characterised by sexual flight and there is some posturing on the part of both sexes, but it is not until the next period, which corresponds to the mammalian œstrus, that coition occurs. (There is no evidence of a synchronous physiological change in the male, which is probably capable of intercourse at the time of the female's proœstrum.) Howard remarks that the value of posturing chiefly lies in the œstrous phase, its purpose being the provocation of sexual reaction by mutual stimulation. During the phase of proœstrum, instead of there being one form of stimulation, there are a number—voice, appearance, and movement. At œstrus, the female bird, instead of flying or shuffling away on the approach of the male, stays, raises her tail and quivers her wings. "A stonechat flutters one or both wings; a willow wren flaps them; a guinea fowl rushes along the ground, checks herself, and lies on the ground with wings

[1] Newton, A., "Dictionary of Birds" (1896).
[2] Howard, H. Eliot, "The British Warblers" (1914); "Territory in Bird Life" (1920); "An Introduction to the Study of Bird Behaviour" (1929).
[3] Selous, E., "Realities of Bird Life" (1927).
[4] Huxley, J. S., *Proc. Zool. Soc.*, 1914; *Journal Linnean Soc.*, 1923.
[5] Nicholson, E. M. ("How Birds Live." Second edit., 1929), says that greenfinches, lesser redpoles, linnets, and serins tend to nest in communities and do not form territories.

outspread; a hedge sparrow quivers her wings and springs a few inches from the ground, and so we might give a long list of the different fashions in which females disclose sexual reaction".

There can be little doubt that the simultaneous bobbing up and down of the head and neck by the drake and duck in the water, the bowing and puffing out of the neck by the wood pigeon, which at the same time coos loudly and fans its tail, and the similar display by the lapwing and other birds, are all procœstrous or œstrous phenomena, and belong, therefore, to the same category, though not necessarily showing that the birds are ready for immediate coition. In these cases the display can have no significance in relation to preferential mating as postulated by Darwin's theory of sexual selection, for it concerns a pair of birds which have already mated, although, as Selous has recently shown, preferential selection of the male by the female undoubtedly follows the courtship antics of the ruff and the blackcock. In most birds, however, in which mating occurs before posturing,[6] the latter must be supposed to have a physiological significance, and Howard has shown that this probably consists in its securing an effective synchronisation of the reproductive capacities of the male and female.

Light is thrown upon this subject by the older observations by E. H. Harper on egg-laying in the domestic pigeon. This author writes as follows:

"When a pair ready for mating is put together, egg-laying ordinarily ensues at the end of a rather definite period, at the least eight days. The female functions are held in abeyance till the proper stimulus is received from a mate. The maturing of the egg is so exclusively a female function that it seems odd at first thought that an apparent exception should occur to the rule. Of course, we know that the final maturation of the egg, or the giving off of the polar bodies, awaits in most animals the act of fertilisation. But here the effect is produced upon the egg by the entrance of sperms. How mating and the act of copulation (which is repeated at frequent intervals every day at this time) could influence the ripening of the egg in the ovary is another problem. In this connexion the curious fact must be mentioned that two female pigeons placed in confinement may both take to laying eggs. The function of ovulation is in a state of tension, so to speak, that requires only a slight stimulus, 'mental' apparently in this case, to set the mechanism to working. At any rate, it is impossible to regard the presence of sperm in the oviduct as an essential element of the stimulus to ovulation, although it may have an important influence in the normal case. Our attention is directed to the various and complex instincts of the male which come under the head of courtship, both before and after mating is effected, as furnishing a part of the stimulus to the female reproductive organs." [7]

Harper proceeds to describe a curious habit which is common among pigeons before copulating. The male bird regurgitates some secretion in its throat, and this is taken up by the bill of the female in much the same manner as the young take their food. "It is easy to see that here may be one of the sources of indirect stimulation to the female reproductive organs." Numerous observations on the pigeon have been made also by C. O. Whitman,[8] who speaks of posturing as self-stimulating.

To elucidate the subject further we pass to the mammal. It was observed long ago by Walter Heape [9] that, in the rabbit, ovulation or the discharge of the eggs from the ovary is dependent upon coition, and that it takes place approximately ten hours after coition. During the intervening time, the egg undergoes the characteristic maturation changes. The actual process of ovulation has been observed in anæsthetised rabbits the ovaries of which were exposed.[10] Similarly, it has been found that the ferret depends upon coition for the rupture of the follicles and the discharge of the ova. The injection of semen is not essential, for ovulation occurs after copulation with a sterile male. There is evidence that in the sheep also at the end of the sexual season the stimulating power at the disposal of the ewe is not sufficient to admit of spontaneous ovulation at the œstrous periods, and that in the non-occurrence of coition the egg is not discharged.[11] Further, it has been observed in rabbits that if two does 'on heat' are kept together and 'jump' one another after the manner of cows in that condition, ovulation may occur as a result of sexual excitement and in the absence of the male.[12] The latter process is clearly comparable to what Harper and Whitney have observed in pigeons. In all these cases it would seem evident that ovulation is brought about by a nervous stimulus which may be due to the orgasm or to the sexual excitement which is an accompaniment of posturing.

Additional light has been thrown on the problem by recent investigations on the anterior lobe of the pituitary body, and more particularly by C. W. Bellerby's researches.[13] By intravenous injections of extract of anterior lobe into an œstrous rabbit kept under anæsthesia, Bellerby has been able to bring about ovulation experimentally at about the same time after injection as it occurs normally after coition (to be precise, at $11\frac{1}{2}$ hours after). He suggests, therefore, "that the act of copulation, or the orgasm resulting from it, stimulates the anterior lobe of the pituitary to secrete into the blood-stream a hormone that initiates in the follicle those internal changes that finally result in its rupture".

In view of the facts above cited, there is a strong presumption that sexual posturing in birds has a definite physiological significance in that it exercises a stimulating influence upon the anterior lobe of the pituitary body, thereby causing it to secrete in greater quantity and so bring about those ovarian processes which result in egg-laying. The mechanism is perhaps comparable to the

[6] According to Nicholson, mating with hawfinches commences in February and before the breaking up of the flock.

[7] Harper, E. H., *Amer. Jour. of Anat.*, vol. 3, 1904.

[8] Whitman, C. O., "The Behaviour of Pigeons" (1919).

[9] Heape, W., *Proc. Roy. Soc.*, B, vol. 76, 1905.

[10] Walton, A., and Hammond, J., *Brit. Jour. of Exp. Biol.*, vol. 6, 1928.

[11] Marshall, F. H. A., *Phil. Trans.*, B, vol. 196, 1903; *Quart. Jour. Micr. Sci.*, vol. 48, 1904.

[12] Hammond, J., and Marshall, F. H. A., *Proc. Roy. Soc.*, B, vol. 87, 1914.

[13] Bellerby, C. W., *Proc. Physiol. Soc., Jour. of Physiol.*, vol. 67, 1929.

secretion of the suprarenal glands in animals as a result of strain or emotion in the manner postulated by W. B. Cannon.[14] This conclusion is of course speculative, but it is to be pointed out that the anterior lobe is supplied by sympathetic nerve fibres which are probably derived from the superior cervical ganglion.[15]

That the anterior lobe of the pituitary is functionally correlated with the sexual organs is now definitely established, but the precise sequence of events leading up to the phenomena associated with œstrus is yet to be determined. P. Zondek and S. Aschheim,[16] P. E. Smith and E. T. Engle,[17] A. S. Parkes[18] and others have shown that anterior lobe extracts injected into mammals exert a powerful stimulating action upon the gonads, increasing in the female the number of follicles available for ovulation eight or ten times, besides affecting the other ovarian functions in a marked degree. That such a correlation exists in the birds has been shown by Oscar Riddle,[19] who found that the grafting of anterior lobe tissue or the injection of extracts into immature ring-doves promoted the growth of the gonads in both sexes and accelerated the attainment of sexual maturity.

It is no less evident that the gonads are themselves responsible for the development of sexual change, as is indicated negatively by the familiar effects of castration and oöphorectomy. W. Rowan[20] has suggested that the periodic growth of the gonads provides the necessary stimulation for migration, and the non-existence of the migratory instinct in sterile birds is consistent with this view. Moreover, Rowan has shown experimentally in the Junco (*Junco hymenalis*) that a premature recrudescence of the gonads, brought about by the use of artificial light from powerful electric bulbs, induced the birds to fly away, although the season was inappropriate, being mid-winter, whereas control birds with undeveloped gonads did not migrate but remained close at hand.

As to whether the gonads react upon the anterior lobe of the pituitary, there is at present no evidence excepting that in mammals the gonads seem to control the sexual cycle. In reality there is probably a complicated cycle of processes in which the thyroid and other endocrine organs play their part. The most that can be said at present is that certain links in the chain of causation can be demonstrated and that Eliot Howard is probably right in his conclusion that mutual posturing in birds secures an effective synchronisation of the essential reproductive conditions of the male and female, and so promotes the successful fertilisation of the eggs, a conclusion which he has reached as a result of prolonged and intensive watching of birds in a state of Nature.

[14] Cannon, W. B., *Amer. Jour. of Psych.*, vol. 25, 1914; *Amer. Jour. of Physiol.*, vol. 33, 1914.
[15] Sharpey-Schafer, E., "The Endocrine Organs", vol. 2 (second edition, 1926).
[16] Zondek, Paul, and Aschheim, S., *Klin. Wochensch.*, vol. 6, 1927.
[17] Smith, P. E., and Engle, E. T., *Amer. Jour. of Anat.*, vol. 40, 1927.
[18] Parkes, A. S., *Proc. Roy. Soc.*, B, vol. 104, 1929.
[19] Riddle, O., and Flemion, F., *Amer. Jour. of Physiol.*, vol. 87, 1928.
[20] Rowan, W., *Proc. Boston Soc. of Nat. Hist.*, vol. 38, 1926; cf. F. H. A. Marshall, "The Physiology of Reproduction" (second edition, 1922).

Molecular Air-Pumps.[1]

By Prof. E. N. DA C. ANDRADE.

ACCORDING to the kinetic theory a gas consists of molecules, which may be considered as little spheres, or, more generally, as little bodies of a more or less marked degree of symmetry, about a hundred-millionth of an inch long, rushing about in all directions and frequently colliding with one another and with the walls of the vessel. The collisions with the walls produce the pressure. The molecules move with a very high velocity, some hundreds of yards per second for gases at ordinary temperature, and this high velocity deduced from elementary considerations, was a point of difficulty in the early days of the theory, critics objecting that such speeds would imply very rapid diffusion, so that, for example, the vapour of any odorous liquid should be detected by its smell at the furthest parts of a room as soon as the bottle is opened. Such criticism leaves out of account the frequent collisions, which make the path of an individual molecule a zigzag with frequent turns back on itself. The average distance between collisions is called the mean free path, and is an essential factor in all questions of diffusion and of viscous forces. It is about a hundred-thousandth of a centimetre for air at ordinary pressure, and is, to a first approximation, independent of the temperature. It varies, with a given gas, inversely as the pressure, so that at low pressures it becomes quite large: in air at a pressure of 1 microbar it is 10 cm., and at a pressure of 0·01 microbar, easily attained with modern technique, it is 10 metres.

If we consider the passage of a gas through a tube of any kind, a change in the laws governing the movement begins to manifest itself when the pressure becomes low enough for the mean free path to be about equal to the linear dimension of the cross section of the tube. The physical reason of this is clear: at higher pressures most of the collisions are between molecules, collisions with the walls being comparatively infrequent; at very low pressure collisions with the walls are common compared with those between molecules, and dictate the nature of the bulk movement of the gas. Knudsen, who studied the flow of gases through tubes at very low pressure, found that his results could be explained on the supposition that the molecules which struck the walls did not bounce off at the reflecting angle, like tennis balls from a smooth floor, but came off in random directions, like tennis balls thrown into a crowd, where they are caught and thrown up again at hazard. The gas behaves as if momentarily condensed on the wall, and then re-evaporated. He worked out the consequences of such behaviour, and deduced laws

[1] From a discourse delivered at the Royal Institution on Friday, May 31.

which he found to agree closely with experiment. If the quantity Q of gas issuing be measured by the volume multiplied by the pressure at which it issues, then

$$Q = pv = \frac{4}{3}\sqrt{2}\pi\ (p_2 - p_1)\ \frac{r^3}{l}\ \frac{1}{\sqrt{\rho}}\ t,$$

where ρ is the density of the gas *at unit pressure*; p_1 and p_2 are the pressures at the two ends of the tube respectively; r is the radius and l the length of the tube; t is the time. This formula shows that a gas at low pressure will take a surprisingly long time to pass through quite a wide tube into a perfectly exhausted vessel. For example, suppose a volume of 2 litres, containing air at 15° and at a pressure of 10 microbars, connected by a tube 50 centimetres long and 5 millimetres in diameter to a second vessel in which a pump maintains a pressure of only 0·01 microbar. It will take 5 minutes for the pressure in the first vessel to fall to 0·2 microbar. Many physicists who are familiar with this speak, however, as if the resistance to flow at low pressure were *greater* than that which we should anticipate if the ordinary law of flow which holds for higher pressure, namely,

$$Q = pv = \frac{\eta\,(p_2 - p_1)}{8\,\eta\,l}\ p\ r^4,$$

with constant coefficient of viscosity η, held down to very low pressures. This is, however, incorrect, the resistance at such low pressures being less than if the normal laws of viscosity were valid. For example, if we take oxygen at such a pressure that the mean free path equals the radius r of the tube, we find that Knudsen's formula indicates rather more than four times as much gas passing through under a given pressure difference as would issue if the ordinary viscosity formula were applicable. The reason that, even so, wide tubes offer such a large resistance to the flow of gases at low pressure, is that the driving difference of pressure is very small. It is therefore necessary with all modern vacuum pumps to have very wide connecting tubes, made as short as possible, and very wide bore taps, if exhaustion is to proceed efficiently.

Considerations of the behaviour of gases at low pressure led Gaede in 1912 to design a new type of pump, termed by him a molecular pump. Since the molecules behave as if condensed on the surface and then quickly re-evaporated, if we move the surface rapidly we communicate a common velocity component to all molecules. If, then, part of the walls of a tube could by some means be kept in steady motion in the direction of the length of the tube a difference of pressure would be maintained between the two ends of the tube, the tendency of the gas to flow under the difference of pressure being counteracted by the drift imposed on the molecules. Calculation shows that with a given gas the *ratio* of the pressures at the two ends is fixed by the speed of the walls and the length of the tube. If the ordinary laws of viscosity were valid at these low pressures the *difference* of pressure would be fixed in this way. Clearly the ratio of pressure also depends upon the ratio of the speed of the gas molecule to the speed with which the walls move, so that at a given temperature this pressure ratio is much less for hydrogen than for a heavier gas.

In Gaede's pump the walls of the supposititious tube, which has just been discussed, are constituted by grooves cut in a drum which can be set in very rapid rotation. The drum fits closely into a housing from which a tongue protrudes into each groove, dividing the groove into a low-pressure side, where the walls are running from the tongue, and a high-pressure side, where the walls are approaching the tongue. The high-pressure side of one groove is connected to the low-pressure side of the next groove, so that we have virtually several pumps in series. A preliminary pressure of a fraction of a millimetre of mercury (say 0·1 mm.) is necessary to ensure the efficient working of this type of pump, but with such conditions a very low vacuum can be rapidly attained. A great advantage of pumps of this type is that they deal with condensable vapour as readily as with gases.

Another form of molecular pump has been recently designed by Holweck. In this pump a spiral groove is cut in the casing, and the drum has an unbroken cylindrical surface. The depth of the groove is tapered so as to allow for the decrease of mean free path with increasing pressure.

We now turn to another type of pump which has come into great general use in the last few years. As a preliminary let us consider the influence of a volatile liquid on a vacuum, in particular the question of obtaining a high vacuum in a vessel connected to which by a wide tube is a second vessel containing a liquid.

A celebrated German text-book of physics, published in 1906, says, for example, "If a receiver containing a little gas is in connection with a pump that contains mercury, the pressure of the gas cannot be less than 0·0013 mm. (the vapour pressure of mercury), and if there is mercury vapour in the receiver the total pressure cannot be less than 0·0013 mm. of mercury". This sounds reasonable, and is indeed true so long as everything is at rest and the problem is a statical one. It need not be true, however, if the vapours are streaming. We can, for example, actually connect a receiver to another vessel containing boiling mercury, and yet have a very low pressure in it. To do this we put a liquid air trap in between; the pressure in the trap is very low indeed, and there is a continuous stream of mercury vapour into it; the vapour condenses and the pressure in the receiver remains exceedingly low.

Gaede obtained some very interesting results by connecting a vessel containing a little air with a vessel of heated mercury, with an ice-cooled trap between the two vessels. If the total pressure of gas and mercury vapour were the same in both vessels, then, since there is only air in one, when the mercury is heated sufficiently to give this pressure, there should be no air in the other. However, it was found that air diffuses into the mercury vapour space against the current of vapour. The laws of diffusion are somewhat complicated, but Gaede worked out the case in detail, everything

being at low pressure, and his results led him to devise his mercury vapour pump.

The principle is to let the gas diffuse into a rapid stream of mercury vapour which carries it away to a place where it can be removed by a rough pump. The vapour stream is produced by strongly heating liquid mercury; vapour which diffuses into the receiver space is condensed. Although the fore-vacuum is necessarily at a higher pressure than the receiver, gas cannot get back against the stream of mercury vapour. The pump will only work well at low pressure, for unless the mean free path is long the diffusion process does not become really operative. To render the diffusion effective Gaede used a slit, which diminishes the counter-current of mercury vapour. This case can be worked out mathematically, and it can be shown that diffusion is most effective when the width of the slit is equal to the mean free path of the gas. If the slit is too wide the density of the mercury vapour is too great, and the 'brush' action of the slit loses its sharpness; if it is too narrow not enough gas molecules diffuse through. Similarly, if the vapour pressure is too high the counter-current is too vigorous; if it is too low the stream is not fast enough.

A better arrangement of the vapour stream was devised by Langmuir. In his type of pump the vapour issues through a tube, which is surrounded by a wider tube, the walls of which are water-cooled. The tube to the receiver enters the outer tube at a point in the rear of the vapour jet. If the pressure is so low that the mean free path of the vapour is greater than the distance between the tubes, the molecules cannot diffuse back against the gas stream, but strike the wall and condense. It is true that a much lower temperature than the boiling point of mercury is needed for condensation at such low pressures, but with tap-water cooling the condensation is fairly effective. The importance of condensation is clear, and Langmuir called his pump a condensation pump, but the gas enters the vapour stream by diffusion just as in Gaede's pump. Both the original Gaede pump and Langmuir's pump are really diffusion-condensation pumps.

The different types of diffusion pump all need a good preliminary vacuum, as they cannot hold up against more than a slight difference of pressure without gas coming back against the vapour stream. A fore-pump producing something between a tenth and a hundredth of a millimetre of mercury should be employed. However, at higher pressures, where the diffusion effect is small, we can use the steam-injector principle, for in a jet of fast-moving comparatively dense vapour there will be a diminution of pressure corresponding to the kinetic energy of the accelerated vapour. The surrounding gas will flow in as a whole under the difference of total pressure, not partial pressure. This principle has been used for the creation of a fore vacuum by a vapour stream. In Gaede's three-stage steel mercury-vapour pump, for example, which has great speed of pumping, there is an injection stage working at comparatively high pressure, and a diffusion stage for the lowest pressure, while in between there is a stage of mixed action.

Mercury is not the only liquid which is suitable for use in a vapour pump. Quite recently Mr. Burch, by a process of distillation *in vacuo*, has obtained an oil the vapour pressure of which at ordinary room temperatures is extraordinarily low. This oil can be used effectively as the working fluid in pumps. Another liquid which can be used is normal butyl phthallate.

In addition to the types of vacuum pumps to which reference has been made, it must be remembered that other processes are widely used, especially in industrial laboratories, for producing high vacua. Solid surfaces in general exercise a marked condensing action on gases, and absorb on themselves thin layers of gases at temperatures and pressures under which the substance is gaseous in bulk. Consideration of these surface actions lie outside the scope of this discourse, as do the methods of combining the residual gases chemically with a substance which deposits on the walls of the glass, by the use of the so-called 'getters'. We may, however, with reference to the part which the walls of the vessel play in these processes, refer to these methods as *mural* methods. If we are allowed to do this we may alliteratively divide the methods of producing high vacua into *mechanical*, as exemplified not only by the Geryk pumps, and box-pumps, but by all pumps, such as the Gaede rotary pump, in which a portion of the gas is cut off and bodily expelled; *molecular*, including in this term both what is ordinarily called the molecular pump and also the vapour stream pumps, since they are based upon molecular theory; and *mural*. The action of the first is perfectly understood; the action of the second is largely understood, but more difficult; the third method, though widely applied, is theoretically still very obscure in many cases.

Finally, it may be mentioned that while pressures as low as a ten-thousand-millionth of atmospheric pressure can be certainly produced in the laboratory, even at this pressure more than a thousand million molecules are present in every cubic centimetre. We are still very far from being able to produce the kind of vacuum that exists in outer space.

Obituary.

DR. C. EASTON.

ON June 3, 1929, Dr. Cornelis Easton died at the Hague at sixty-four years of age. Though he was not professionally engaged in science, his work attracted the attention both of astronomers and of meteorologists, and a short account of his life and work, abstracted from a contribution by Dr. J. Stein, S.J., to *Hemel en Dampkring*, July-September 1929, may interest readers of NATURE.

Born at Dordrecht on June 10, 1864, Dr. Easton attended schools there and passed the entrance examination to the Polytechnicum at Delft in 1881. From early youth the stars had interested him, and one of his teachers encouraged observational

work, so that even during his student's time at Delft he began observing the Milky Way with the view of producing an exact picture of Galactic details and nuances. Though he left his technical studies in 1884 for a literary career and eventually became editor of a leading newspaper, he continued his astronomical work, and after many difficulties, succeeded in 1893 in publishing his first and important work: "La Voie lactée dans l'hémisphère boréal", containing four maps in lithography, prepared with the author's assistance and under his supervision.

This work, which was very favourably received by professional astronomers, was followed by a series of papers dealing with the distribution of the stars near the Galactic system. The principal view put forward is that the Milky Way must be considered as a spiral with two principal curves, a centre in Cygnus, secondary streams going in the direction of Perseus and Ophiuchus, the sun in a rather open space between the windings. The theory was further developed in "A Photographic Chart of the Milky Way and the Spiral Theory of the Galactic System" (*Astrophys. Journal*, **27**, Mar. 2, 1913). The original maps on which this photographical chart was based, were partly published this year (*Monthly Notices R.A.S.*).

In the meantime another research had been undertaken, and in 1903 the result appeared in the memoirs of the Kon. Akademie van Wetenschappen at Amsterdam, "La distribution de la lumière galactique comparée à la distribution des étoiles cataloguées dans la Voie lactée boréale," followed by other treatises on the distribution of nebulæ (1904) and the distance of galactic star-clouds (1921). Soon after the first of these publications, June 13, 1903, he obtained from Kapteyn's hands the honorary degree of doctor of the University of Groningen.

Easton's important studies on periodicity in climate ultimately led to the publication of his book: "Les hivers dans l'Europe occidentale", recently reviewed in NATURE. This work, like that on the Milky Way, involved careful and patient collection and criticism of a vast amount of material, and apart from the value of the results regarding periodicity, it will form a basis for other theoretical investigations. The principal conclusion in favour of an 89-year cycle in the frequency of severe winters certainly was confirmed by the severe winter 1928–29.

Of course, a journalist so well acquainted with astronomy and meteorology, which appeal most to the general public, had an excellent opportunity of popularising these sciences in the papers, and he did so with great success. This was one of the reasons why Easton was chosen as a member of the board of visitors of the Royal Dutch Meteorological Institute of the Netherlands. Since 1921 he was president of the Society for Meteorology and Astronomy, and since 1922 chief editor of its periodical, *Hemel en Dampkring*, which was much extended under his leadership. In every respect Easton will be very difficult to replace, but his work remains and will long continue to be appreciated.

E. VAN E.

PROF. LOUIS CAPITAN.

THE death is announced from Paris of Prof. Louis Capitan, one of the foremost French archæologists of the day. M. Capitan was a doctor of medicine, a member of the Academy of Medicine, and had for many years been a professor at the École d'Anthropologie. He was the author of numerous communications dealing with archæological subjects which appeared in French scientific periodicals, and especially in *L'Anthropologie*.

With various collaborators Prof. Capitan was responsible for several of the magnificent publications dealing with the exploration of the French palæolithic caves, which appeared under the patronage and with the subvention of the Prince of Monaco and under the auspices of the Institut de Paléontologie humaine. "La Caverne de Font de Gaume", written with MM. Breuil and Peyrony, was published at Monaco in 1910. "Les Combarelles aux Eyziès", written with the same collaborators, appeared in Paris in 1924. Other volumes were "Limeuil, son gisement à gravures de l'âge du Renne", Paris, 1924, in collaboration with M. Bouyssonière, and "La Madeleine", Paris, 1928, of which M. Peyrony was joint author.

M. Capitan was a strong supporter of the view which claims a very high antiquity for the art of flint working, and argued forcibly that the flints of earliest date from East Anglia for which an artificial origin was claimed were rightly attributed to man or a pre-human precursor of man. The ground for this conclusion which appealed most strongly to him was a classification of the specimens into 'artificial' and 'natural' based upon his long experience in handling flint implements in large numbers. In fact he had practically reached the position that the final test of the eolith was a judgment which had become almost intuitive as the result of experience—a subjective test which was likely to appeal more to its author than to his audience.

M. Capitan was also keenly interested in Americanist studies. He was one of the French delegates who attended the International Congress of Americanists held in London in 1912, and in 1914 he published, with the assistance of M. Lorin, a book entitled "Le travail en Amérique avant et après Colombe". He was actively concerned in the record and preservation of ancient monuments, and took a prominent part in relation to a projected series of archæological maps, recording the existence and distribution of prehistoric monuments, for which he hoped to obtain international co-operation.

MR. E. H. MAN, C.I.E.

WE regret to record the death of Mr. Edward Horace Man, which took place on Sept. 29 at Preston Park, Brighton. Mr. Man, who was formerly in the Indian Civil Service, retiring in 1901, was born in 1846. As a young man he was appointed to the Andaman Commission, and not only entered into close and friendly relations with the

aboriginal tribes, but also made them the subject of close study. In this he ran no inconsiderable personal risk, for the tribes were then and continued for many years to live in an entirely wild state. Not only did they raid the settlements but many of them resented, and often actively resisted, European visitation, especially if its object were punitive.

Mr. Man's relations with the Andaman Islanders were, however, normally of a happier nature, and he was thus able to visit and study them in their native haunts. As a result he became, and continued to be until the end of his life, our foremost authority on Andaman beliefs and customs. His work has been supplemented by the work of Sir Richard Temple, who for some years was resident High Commissioner, and by that of Prof. A. R. Radcliffe-Brown; but Mr. Man's records will always be the main authoritative source of information relating to this important and interesting relic of a primitive stage in human culture.

The results of Mr. Man's observations were embodied in a number of papers contributed from time to time to the *Journal of the Royal Anthropological Institute*. These, with other material, were afterwards published in his "The Aboriginal Inhabitants of the Andaman Islands" (1883). He also published a grammar and dictionary of the Central Nicobarese and South Andaman languages and contributed frequently to the *Geographical Journal* and the *Journal of the Royal Asiatic Society*, as well as to the *Indian Antiquary*, the editor of which, Sir Richard Temple, has recently still further contributed to our knowledge of the Andamanese in notes appearing in that periodical. Mr. Man made a large collection of photographs of the Andamanese which are deposited with the Royal Anthropological Institute.

News and Views.

THE Royal Commission on National Museums and Galleries has carried out its labours expeditiously. Scarcely more than a year after its appointment it issued an interim report, accompanied by a volume of evidence and memoranda, and now the first part of the final report has appeared and the second is promised at an early date. The Commission's terms of reference suggested a roving commission through the institutions containing the national collections, and there was a danger that a too close interpretation of them might have led to a prolonged inquiry in which useful conclusions would have been lost under a dead-weight of detail. This danger has been seen, and has been avoided by the concentration of attention on the main aspects as they presented themselves to the commissioners in the course of their extensive investigation. The present report, therefore, deals with the more general aspects of the relationships of museums to the public and to each other, as well as to the state. It examines the actual workings of the different institutions, and makes many suggestions for more efficient methods, for example, of exhibition and of storing, of co-ordination and co-operation, and of public contact. It stresses the need of central co-ordination, and suggests as the best means to this end the appointment of a Standing Commission covering all the institutions concerned, and having, through its chairman, ready access to the Prime Minister and the Chancellor of the Exchequer. We propose to deal in separate articles with some of the points raised in this important report. The second part will be devoted to remarks and recommendations applicable to the individual institutions which house the national collections.

ON Oct. 16 the Royal Swedish Academy of Science, Stockholm, celebrated the 150th anniversary of the birth of Berzelius, the great chemist. Born on Aug. 29, 1779, a year before Davy, Berzelius graduated at Upsala in 1804, and in 1806 succeeded Spaurnau, professor of medicine, botany, and chemical pharmacy at Stockholm, where the remainder of his life was passed. Of the Academy of Science he became president in 1810; he was made a baron in 1835, and died on Aug. 7, 1848. Distinguished "as an experimenter, as a discoverer, as a critic and interpreter, and as a lawgiver", Berzelius made contributions to every branch of chemical science, and Ramsay once said "that he believed that since the time of Boyle none had done more for the advancement of chemistry than had Berzelius". His kitchen laboratory at Stockholm, in which Dulong, Mitscherlich, Gmelin, Gustav and Heinrich Rose were taught, has been described for us by Wöhler. In the gardens at Stockholm "not far from the statues of the kings, amidst trees, with a fountain playing before it, is the bronze figure of Berzelius, the great chemist. He is enveloped in a thick, heavy mantle, the stoic fur of the philosopher, and the face and the whole pose indicate the union of perseverance and intelligence which belongs to such conquerors in the field of science."

DR. D. ADAMSON'S presidential address to the Institution of Mechanical Engineers on Oct. 18 was of a somewhat discursive character; the topics he touched upon ranging from examinations to salesmanship; from researches to public affairs. Among the activities of the Institution is that of holding examinations in conjunction with the Board of Education. On the results of these examinations, which are held in many centres, National Certificates are granted, and these in some cases form the first step towards qualification for membership. Speaking of himself as the "one dissentient" in February 1912 when compulsory examination for admission to associate membership was approved by a general meeting of the Institution, Dr. Adamson said he has been much interested in the success of the scheme of National Certificates which has since been developed. "What is wanted now is that the Institution should foster the co-operation of reputable engineering employers and endeavour to include on the National Certificate a record of the holder's practical training in works". Dr. Adamson laid stress on the need of

works experience, which he said "does not necessarily mean the acquisition of skilled craftsmanship, although this is a great asset if it can be achieved, but it does mean acquiring knowledge of commercial limitations". There are almost as many different views on engineering education as there are engineers, but we gather Dr. Adamson thinks the holidays at school and college are unnecessarily long and that the pendulum has swung too far in the direction of academic teaching.

THE increase in the prestige of the Institution to which Dr. Adamson referred is due to many things, not least among which is the support given to research. He recalled the work of Beauchamp Tower on friction and lubrication in 1883, the experiments on riveted joints of 1881, the marine-engine trials of 1889–1894, the steam-jacket research of 1886–1894, the gas-engine research of 1898–1908, the marine oil-engine trials of 1924–1926, and he said that "Researches to be of direct value to any industry must combine correct scientific control with a proper appreciation of commercial limitations and practical requirements".

WHETHER Dr. Adamson's remarks on public affairs will carry conviction we are doubtful. Many engineers, like many men of science, are too absorbed in their work to devote much time to public activities. He had headed one section of his address "Non-producers". "The great improvements that have been made in the methods of production", he said, "have increased the number of non-producers without improving the position of the producers. The mechanical engineer has still to work as hard, or harder, than his forefathers, while he sees around him increasing numbers of merchants, distributors, and others who neither toil nor spin. . . ." This division of the community into producers and non-producers, we think, is not justified. Civilisation is a vast and complex organism, and the banker in his office, the clerk at Lloyd's, the commercial traveller, the tradesman, the labourer in the docks, and the typist are as indispensable as the man with the hammer and chisel. There are, it is true, some actual non-producers, but their number is negligible. Dr. Adamson suggested young engineers might well become salesmen; by doing so they would scarcely consider themselves to have become non-producers.

IN its report to council for the year 1928 at the meeting held last February the executive committee of the Association of Scientific Workers expressed the hope that a non-party Parliamentary Science Committee would be created which would be prepared to act as a consultative body on all matters affecting the interests of science and scientific workers. At its meeting held on Oct. 19 the Council was informed that this hope had been fulfilled, the general secretary of the Association, Major Church, having made this his first task on his return to the House of Commons. Now that the Parliamentary Committee has been formed, the Association intends to invite the co-operation of other bodies representative of the scientific interest to make its work effective. The British Science Guild has already expressed its intention to assist, and it is hoped that support will be also forthcoming from the British Association for the Advancement of Science, and possibly the Royal Society. Some of the subjects to which the Parliamentary Science Committee may usefully be asked to give its attention are indicated in the leading article in the present issue. The attention of the Committee will also be directed to another matter with which the Association is concerned: namely, the production, importation, collecting and distribution of cinematograph films of scientific interest, and the modification of certain restrictive censorship regulations. For the information of the Parliamentary Committee, as well as the general body of scientific workers, the executive has requested the research committee of the Association to produce a further report on fundamental research, giving as detailed an account as possible of what researches are in progress, what urgent problems need investigation, and what funds and other facilities are needed for their prosecution.

AMONG the resolutions carried at the council meeting of the Association of Scientific Workers was one deploring the failure of the present Government to appoint direct representatives of the scientific interest on important committees and commissions, as, for example, the Royal Commission on the Civil Service, the Patents Committee, and the Advisory Committee on Colonial Development. The omission of a naturalist from the commission appointed to consider the creation and preservation of National Parks was the subject of executive comment, as well as the failure of the Government to appoint a direct representative of science on the Research Grants Committee of the Empire Marketing Board. The executive also commented on the attitude taken up by the Secretary of State for the Dominions (Lord Passfield) towards anthropological research. Lord Passfield, while acknowledging the importance of this field of research, was not prepared to recommend the appointment of an anthropologist to the Colonial Office or to any of the Colonial Governments.

TWENTY years ago the late Mr. Leon Gaster delivered a series of four Cantor lectures before the Royal Society of Arts upon modern methods of illumination. At the end of this course he announced that a society had been formed to focus interest upon the subject of illumination and to bring into contact engineers, architects, oculists, and others concerned with various aspects of it. This was the beginning of the Illuminating Engineering Society, the first president of which was Prof. Silvanus Thompson. The work of this Society is well known to many readers of NATURE, and frequent reference has been made in these columns to it. Mr. Gaster created the Society; and his devoted services and untiring labours in promoting the scientific study of illuminating engineering should not be allowed to be forgotten. We are glad, therefore, that the council of the Illuminating Engineering Society has decided to institute a Leon Gaster Memorial Fund, the interest on which will be devoted primarily to the establishment of a premium to be awarded annually for the best contribution on any

aspect of illuminating engineering. Subscriptions to this fund are invited and may be sent to the honorary secretary of the Society, Mr. J. S. Dow, 32 Victoria Street, S.W.1.

IT is now possible to state that the rainfall over the British Isles as a whole during September 1929 was just less than half the usual amount. During the last sixty years there have been four drier Septembers, of which only those of 1907 and 1910 were appreciably drier and those of 1894 and 1895 were slightly drier. The drought was most intense in the south of England, in the south-east of Scotland, and in the neighbourhood of Dublin, where the total fall amounted to less than a quarter of the average. In parts of Surrey, Hertfordshire, and Buckinghamshire rain fell only on the last two days of the month.

THE total rainfall recorded over the British Isles up to the end of September this year was less than that of any similar period in the last sixty years, although there was very little more in 1870, 1887, and 1921. Over England and Wales alone January to September 1929 was drier than any similar period in the last sixty years, the general fall being 15·0 inches compared with 16·7 inches in 1870, 17·0 inches in 1921, and 17·4 inches in 1887. In both 1887 and 1921 the last three months of the year were dry, so that it is by no means certain yet that 1929 will rank as the driest year on record. The relatively wettest parts of England and Wales were the Devon-Cornwall Peninsula, western Wales, and the English Lake District, where the rainfall of the nine months, January to September 1929, was about three-quarters of the average amount. Rather less than half the average was recorded in the neighbourhood of Margate and Skegness, and over a large area stretching from Woburn in Bedfordshire to Southampton. At Oxford the total rainfall (44 per cent of the average) was only about 7·5 inches, or 1·5 inches less than that recorded in the previous driest group of nine months during the last sixty years, namely, February to October 1921.

THE *Discovery*, with Sir Douglas Mawson's Antarctic Expedition on board, left Cape Town for the south on Oct. 19. The King sent the following message to Sir Douglas Mawson: "The Queen and I send you and all members of the Expedition our best wishes for your success and for a safe journey." In an outline of his plans, published in the *Times*, Sir Douglas Mawson gives the probable route of the ship. From Cape Town, with a possible call at the Crozets, a course will be set for Kerguelen, where several hundred tons of coal sent from Cardiff will be taken on board. A call will then be made at the volcanic Heard Island, previously visited by the *Challenger* and the *Gauss*. From there the course will be south-east into the pack-ice towards the edge of the continent. If the ice allows, the ship will follow the edge of the land, but in any event a series of oceanographical observations will be made so far south as possible. A small scout aeroplane will assist navigation by reporting on the nature of the pack. Should the *Discovery* reach the coast, small survey parties will be landed for a few days, but no lengthy sledge journeys are contemplated, and it is not proposed to winter if the ship can be extricated from the pack in autumn. It is hoped to reach Australia in April 1930. Capt. J. K. Davis is master, and with a scientific staff of twelve the *Discovery* carries a complement of forty.

THERE is suggestiveness for the public health authorities of the United States in the results of Raymond Pearl's investigation of the "Biological Factors in Negro Mortality" reprinted from the May number of *Human Biology*. Studies of bodily structure have already shown distinct differences between the negro and white races, and now it is apparent that the differences extend into the realm of susceptibility to disease. The negro reacts differently to diseases in a great many ways, including incidence and distribution of disease amongst the bodily organs. For example, amongst negroes, fatal illnesses due to disease of the alimentary tract and its associated glandular organs are less common than amongst whites. On the other hand, mortality due to lesions of the circulatory system and to the respiratory system forms in each case a greater proportion of the total mortality of the negroes than of whites. These and other results show that in some respects the negro appears to enjoy a greater biological fitness than the white race, while in other respects he is apparently less well adapted to the general environment in which he must live.

A SERIES of Nature reserves has been created in Soviet Russia through the Institute for Natural Science, we learn from a *Daily Science Bulletin* issued by Science Service of Washington, D.C. In the Urals a small park of 55 square miles has been created in a district famous for its variety of precious stones. At Astrakhan, in the Volga district, there is a bird reserve of 88 square miles, and in the Crimea a smaller area has been given over to mouflon and various kinds of deer. A rest station for birds on migration exists in a marshy region midway between the Caspian Sea and the Arctic, the island of Kondo in the White Sea has been set aside for eider duck; but the largest of all the reserves is that in the Caucasus, which extends to about 1097 square miles. The unfortunate thing is that the creation by edict of Nature reserves is a gesture of little real significance unless steps are taken to give the animals in the areas active protection. That this protection is not forthcoming is shown by the fate of the wild bison of the Caucasus reserve, which are thought to have been exterminated by poachers. Furthermore, an active policy of extermination is encouraged by the game laws of 1924, which make it more or less a public duty to kill the larger predatory birds and beasts, some of which are said now to be very rare.

AT the opening meeting of the Illuminating Engineering Society on Oct. 8, a report was presented reviewing progress in illumination. Allusion is made to the proceedings at the recent annual conference of the Association of Public Lighting Engineers, to the International Lighthouse Conference, and to the

informal International Aviation Lighting Conference held at Olympia in July. Numerous specifications and reports have been issued. New committees have been formed by the National Illumination Committee to investigate aviation lighting, lighting education, traffic-control signals, and colorimetry. A feature of the past year has been the development of illuminating engineering abroad. A long series of papers was read at the 23rd annual convention of the American Illuminating Engineering Society; other reports and papers have been presented at the annual conference of the Illuminating Engineering Society in Germany and to the Société Française des Électriciens. 'Festivals of Light' have been organised in a number of continental cities, and have led to permanent improvements in lighting conditions. A shop-lighting contest organised in Milan also proved very successful, though the taxes imposed on lamps and on current used for lighting in Italy constitute a grave drawback. Preparations are now being made for the next International Illumination Congress which is to be held in Great Britain in 1931.

We learn from the *Record of the Bell Laboratories* that work has been commenced on the development of a deep-sea telephone system between London and New York. It is expected that the cable will be completed before the end of 1932. It gives only a single telephone circuit, but this will be a most trustworthy one, free from the variability and disturbing noises of a radio circuit. It is not intended that this line should compete with radio circuits; it will supplement them. The attenuation of the voice signals will be much greater than that permissible on telegraph cables. This is made possible by using a sheath made from one of the alloys called 'perminvars', which are composed mainly of nickel, cobalt, and iron. They are characterised by high electrical resistivity, and their magnetic permeability is practically constant over a wide range of magnetizing forces. The conductor is insulated by 'paragutta', a composite material giving much better insulation than gutta percha. The losses are so low that a very high sending level can be used for the signals and, as there is practically no interference, a very low receiving level can be employed. The route of the cable is not yet completely settled, but it is probable that the main trans-Atlantic link will extend directly from Newfoundland to Ireland, a cable length of approximately 1800 nautical miles. From Newfoundland it is expected that the circuit will be carried through several sections of submarine cable through Nova Scotia, New Brunswick, and the New England States to New York City, where it will terminate. From Ireland the circuit will probably be carried through submarine cables to Scotland, and thence by land cable to London, the other terminal.

The Council of the Royal Meteorological Society has awarded the Symons gold medal for 1930 to Dr. G. C. Simpson, director of the Meteorological Office, Air Ministry. The medal is awarded for distinguished work in connexion with meteorological science, and will be presented at the annual general meeting on Jan. 15 next.

The Kelvin medal of the Institution of Civil Engineers has been awarded to M. André Blondel of France. The presentation of the medal will be made by Sir Donald Macalister of Tarbert, Bart., in the Great Hall of the Institution on Tuesday, Nov. 5, at 5 P.M. His Excellency the French Ambassador will receive the medal on behalf of M. Blondel, whose health does not permit him to travel to London. Sir Brodie H. Henderson, president of the Institution, chairman of the award committee, will take the chair.

At the end of last session the Society of Glass Technology decided to form a London section of the society. This section began its activities on Oct. 2, when its first meeting was held at the offices of Messrs. Holophane, Ltd., Westminster. In a general discussion on the possible activities of the section it was suggested that the main object of the meetings should be to provide opportunities for the free discussion of matters of practical interest. It was emphasised that the activities of the section should include, in addition to matters primarily of interest to the glass industry, those of interest to closely allied industries in which glass is an important raw material, such as the manufacture of electric lamps, wireless valves, thermometers, hydrometers, scientific glassware, mirrors, etc. A representative council of the London Section was formed to act as an executive committee, and consists of officers of the Society resident in the London district and London members elected at the meeting. Mr. Verney Stott, of the National Physical Laboratory, Teddington, Middlesex, was elected honorary secretary of the section. The next meeting will be held at 7.30 P.M. on Wednesday, Nov. 6, at the Osram G.E.C. Glass Works, North Wembley.

The value of charts in the study of the development of sciences is well recognised, and Dr. Joseph Needham, of the Biochemical Laboratory, Tennis Court Road, Cambridge, has produced an excellent chart, 6½ ft. × 3 ft., by lithography, which will be found very useful in studying the development of biochemistry and physiology and, for the earlier periods, of general biology. It may be obtained from Dr. Needham, price 10*s*. 6*d*. The chart gives the dates of the principal investigators, short descriptions of their books or memoirs, and interesting quotations and notes. The time scale starts at 1450, but the earlier period is briefly referred to. The whole forms a very interesting survey of the subject, and should prove very useful to students.

Messrs. Murby and Co. have recently added to their Geological List two series of "Patterns for the Construction of Block Models" prepared by Dr. F. Smithson. These may be pasted on card, cut out, and made up into hollow blocks; or they may be mounted directly on cardboard blocks supplied by the publishers to the required size (3 in. × 2 in. × 1 in.). Solid wooden blocks, it may be added, would be better still, especially for class use. The models should prove useful to students of geology and physical geography, helping them to visualise structures from every angle, and so to gain the experience necessary to read geological maps intelligently. The first series

(12 models) illustrates faults in horizontal and tilted strata; folded strata; faults in folded strata; and unconformity. The second series (14 models) illustrates folds, overthrusts, and igneous intrusions. The patterns are clearly printed in a standard system of shading and numbering, and the paper used is well adapted for taking colours. The price is 1*s.* 6*d.* per set, and cardboard blocks are supplied at 1*s.* 6*d.* per dozen. The publishers can also supply the models ready made up, either plain or hand-coloured.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A whole-time Principal of the Woolwich Commercial Evening Institute, Plumstead—The Education Officer (T.7), County Hall, Westminster Bridge, S.E.1 (Oct. 28). A lecturer in mathematics at the Exeter Diocesan College for Schoolmasters—The Principal, Saint Luke's College, Exeter (Oct. 30). A lecturer and/or demonstrator in rubber technology and rubber workshop practice at the Newton Heath Technical School, Manchester—The Director of Education, Education Offices, Deansgate, Manchester (Oct. 31). An assistant part-time lecturer in the biology department of the Plymouth and Devonport Technical College—The Secretary for Education, Education Office, Rowe Street, Plymouth (Nov. 1). A science master at the Royal Naval College, Dartmouth—The Headmaster, Royal Naval College, Dartmouth (Nov. 1). An assistant lecturer in physical chemistry in the University of Bristol—The Secretary, University, Bristol (Nov. 4). A lecturer in natural and agricultural sciences at Harrison College, Barbados—C.A. (N), The Secretary, Board of Education, Whitehall, S.W.1; Scottish candidates, C.A. (N), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Nov. 11). A George Henry Lewes student in physiology in the University of Cambridge—Prof. Barcroft, Physiology School, Cambridge (Nov. 15). A Foulerton research student to conduct researches in medicine or the contributory sciences—The Assistant Secretary of the Royal Society, Burlington House, W.1 (Dec. 9). A cancer research fellow in the Department of Experimental Pathology and Cancer Research, University of Leeds—The Clerk to the Senate, The University, Leeds. A male junior assistant at the Chemical Warfare Research Department of the War Office—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. An assistant lecturer in mathematics at the Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11.

Our Astronomical Column.

The New Telescope for Edinburgh Observatory.—In *Engineering* for Sept. 6 and 20, and Oct. 4 and 18, is a description of the 36-in. reflecting telescope for Edinburgh Observatory, made by Messrs. Sir Howard Grubb, Parsons and Co., to the specifications of Prof. R. A. Sampson, Astronomer Royal for Scotland. The article is accompanied by some fifty illustrations, many of them from working drawings, and with their aid it is possible to understand the construction of all the principal parts. The optical system is arranged on the Cassegrain principle, the main mirror being 36 in. in diameter, with a focal length of 15 ft. The Cassegrain mirror mounted near the upper end of the tube is 10 in. in diameter and is designed to give an equivalent focal length of 54 ft. in conjunction with the main mirror. The mounting is of the equatorial type, and the illustrations include sections through both polar and declination axes and the methods of driving and controlling the instrument.

The spectrograph to be used with the telescope has been made by Messrs. Adam Hilger, Ltd. Either one, two, or three glass prisms or one quartz prism can be used, and these, together with the three cameras, are carried in a single-piece aluminium casting lined with felt and kept at a uniform temperature by electric heating wires.

Special attention is directed to the very extensive use made of ball bearings for both polar and declination axes and many other parts. In 1888, 1904, and 1916 respectively, *Engineering* fully described the 36-in. telescope of the Lick Observatory, the 40-in. refractor at the Yerkes Observatory, and the 72-in. reflector for the Canadian Government. These three instruments were constructed by Messrs. Warner and Swasey of Chicago. Of Mr. Warner there is an obituary notice in *Engineering* of Sept. 20.

The Satellites of Mars.—The two tiny bodies that revolve close to Mars afford an example of an interesting kind of motion. Our moon is so far from the earth that the sun's disturbing action is far more potent than the effect of the earth's equatorial protuberance; the result is that the pole of the moon's orbit plane goes round a centre that is sensibly the pole of the ecliptic; on the other hand, in Neptune's system the sun's disturbing action is infinitesimal, and the pole of the satellite's orbit goes round Neptune's pole of rotation. In Mars we have an intermediate state of things; the poles of the satellites' orbits go round points between the poles of the planet's rotation and revolution. The pole of the orbit of Phobos describes a circle with radius 1·1° in a period of 2·264 years. In the case of Deimos the radius is 1·77°, the period 56·127 years.

H. Struve made two careful investigations of the positions of the centres of these circles and of the pole of Mars; the first was made about 1894, the second about 1909; as twenty more years have now passed, and numerous observations of the satellites have been made at Lick, Yerkes, and Washington, Mr. H. E. Burton, of Washington Observatory, has made a new discussion in *Astr. Journ.*, 929, of the whole series of forty-nine years. The point that is of most interest to Martian observers is the position of the planet's axis; there has been much discussion as to whether this is best determined from the satellites or from markings on the disc. Mr. Marth adopted Struve's 1894 result from the satellites, but afterwards the ephemerides went back to a value derived by Lowell and others from markings on the disc. There is no question that the various determinations from the satellites agree excellently *inter se*, and it is difficult to think that they can be wrong by as much as a degree. Burton's position of Mars' north pole is R.A. 316·99°, N.Decl. 52·51° (equinox of 1880); this gives 25·20° for the obliquity of Mars' equator to its orbit, which is just 2° larger than Lowell's value. From past experience, however, it is unlikely that the observers will accept a value derived from the satellites.

Research Items.

Beakers from the Isle of Skye.—In *Man* for October, Mr. W. Lindsay Scott figures and describes two beakers discovered in the recent excavation of a cairn at Kraiknish, Loch Eynort, Isle of Skye. The cairn is circular and now some 27 ft. in diameter and 4 ft. in height. The cover stone, which has been laid bare, is of irregular shape, measuring 5 ft. 6 in. in length, 3 ft. in breadth, and 1 ft. in thickness. There are no traces of an entrance. The chamber was found to be filled with earth and stones to within 15 in. of the cover stone. The contents consisted of several distinct layers of material—bones brought in by crows, peaty earth, blackened and burned matter also containing charcoal, and red-brown earth. The floor was practically covered with water-worn pebbles which also occurred throughout the layers. In the lowest layer were found fragments of one of the beakers, which has now been reconstructed, a second beaker complete except for a hole in the upper surface, and a tiny flint button scraper. No traces of human bones were found. The second beaker was tightly wedged in with water-worn pebbles around and below it. Beaker *A* is of thick gritty paste, light brown with black core, flat base, tall, slightly rounded body, faintly constricted neck, and short upright rim with lip bevelled inside. The whole of the exterior is ornamented with a broad belt of irregular chevrons, with narrow cross-hatched zones on neck and shoulder separated by bands of horizontal lines. Beaker *B* is of similar paste, but the exterior is of a darker brown and the interior blackened on one side. It has a flat base with a distinct foot. The body is short and rounded with a constricted neck. It is ornamented on the body and rim by broad zones of open lozenge pattern. The lower zone has no margin below and finishes in short double strokes hanging vertically. When completely excavated the chamber was found to be pentagonal and formed of six vertical slabs at a height of about 2 ft. from the floor. The floor was composed of small slabs of irregular shape neatly fitted together.

Archæology of Disease in South America.—A well-illustrated article by Prof. Roy L. Moodie in the *Scientific Monthly* for September reviews the evidence bearing upon the antiquity of disease in South America afforded by archæology. The most important source is the mummies. Those which still remain in the mummy packs have been examined by X-rays. Of those which have been unwrapped, some have been soaked in a weak solution of formalin, and it has then been possible to identify muscles, nerves, tendons, arteries, and other organs microscopically, and even to find evidence of disease in the walls of the arteries. Pottery jars representing part or the whole of the human form have furnished evidence of the disease known as *uta*, a loathsome affliction of the mouth and nose due to a blood parasite. The effects of this disease are shown in a skull which has been discovered. The evenness of the wound suggests that a surgeon may have attempted to arrest it by excision of the diseased part with an obsidian flake. The skin disease Veruga Peruana and a rare disease *goundou* are also shown. In the mummies of children, which by their number suggest a heavy mortality, few diseases have left traces on the bones. Rickets did not exist. The nutritional disease osteoporosis, which leaves its effect in paired lesions of the roof of the orbit or bones of the cranial vault, is found, while several specimens suggest hydrocephalus. There are numerous instances of tumours, mostly of the benign type. Bony tumours of huge growth due to irritation from tumours in the brain membranes are sometimes found. Of dental troubles there are a variety. Caries are not so prevalent as pyorrhea. Abscesses are common, often of enormous proportions. Accidental injuries and wounds are common, especially in the highlands. Some produced by a heavy mace were immediately fatal. Broken limb-bones were crudely set. Most surgical practice was restricted to the head. Trephining was commonly followed, heat being applied as a counter irritant.

The Food of Birds.—In a letter to NATURE (Oct. 12, p. 577) Prof. Poulton shows that inaccurate conclusions as to the diet of birds may follow upon the sort of examination ordinarily made of stomach contents. That deductions drawn from the cast-up pellets of owls and hawks may be equally untrustworthy is shown by Allan Brooks in the *Canadian Field Naturalist* (October 1929, p. 160). The difficulty here is that the pellets are limited to certain elements of the food. Only where fur or other absolutely indigestible matter is swallowed is any pellet thrown up. But give a hawk or owl a bird that it can pick or strip the skin from, flesh only is eaten, and no evidence of this item of diet appears in the pellet unless it be accidentally involved in mammal's fur. An experiment made with snowy owls seems to prove the point. A number of these birds when shot had in their stomachs only mice, although they were shot in the act of killing ducks. This suggested the experimental feeding of captive owls on birds, and it was found that the skin and feathers were first torn away, and that only flesh, without even bones, was eaten. On the other hand, in the case of mice, skin, bones, and fur were swallowed; so that while the mice were readily distinguishable in the stomach, the flesh of the birds was not. It was also noticed that the captive owls ejected pellets only when mice were swallowed or when indigestible matter was forcibly fed to them.

The Wool of Domesticated Sheep.—In recent years the development of apparatus by which wool can be minutely measured has given a stimulus to the investigation of wool qualities as indicating the relationship of domesticated breeds of sheep. In a lengthy paper B. Kaczkowski has recorded the results of his application of this method to the races of Polish sheep (*Bull. internat. Acad. Polonaise Sci. u. Lettres*, 1929, p. 521). He discusses the classificatory value of the composition of the fleece as regards the relative proportions of the long, rough, medullated hairs of the original outer coat, and the finer, non-medullated hairs of the under coat of wool. As a result he divides the Polish races of sheep into three groups. The first contains the most primitive, original domesticated races, in which the outer hairy coat tends to predominate in amount and length; the second includes more highly bred and transitional races differing distinctly from the primitive forms; and a third group shows still more clearly the results of breeding and selection in the predominance of fine wool and reduction of medullated hairs.

Behaviour of Sponge Cells.—Mr. M. W. de Laubenfels in an interesting note describes experiments with sponge cells of different species, made by mixing two of these together (Year Book No. 27 of the Carnegie Institution of Washington, 1928. Tortugas Laboratory). Three as yet undescribed sponges were used, which he designates the red, green, and purple species. Two species were conglomerated together by cutting

portions of the adult into small bits and mixing in a bolting cloth bag, both being expressed simultaneously. The red-green conglomeration settles in masses of a few score cells and remains inactive until death sets in in a few hours. The green-purple conglomeration behaves in a manner which is closely similar to the monospecific culture but with characteristics halfway between those of the green and the purple, but metamorphosing more slowly than either, and the cells of the two species gradually sort themselves into separate masses. The red-purple conglomerations are formed before settling and have a characteristically flocculent appearance, persisting throughout their life of only about a week; they make a feeble attachment to glass and develop flagellate chambers. If cells separately expressed are mixed they form aggregates of cells of their own species only. Aqueous extracts of the separate species were made and separately added to each of the others with the curious result that the red and the green were most inimical to one another and yet are of the same genus, whilst the purple, of a different family, damaged neither of the others. Heating the extracts caused them to lose their effect. Similar experiments were made with other sponges, the commercial sponge *Euspongia officinalis* proving unsuitable, but a Halichondria was nearly as good as the original forms used, and conglomerations were secured.

Lampreys and their Ways.—Under this title there is an exceedingly interesting article by Prof. Simon Henry Gage in the *Scientific Monthly* for May (Science Press, Lancaster, Pa.). Not only is it a good survey relating to the general knowledge of the group, but the author also includes much of his own personal observation. Directly the larval metamorphosis is over (no food being taken during the process, which may last for four or five months) the young lampreys pounce on any fish available, even attacking large pike. Their food is the blood of the fish attacked, and there are special glands near the neck of the lamprey which secrete a fluid to prevent blood-clotting. By measuring the capacity of the intestine of a full-grown lamprey it was estimated that 25 c.c. of blood could be taken at one meal, a satisfactory meal lasting about a month. After that time attachment for several days would be made to another fish and a fresh meal taken. All lampreys lay their eggs in freshwater streams, those from ocean and lake often overcoming enormous obstacles in order to reach suitable places, sometimes swimming hundreds of miles. The adults, probably three or four years old, die after depositing their eggs and do not return to lake or ocean. The larvæ, or ammocœtes, are plankton feeders, but it was found that they were capable of digesting milk, having a digestive ferment serving the same purpose as the serum in mammals. The article is well illustrated and is altogether worth reading.

A New Squid.—Mr. S. Stillman Berry describes a new squid which is peculiar in the male having both ventral arms modified sexually ("*Loliolopsis chiroctes*, a new Genus and Species of Squid from the Gulf of California." *Trans. San Diego Soc. Nat. Hist.*, vol. v., No. 18, 1929). In several other respects it differs from the other genera of the family Loliginidæ and the organisation of the left ventral arm with its peculiar comb-like structure is unique. These squids were collected by Mr. Tom Craig, who found them swarming round the light in schools of several hundred. A detailed description of the external anatomy and of the mouth parts are given, and beautiful illustrations accompany the paper.

Plankton of the Tyne Estuary.—In the *Proceedings of the Durham Philosophical Society* (vol. 8, pt. 1, 1928), Miss O. M. Jorgensen describes plankton samples from the tidal region of the River Tyne made for the purpose of studying the conditions of the river with regard to pollution. Two series of samples were taken, from the region of the Black Middens up to Newburn Suspension Bridge, a distance of fifteen miles up the river, and from the region of the Swing Bridge, Newcastle-upon-Tyne. These are compared with tidal conditions in the River Coquet as free from pollution, where it was found that with the exception of one estuarine mysid and one larval psychodid, the planktonic species were all marine (36), the number of species and individuals, consisting chiefly of Copepods with a small number of diatoms and peridinians, varying with the state of the tide. The outstanding fact brought out is the large quantities of marine organisms carried up the Coquet estuary at a certain rate by the flood tide which are driven back again during the ebb with increased rapidity, the latter due to the stronger current produced by the combined effect of tide and river. On the other hand, the numbers of species and individuals in the Tyne were comparatively small, also consisting of copepods, diatoms, and peridinians. The commonest copepod in the Coquet was the marine *Temora longicornis*, whilst in the Tyne it was replaced by the closely allied *Eurytemora hirundoides* which is a more estuarine form, and this species does not occur lower down the river than about three miles from its mouth. Of marine species only diatoms and peridinians seem to be able to survive along the whole reach of the polluted estuary, and only firmly established estuarine forms are able to withstand the adverse conditions. Even Eurytemora, which has a tremendous power of resistance, is very susceptible to a low percentage of oxygen and a temperature increase, and the same may be said for Neomysis. The presence in the Tyne estuary plankton of the littoral enchytræid *Lumbricillus lineatus* is interesting and probably to be accounted for by dredging operations further up the river.

Crab-marking.—The Fishery Board for Scotland has published a paper entitled "Crab Marking Experiments, September 1916 to February 1924" (*Scientific Investigations*, 1928, No. 4; 1929), which contains tables and diagrams embodying records of crab-marking experiments carried out under the supervision of Dr. H. C. Williamson by the Fishery Board for Scotland on the east coast, from September 1916 until February 1924, and the data relating to specimens from the experiments prior to 1927. 2819 crabs were marked and liberated, and of these 201 (7·1 per cent) have been recovered. A series of small charts shows the approximate positions of those recaptured ten miles or more from the place of liberation and days of freedom. The largest number recaptured from any one experiment was 25 out of 139 crabs liberated off Burnmouth in 13-15 fathoms, one of which had 650 days of freedom and was recaptured to the east of North Sunderland; another having 530 days of freedom was captured to the north-east of Berwick. Several others from the same experiment were captured after 300 days or more. The longest time before capture for any crab was 1493 days, released one and a half miles north of Portsay in 23 fathoms, a distance of well over 90 miles from the place of release. Four others had over 1000 days of freedom, the other periods varying from 2 to 900 days. Although the breadth of the crabs when liberated is given, there are no measurements after recapture, but details of condition of

shell and sex organs are shown. Berried crabs with pink or red ovaries (immature to nearly ripe) were recovered from depths varying from 3 fathoms to 40 fathoms.

True Endoskeleton in Insecta.—What little research has been done on the endoskeleton of insects has been chiefly on the internal structure of the head and thorax. The endoskeletal structures have hitherto been regarded as chitinised invaginations of the exoskeleton and are known as apodemes. That is to say, there is no true endoskeleton in the Insecta. In this connexion it is of some interest to note the recent discovery by Mr. S. Maulik (*Proc. Zool. Soc. London*, **2**, pp. 305-308; 1929) of a very curious endoskeletal structure in the hind femur of Halticine beetles which appears to arise independently of the exoskeleton. This structure consists of a strongly chitinised curved plate with a narrow end which is hinged to the tibia, and a broad end along the edge of which is attached a strong femoral abductor muscle. The curvature usually occurs close to the attachment of the muscle, so that the organ apparently acts as a lever, a slight contraction of the muscle magnifying the movement of the tibia, and so enabling an extremely rapid flexion of the tibia. The jumping power of these insects is very great, but not greater than in many other insects. It is therefore interesting to note that the author has failed to discover any similar structure in such well-known saltatorial groups as the grasshoppers, fleas, and froghoppers. Mr. Maulik regards the structure as having arisen by the chitinisation of the abductor tendon. A point of importance to systematists is that this structure affords a sure means of distinguishing Halticine beetles, which previously have been frequently confused with certain Galerucinæ, particularly those with inflated hind femora. It is also of interest to know that certain Halticinæ, such as the poisonous beetle of the Kalahari Desert, although they do not jump, possess this structure in a degenerate condition.

Geology of Southern Rhodesia.—A particularly valuable publication to those interested in the comparative geology of Africa is H. B. Maufe's "Outline of the Geology of Southern Rhodesia" now issued in its second edition as *Short Report No. 24* of the Geological Survey of Southern Rhodesia. It contains not only an excellent coloured geological map (1/3M), with more detail than appeared in the first edition, but also a layer-coloured topographical map to the same scale. The chief difference in the tabulated scheme of geological history is that the epoch of intrusion of the Great Norite Dyke is now placed between the Lomagundi System (regarded as equivalent to the Transvaal system) and the Umkondo system (probably equivalent to the Waterberg). This makes the Great Dyke approximately contemporaneous with the Bushveld complex, which has now been proved to be pre-Waterberg in age. Similar summary reports from other Colonial surveys would be extremely welcome to those who have little time to follow the unfamiliar details of longer memoirs confined to local areas.

The Auroral Spectrum.—The spectrum of the aurora shows conclusively that the upper atmosphere contains both molecular nitrogen and atomic oxygen, and according to a letter appearing in *Die Naturwissenschaften* for Oct. 11, from V. M. Slipher and L. A. Sommer, of the Lowell Observatory, it appears now that atomic nitrogen is also almost certainly present. Spectra of the aurora, obtained by these observers with a fast instrument, show a line in the green at 5206 A., which is coincident within the limit of accuracy of their measurements with a 'forbidden' line in the arc spectrum of nitrogen, the wave-length of which can be predicted from recent analyses of the latter based on laboratory data. The energy required to produce the metastable nitrogen atoms from which this line originates is 2·37 electron-volts, and it seems not unlikely that it will prove possible to excite this forbidden line in discharge tubes in much the same way as the forbidden green oxygen auroral line at 5577 A. Some earlier investigators of the aurora have recorded a line at a wave-length a little greater than 5000 A., but their measurements have been generally inaccurate and inconsistent, and it is of course only in the last few years that it would have been possible to say from which element it arose, even if its existence had been established beyond doubt.

Colloidal Gold.—Prof. P. P. von Weimarn, in the *Japanese Journal of Chemistry*, vol. 3, No. 4, gives a long description of the preparation of red solutions of colloidal gold, which contains some interesting results. He shows that it is not necessary to use reagents of extreme purity (as recommended by Zsigmondy). However, the higher the degree of purity the higher is the concentration which can be reached, by evaporation, without the change of colour from red to violet and blue taking place. The solutions are prepared by reducing chlorauric acid by alkaline formaldehyde, and precise directions are furnished. A number of quotations from authors who failed to prepare the red solution by Zsigmondy's method are given. Weimarn concludes from these, and his own experiments, that "perfectly transparent and absolutely non-turbid solutions of purely red colour" are formed "only when there are left traces of unreduced gold compounds", probably AuOH. To obtain solutions of exactly reproducible properties, however, it appears to be necessary to work in gold or platinum vessels, preferably conical beakers, with freshly redistilled formaldehyde, and extra pure water and reagents.

Electric Power in Japan.—Practically all the electric power required for the Tokyo and Yokohama districts in Japan is supplied by the Tokyo Electric Company. We learn from the *Westinghouse International* for October that the number of its consumers is now well above two million, which is greater than that supplied by any other company. If we rate it by the bulk of the energy supplied it comes fifth in the world's list, three companies in the United States and one in Canada having a larger output. Its chief source of power for delivery in Tokyo is from the hydroelectric installations located in neighbouring watersheds. As the amount of hydraulic power available varies appreciably at different periods of the year, it was found necessary to install a steam reserve plant in the city of Tokyo. Most of this reserve plant would normally lie idle for about eight months of the year. The Japanese, however, have found a use for the electric generator part of their turbo-alternators during the slack periods. The generators are disconnected from the set. They are then run as synchronous motors without any load, their magnetic fields being strongly excited. In this case they act in a similar way to very large electrostatic condensers. An important result is that they bring the supply pressure and the load more nearly into phase with one another. This has the effect of diminishing the supply current although the load remains constant, and also makes all the power generators run more smoothly in parallel with one another. Special machines called rotary condensers are often used for this purpose, but this method of using reserve plant is novel and is to be commended.

The University of Liverpool.

OPENING OF THE LADY HERDMAN GEOLOGICAL LABORATORIES.

ON Monday, Oct. 21, the Rt. Hon. Stanley Baldwin formally opened the new geological laboratories of the University of Liverpool. The building is a memorial to the late Lady Herdman, who, jointly with her husband, Sir William Herdman, Derby professor of natural history in the University from 1881 to 1920, founded the chair of geology. On her untimely death in 1922, Sir William Herdman added to his earlier munificent gifts to the University a sum of £20,000 towards the cost of new geological laboratories. The generosity of his family and of other friends in Liverpool provided the further funds necessary to enable the scheme he had in mind to be completed.

The new building has a frontage of 97 ft. on Brownlow Street (Fig. 1) and consists of four storeys. An entrance hall occupies the centre of the ground floor and contains on its south wall a bronze memorial tablet to the late Lady Herdman. Also on the ground floor are the professor's room, private laboratory, secretary's room, etc., as well as a large rock-cutting room and laboratory assistants' room, all of which lie on the northern side of the entrance hall, while on the southern side are a map room, research rooms, and a lecturer's room. One of these research rooms is specially fitted for rock-analysis and chemical work. The map room serves as a drawing office and is, moreover, equipped for use as a subsidiary lecture-room. On the first floor is a similar central hall to that below, flanked on one side by a spacious library and on the other by the lecture theatre. The library, 50 ft. in length by 30 ft. in width, is fitted in dark oak, and has accommodation for 20,000 volumes in bays around the walls. Centre tables allow more than thirty students to read in comfort. The lecture theatre is also furnished in dark oak, and accommodates rather more than a hundred students. It is equipped with lantern screens and map screens in duplicate, so that the epidiascope (with micro-projector) and an additional lantern may be in use at the same time. Adjoining the lecture theatre are a preparation room and a lecturer's room.

On the second floor the central area is occupied by the museum, with a balcony surrounding its upper part. Lighting from both top and sides can be adjusted. North and south of the museum are large laboratories, each 50 ft. by 30 ft., for petrological and palæontological work respectively. These rooms are well lit by large windows, in part of plate-glass.

Photo by [*Stewart Bale.*

FIG. 1.

The flat roof is specially strengthened in order that it may take a further storey if and when required.

On the lower ground floor are the library and other storerooms, cloak-rooms, and two optical laboratories. Like all the laboratories in the building, the optical rooms can be completely darkened. They are fitted for goniometry, optical mineralogy, and photomicrography. One of them gives access to a good-sized photographic dark-room. In a constant temperature chamber in the central hall of the lower ground floor is a concrete block designed to support earthquake-recording apparatus. This is sunk into the solid rock-foundation and is free from any direct connexion with the building.

In appearance, whether viewed from within or without, the building is pleasing. Critics will find nothing to offend their æsthetic sense; admirers would simply describe it as beautiful; but both would be impressed by its freedom from any trace of subordination of scientific requirements to internal or external appearance. This is an achievement on which the architects (Messrs. Briggs and Thornely, of Liverpool) are to be congratulated. Those who will have the opportunity of working in the building will find in their surroundings a real expression of the University's motto: *Haec otia studia fovent.*

Mr. Baldwin, before declaring the building open, spoke of the wide field of interest that presented itself to students of geology. As an example of the growing interest in the subject at Liverpool, he mentioned that the Workers' Educational Association had recently asked that an evening class in this subject should be established. After commenting on the relationship between geology and allied subjects, he referred to the increasing importance of experimental geology. Mr. Baldwin laid special stress on the practical side of geology, a side on which the Liverpool school is particularly well equipped. He expressed his pleasure in opening a department that would take its part in training men to spread the knowledge of geological science and promoting the development of the great country from which they sprang.

The opening ceremony was preceded by a largely attended meeting in the main University buildings, presided over by the Chancellor, the Rt. Hon. the Earl of Derby, K.G. He was supported by a number of distinguished visitors, including the Lord Mayor of Liverpool, the Mayors of Birkenhead, Wallasey, and Bootle, and many leading British geologists.

Stability of the Value of Gold.

IN a paper on "The Problem of the Future Value of Gold", read before Section F (Economic Science and Statistics) of the British Association during the meeting at Cape Town, Mr. D. T. Jack stated that the general return to gold standard conditions within the last five years has again directed attention to the problem of stability in the value of gold over long periods.

The general problem of monetary reconstruction presents three distinct phases. The first is the cessation of inflation, the second involves the various readjustments consequent upon stabilisation, and the third and present phase involves the long period problem of the stability of the value of gold. The difficulties which arise from unstable price levels are now generally recognised. They generate artificial stimuli and checks to trade and industry; they make for industrial friction, and they alter the real terms of long-dated debts. To Great Britain, a rise in the value of gold would be particularly detrimental, since it would restrict the recovery of British trade, more especially in view of the high proportion of overseas trade to total trade and the peculiar sensitiveness of international trade to a falling price level. It would increase the real burden of the national debt still further, while the necessity of deflating money costs of production would undermine the recent progress which has been made in negotiating satisfactory wage settlements.

The future value of gold is naturally governed by the conditions of demand for, and the supply of, gold. The world's gold production increased from 69 millions sterling in 1920 to 83½ millions sterling in 1928, but it is still about 12 per cent below the 1913 level. In considering the probable future production of gold, it is necessary to allow for further technical improvements in mining which may make profitable the fuller utilisation of low-grade ores. There is also the consideration that gold production would receive a certain stimulus from an increase in the value of the metal. With regard to the Transvaal, taxation and transport charges are factors of some special importance.

More important factors in the position, however, arise from the side of demand rather than from the side of supply. Since the War, gold has not generally been restored into general circulation, and the widespread adoption of gold-exchange standard principles has made possible important economies in the monetary use of gold. It is important that full advantage should be taken of such economies now possible in the monetary use of gold. Among other things, that means that the reserve requirements of central banks should be restricted. It is necessary also to distinguish the free or effective gold reserves of central banks from the other part, which is immobilised as the minimum legal reserve against the ordinary internal note circulations. At the beginning of 1929, only 35 per cent of the total gold holdings of the central banks of England, France, Germany, and the United States consisted of free or effective gold reserves. There has been a tendency also for certain European central banks to convert part of their reserves in foreign balances into gold for withdrawal to their own vaults, and the danger is that the countries in which these balances are held may find that the demands are so large that they are driven in self-protection to raise their discount rates. For these reasons, central bank co-operation in the use of gold reserves is essentially desirable.

The recent proposals for the establishment of an international bank, if carried into effect, may further this co-operation and in that way will assist in the attempt to prevent any marked appreciation in the value of gold. But the specific proposal raises many difficulties. It is improbable that central banks would sacrifice their individual gold reserves to the management of any international institution. On the other hand, such an institution would facilitate co-operation in connexion with the payment of reparations, and that co-operation, if wisely and cautiously followed, might materially assist in the working out of a closer collaboration in connexion with international gold movements.

Work of the Government Chemist.

TO those familiar with the intricacies of British law in so far as it demands the services of the chemist, and familiar also with the numerous kinds of chemical inquiry necessary for the proper functioning of the government departments, the Report of the Government Chemist upon the work of the Government Laboratory for the year ending Mar. 31, 1929 (London: H.M. Stationery Office, 1*s.* 6*d.* net), will prove both informative and suggestive. The work is of the most varied character, and the responsibilities are of the most diverse, whilst the list of 'other activities' of the Government Chemist, the Deputy Government Chemist, and other members of the staff affords ample evidence both of the importance of the laboratory in State and scientific affairs, and of the progressive spirit which pervades it.

Included in the report are statements which immediately arrest the attention of the general scientific reader. It is, for example, of interest to note that 37 samples of home-grown leaf tobacco, which is being experimentally cultivated in East Anglia and the south of England, were examined, and that of 32 samples of herb beer, ginger beer, etc., 14 contained alcohol ranging from 2 to 7 per cent of proof spirit. A sample of honey purporting to be of British origin was shown, by the character of the pollen grains, to be foreign produce.

The investigations carried out by the laboratory are by no means confined to questions affecting the revenue, to matters involving the possibility of legal process, or to specifications for contracts. Thus, fifty-four samples of river water, muds, and effluents were examined to ascertain the condition of fishing streams from the point of view of fish life, and the effect of certain types of pollution, including that by road drainage, on fish and fish food. Further attention has also been given to the phenomenon of diurnal variation in the quantity of dissolved oxygen in rivers. Moreover, sea-water samples have been examined in connexion with a scheme of oceanic research carried out by the Ministry of Agriculture and Fisheries, and the Fishery Board for Scotland, acting in concert with the International Council for the Exploration of the Sea, in order that accurate data may be available for hydrographers and biologists.

It is also reported that examination of a material obtained during excavation at Rievaulx Abbey proved the substance to be spent oak bark, suggesting that part of the abbey building may at some period have been used as a tannery. A number of samples

of wood and wood preservatives have been examined in connexion with experiments on the preservation of timber carried out by the Forest Products Research Laboratory, whilst methods for determining sulphur impurities in the atmosphere and dust in the air of rooms have been worked out. Seventy-three documents, to which were affixed a large number of stamps, were examined and reported on in connexion with the fraudulent use of stamps, and numerous alterations were detected in betting books required for the assessment of betting duty, the original entries being ascertained in many cases.

Two passages from the Report relating to imported dairy produce may be quoted without comment: "*Cheese*. . . . The results indicate that 50 per cent of the samples had been prepared from whole milk; 23 per cent from milk containing from three-quarters to the whole of its fat; 10 per cent from milk containing from one-half to three-quarters of its fat; and the remaining 17 per cent from milk containing from one-quarter to one-half of its fat. As, however, there are no regulations relating to the marking of skimmed or partially skimmed milk cheese, no exception could be taken to any of the importations." "*Cream*. . . . The samples could be classified into two main groups—one group of samples containing from 48 to 62 per cent of fat, and the other group from 18 to 30 per cent. Two samples, however, contained only 11·9 and 12·9 per cent respectively. There is no standard for cream in this country, and no exception could be taken to the samples on account of low proportion of fat."

General Paralysis and Malaria.

THE Board of Control has issued a report[1] on the treatment of general paralysis by induced malaria, the most outstanding development in psychiatry of the last ten years. For the better appreciation of this important subject, Sir Hubert Bond has written in the form of a preface a historical review of the disease, based on Prof. G. M. Robertson's account. The report itself is by Surgeon Rear-Admiral Meagher, and is the result of his investigations of certified cases admitted to county, district, and county borough mental hospitals in Great Britain between July 1922 and July 1927.

The results of treatment during the years 1922–1924 are the most valuable, the three to five year interval allowing a more accurate estimation to be made than in the case of subsequent years. The cases treated prior to the end of 1924 numbered 438; the results as ascertained at the end of 1927 were that 43·6 per cent were dead, 31·7 per cent remained in hospital, and 24·7 per cent were at liberty. A similar survey of 1173 patients certified during 1923 and 1924 and not treated by malaria showed that 86·6 per cent died, 10 per cent remained in hospital, and 3·4 per cent were discharged. The mental and physical state of those remaining in hospital was found to be much better in treated cases than in untreated.

After considering possible sources of error it is shown conclusively that malarial treatment tends to prolong life, to improve the condition of those who must remain under care, and to increase very greatly the proportion of patients who can be discharged from certificate, and the probability that such discharge will be a success. The results during subsequent years confirm these findings. Altogether, the effect of treatment in 1597 cases is reported; as ascertained at the end of 1927, 541 died, 652 remained in hospital, and 404 were at liberty.

Attention is directed particularly to the mortality resulting from malaria. A relatively large number of deaths take place within two months of inoculation. According to the experience of the Wagner-Jauregg Clinic, this is avoidable, and efforts are being made at various mental hospitals in Great Britain to reduce the mortality. There is evidence also that the administration of antisyphilitic drugs in conjunction with malaria might lead to even better results. It is generally agreed that the best results from malarial therapy are obtained in early cases, but there is little or no provision for giving treatment until the patient becomes certifiable and can be sent to a mental hospital. An extension of facilities, either by alteration of the law relating to insanity or by the establishment of other treatment centres, will be necessary before the best results are obtained.

Rear-Admiral Meagher and the Board of Control are to be congratulated on the production of such an important account of malarial treatment. It demonstrates what can be done by utilising the facilities which the Board have for studying such problems, and it is to be hoped that these might be applied to the further investigation of a disease concerning the essential nature of which, as is quoted in the preface, we are quite in the dark.

[1] Board of Control (England and Wales). General Paralysis and its Treatment by Induced Malaria. By Surgeon Rear-Admiral E. T. Meagher. Pp. 88. (London: H.M. Stationery Office, 1929.) 2*s*. net.

Prehistoric Macedonia.

IN *Antiquity* for September, Mr. W. A. Heurtley, Director of the British School of Archæology in Athens, summarises the evidence bearing on the prehistory of Macedonia which has been acquired by the excavations carried out in recent years by the School, by Mr. S. Casson, and by the Archæological Service of the French Army in 1917–19. The sites examined are situated in the Vardar Valley, the neighbourhood of Salonika, the Valley of the Haliakmon, the Lankada Valley, and Chalcidice. An Early Iron Age cemetery at Patele was also excavated by Russian archæologists before the War, and a neolithic site at Olynthus by American excavators in 1928.

The neolithic culture resembles the Second Thessalian period, but as it seems to be earlier the movement would appear to be from north to south. At the beginning of the Bronze Age, Central Macedonia and Chalcidice were colonised by people coming from Asia Minor, evidently in search of gold. The trade relations were not with the Ægean, but with Troy, the Black Sea, and southern Russia. In the Middle Macedonian period, central Macedonia and Chalcidice diverge. In both the Anatolian culture was interrupted, central Macedonia falling under the influence of her northern neighbour, while Chalcidice was overrun by the Minyans, who were thought to have come from Troy, were possibly Indo-European, and may have introduced an Aryan speech into Chalcidice and Greece.

In central Macedonia, on the other hand, the pottery suggests Danubian pottery of an earlier date, or it may have developed locally from the incised style of the previous period. Some passed into Thessaly, the emigrant Macedonians creating the culture of the

Third Thessalian period, and living a nomad life which corresponds generally to the wanderings of the Dorians as recorded by Herodotus. In the late Macedonian period, relations between central Macedonia and Chalcidice were resumed. Either the older population had revived, or the fusion between the old and the new had become more complete.

Iron slag found at Vardaroftsa suggests that iron was worked before the coming of the Mycenæans, and may have been the object of their coming. At the end of the period the Vardar Valley was overrun by Danubians, probably from Hungary, forcing some Macedonians to follow their ancestors into Thessaly. In the Iron Age the former inhabitants and their descendants returned and revived their half-agricultural, half-mining mode of life. Relations with the Ægean were not revived until the arrival of Greek colonists in Chalcidice.

As regards general conclusions, the evidence points to acceptance in Macedonia of the chronological scheme which holds good for Crete, the Islands, and mainland Greece; thus the evolution of Macedonia is parallel with that of the Ægean, of which world it forms an integral part. The archæological results support the claim of the Macedonians to be Greeks.

Superhardening Hardened Steel by Magnetic Means.

THE increase in hardness which occurs with many work-hardened metals when they are subjected to a low-temperature annealing treatment is well known and is made use of in the arts. Mr. E. G. Herbert has now considered, in a paper read recently before the Iron and Steel Institute, the question as to whether it might not be possible to apply some stimulus other than such a heat-treatment to effect a similar result. In a magnetic material a possible means of achieving such an object is to subject the worked metal to repeated changes of magnetic polarity. When this is done, it is shown that the hardness is increased by the magnetic treatment to exactly the same extent as it is by annealing at the optimum temperature.

Such heat and magnetic treatments appear, therefore, to be strictly alternative processes, producing the same atomic rearrangement in the deformed material. Thus it was found that when the specimen which had been magnetically hardened was afterwards subjected to a low-temperature anneal, no further increase of hardness resulted, whilst a specimen, hardened by 'blueing', was not affected by magnetic means. As an indication of the order of the changes of hardness involved may be taken the case of a hardened steel which had originally a hardness number of 810. When severely cold-worked, the hardness was increased to 935, after which it was magnetically treated and was further hardened to 1060.

Mr. Herbert also proposes an explanation of the many small critical points which have been observed in the physical properties of iron, steel, and many other metals and alloys as their temperature is raised. These critical points are clearly independent of any allotropic changes, and a satisfactory explanation has not hitherto been offered. It is now suggested that an explanation, in part at any rate, may be found on the following lines.

The space lattice of the substance must possess one or more natural vibrational periodicities and be capable of resonating to certain 'notes'. When the frequency of the vibrations of the atoms themselves corresponds with this periodicity of the lattice or with one of its harmonics, the lattice is forced into a resonant vibration. The fact that the atomic vibrations are not monochromatic is not considered to do more than to introduce complications since the lattice may correspond to a number of wires tuned to different notes. It is shown that, as would be expected, some at any rate of the critical points are temperatures of high true specific heat. F. C. T.

A Russian Expedition to Seistan.

AN expedition was undertaken to Persia in 1925 by E. Czerniakovska for the purpose of studying the cultivated as well as the wild local plants. In course of her journey she travelled as far as Seistan, and she has now published a general outline of the climate, geographical arrangement, situation, and water supply of this district (*Izvestia* of the State Russian Geographical Society, **60**, 1928).

The Seistan district occupies the delta of the Guilmend River; being situated in the extreme south-eastern corner of Persia, it lies on the borders of Afghanistan and Baluchistan and is separated from Khorossan by the Lut desert. Owing to the fact that it possesses extensive plots of cultivated land, it is in a position to supply Khorossan with wheat, cotton, melted butter, down, etc.

The author divides the Seistan district into the following regions:

(1) Northern and western portions, including the Neysar depressions, bordering in the south on the lakes Khamun-i-Farrakh and Khamun-i-Severak and on the lowland connecting them. This is a swamp country, overgrown with *Phragmites* and *Typha*. Aquatic plants are represented by *Potamogeton* and *Vallisneria spiralis* L. The inhabitants consist of Sayades and Maldars —half-savage tribes, who hunt, fish, and breed cattle.

(2) Riparian clayey strip of land, occupying the northern and western borders of mainland. The meagre vegetation consists of *Aeluropus villosa* Frin, *Cynodon dactylon*, *Cressa cretica*, *Alisma* and *Tamarix* species. Patches of land absolutely deprived of vegetation and covered by a fragile saline crust are met with. The inhabitants—the Goudars—live by cattle-breeding and by capturing birds for the purpose of obtaining their feathers.

(3) The sandy region situated in the southern and the south-eastern portion of the country. The vegetation of the sandy dunes consists of *Anthrophytum*, undersized *Tamarix*, saline *Schanginia baccata*, *Alhagi*, *Prosopis stefaniana*, and *Eragrostis megastachya*. Nearer to the Guilmend River drifting sands, which sometimes bury entire villages, occur. The population consists of Baluchi, who occasionally grow wheat.

(4) The forest region of the delta of the Guilmend River. This is the most fertile part of the country and has an abundance of water; as such it is the centre of cotton cultivation. The forests consist of *Tamarix dioica* and other *Tamarix* species. All the cleared plots serve for the cultivation of cotton, millet, and wheat.

(5) The region of saline clayey soil, lying in the centre of the country. Here trade is brisk, and agriculture is flourishing, the principal cultivated plant being wheat.

The author gives a vivid account of the customs and various occupations of the population. A map of the botanico-geographical division of the country is appended.

University and Educational Intelligence.

ABERDEEN.—Dr. Henry Cook, who graduated M.B., C.M., at the University of Aberdeen in 1883, and died at Bristol on Aug. 3, bequeathed "the entire residue of his estate to the Treasurer for the time being of Marischal College, University of Aberdeen, Scotland, for the use and benefit of the said College". It is estimated that after paying legacy and succession duties, costs and expenses, the gift to Marischal College cannot be less than £50,000.

CAMBRIDGE.—D. R. P. Murray, of Pembroke College, has been re-elected to the Benn W. Levy Research Studentship for one year as from July 1, 1929.

AT the inauguration of the new session at the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3, the chairman of the governing body, the Rev. J. F. Marr, in reviewing the work of the past academic year, stated that the provision of grouped courses of instruction has been greatly appreciated by those engaged in technical branches of industry, and further, that insistence on a good knowledge of fundamental science as an antecedent to specialised or vocational training has led to the most satisfactory results. An extension of advanced and post-graduate work had also been made with considerable success. Valuable contributions to industrial research have been made by students of the Institute trained in methods of research. The programme of work for the present session includes a considerable extension of the course of lectures on coal carbonisation and the addition of two courses of lectures, on the application of X-ray analysis to chemical problems and micro-chemical analysis respectively.

THE League of Nations Intellectual Co-operation Committee presented at the League's recent assembly a report on its work and that of the League's chief executive organs in this field, the International Institute of Intellectual Co-operation, which has its seat in Paris, and the International Educational Cinematographic Institute at Rome. As for the last-named Institute, which was inaugurated on Nov. 5, 1928, a mere outline of its scope is given with an announcement that a circumstantial report on its work will be submitted to the next meeting of the governing body in October. Meanwhile, the Institute is congratulated on the publication of the *International Review of Educational Cinematography*. Educational work figures largely in the account of the other Institute's activities, including the expansion of the Educational Information Centres at Geneva and Paris, the publication of a handbook on "The Aims and Organisation of the League of Nations" for the use, primarily, of teachers, and the publication of a periodical, *Educational Survey*, destined to appear twice a year. Other activities mentioned are the promotion of periodical meetings designed to improve university relations, for example, meetings of representatives of university information offices, of institutes for the scientific study of international relations, and of directors of higher education in various countries, the development of international co-ordination of libraries and of the bibliography of the various sciences, the development of the work of the International Museums Office, both in the field of museography and in that of the co-ordination of museums, and the publication of the review *La Co-opération intellectuelle*.

Calendar of Patent Records.

October 26, 1724.—A patent was granted to John Brent on Oct. 26, 1724, for "a wind engine or machine which would be useful in occasioning motion to all sorts of mill-work and for divers other uses and purposes, far exceeding all wind engines hitherto practised, whose fanes move horizontally and are so disposed as to work with the wind blowing from any point of the compass without turning or altering the position of the engine, the like of which had never been used or exercised in any of our dominions". This appears to be the first patent for a windmill with horizontal vanes.

October 30, 1786.—The power loom was patented by the Rev. Edmund Cartwright on Oct. 30, 1786, and a factory was established at Doncaster the following year with ten looms, worked at first by animal power but later by a steam-engine. This was Cartwright's second loom patent, but the first one, dated the previous year, had been for a crude machine which he had invented, as he himself says, before he had turned his thoughts to anything mechanical either in theory or practice, or had ever seen a loom at work, or knew anything of its construction. The Doncaster factory was not a success commercially, and closed down in 1793.

October 30, 1811.—The steam printing-press was the invention of Friedrich König, who had come to England from Germany in 1806. His cylinder machine—which was used for the first time for newspaper printing by the *Times* in 1814, and delivered on that occasion 1100 sheets an hour—was patented on Oct. 30, 1811.

October 31, 1778.—The first real improvement in the modern door-lock was patented by Robert Barron on Oct. 31, 1778. Previously, security had been obtained only by fixed wards and by tumblers which had simply to be lifted clear of the bolt, but in Barron's lock the levers or tumblers had to be lifted a definite distance by the bits of the key, and blocked the bolt in every other position, whether this was too low or too high. The arrangement of the modern lever lock is the same.

October 31, 1797.—Joseph Bramah's patent, dated Oct. 31, 1797, for a method of raising beer from cellars, includes a process for making jointless lead tubing in which lead in its liquid state is pumped or forced through an annular mould. The mould is kept hot at one end and cooled at the other, so that the lead, entering liquid, issues in the solid state in the form of a tube of the size and shape required.

November 1, 1825.—The first road-cleaning machine with a rotary brush was patented by William Ranyard, of Kingston, on Nov. 1, 1825. The brush was worked by gearing from the road wheels and collected the dust and refuse into a bin carried on the cart.

November 2, 1785.—Lionel Lukin, coachbuilder of Long Acre, has the first patent for a lifeboat, this being granted on Nov. 2, 1785, for a method of "constructing boats for either sailing or rowing which will neither overset in violent gales nor sudden gusts of wind, nor sink if they should by any accident be filled with water". Lukin converted a Norway yawl by placing air boxes at the stem and stern, watertight compartments along the inside of the gunwales, and outside a belt of solid cork, whilst stability was increased by the provision of an iron keel, and a boat of this construction was used with some success. William Wouldhave followed with a self-righting boat in 1789, but Henry Greathead's *Original*, launched in 1790, was the first lifeboat to be placed in regular service. The Royal National Lifeboat Institution celebrated its centenary in 1924.

Societies and Academies.

LONDON.

Optical Society, Oct. 10.—**T. H. Court and Moritz von Rohr**: Development of the telescope (1675–1830). J. Lipperhey was the first to construct a practical telescope for military use in 1608. Galileo developed this type for astronomical purposes. The Capuchin Father v. Schyrle in 1645 printed, in the form of a cryptogram, rules for making an erecting eyepiece made of three collective lenses. Starting from this point the authors trace the development of the telescope in England down to 1830. The invention of the achromatic objective is attributed to Chester Moor Hall in 1733. He kept his invention secret, but it leaked out, and was patented by John Dollond, whose elder son, Peter, brought successful actions for infringement against London opticians. New light is thrown on this celebrated invention and on many others by a careful examination of the instruments and documents in the well-known Court Collection.

ROME.

Royal National Academy of the Lincei, June 16.—**E. Almansi**: The motion of a body of variable mass.—**Q. Majorana**: Absorption of ultra-violet or infra-red rays by cloud. In connexion with the author's two systems of optical telephony by means of ultra-violet or infra-red rays, laboratory tube experiments fail to reveal any sensible absorption of the radiant energy when the tube is filled with either dry or wet air, provided that this is perfectly clear. Under certain cloudy conditions it appears that infra-red rays may be transmitted twice as far as ultra-violet rays.—**S. Franchi**: A new facies of Upper Trias in the Italian Maritime Alps.—**G. Levi**: Supposed specific cytological characters of the cytoplasm of the sexual cells. No constant specific differences exist, in the vertebrates, between the chondriome of the gonocytes and ovocytes on one hand and that of the somatic cells on the other.—**M. Picone**: The isolated singularity of harmonic functions.—**A. de Mira Fernandes**: Christoffel's quadruple tensor and Riemann's tensor.—**F. Sbrana**: Geodetic curvature and parallelism on a surface.—**G. Mazzone-Sangiorgi**: The prime elements of a new general theory for the motion of waters and other fluids (1).—**E. Gugino**: Theorem of the maximum kineto-dynamic effect in relation to the principle of Hertz's directism.—**P. Emanuelli**: The galactic pole and the circumpolar galactic region.—**A. Carrelli**: The longitudinal distribution of photo-electrons.—**A. Tulli**: Further contribution to the study of the mummification of the ancient Egyptians: chemical analysis of a mummy from the Vatican Museum. Analysis of the tissues near one of the vertebræ of the neck of this mummy demonstrated the absence of natron, heavy metals, and arsenic. Treatment with light petroleum, alcohol, and water successively gives 6·2, 12·0, and 23·6 per cent of matters soluble in these solvents. The use of gum-resins is indicated.—**P. Saccardi**: Melanins from adrenaline. When a faintly alkaline solution of the melanin-like substance, obtained by the oxidation of adrenaline with chlorine water, is administered subcutaneously to the rabbit, it causes decided melanuria, characteristic melanoderma and trichoderma, and browning of the subcutaneous connective tissue at the injection area. These results furnish evidence of the analogy in constitution between pyrroles, natural melanins, and adrenaline black, and indicate that, in definite physiological and pathological conditions, adrenaline may give rise to melanins.—**D. Bigiavi**: Reactions of the diazohydrates. The Angeli-Cambi formula for the diazohydrates furnishes an explanation of the transformation of iso- into normal diazohydrate, which resembles the Beckmann conversion, since it consists in the migration of the oxygen atom from nitrogen to nitrogen; in the former change, when induced by hydrochloric acid, the intermediate formation of diazonium chloride is probable. The fact that the sodium salt of an isodiazohydrate does not react with β-naphthol, arsenite, etc., whereas the free isodiazohydrate immediately reacts, has an analogy in the different behaviour of sodium nitrite and nitrous acid towards phenols, etc., and that of benzaldoxime and its sodium salt towards potassium cyanide.—**M. Lecat**: Azeotropy in binary systems containing a hydroxylated compound.—**G. Bini**: Certain characteristics of the Red Sea with regard to the nitrogen cycle. The waters of the Red Sea contain relatively high proportions of ammonia, owing partly to the paucity of vegetation, especially of the fixed variety, and partly to putrefaction of the abundant marine animals, this being favoured by the marked alkalinity and by the high temperatures of the water and air. Large amounts of nitrites are present in certain regions, these being derived from animal putrefaction and from the action of denitrifying bacteria on nitrates. The latter were not found in any of the water samples analysed and are doubtless absorbed by the dentrifying bacteria; to this action is due, in large part, the scarcity of vegetation.—**A. Ferrari and F. Giorgi**: The crystalline structure of bromides of bivalent metals. The following bromides have crystalline structures of the cadmium iodide type, their characteristics being: $CoBr_2$, $a = 3{\cdot}685 \pm 0{\cdot}005$ A., $c = 6{\cdot}120$ A., $c : a = 1{\cdot}66$, density $= 5{\cdot}072$; $FeBr_2$, $a = 3{\cdot}740 \pm 0{\cdot}005$ A., $c = 6{\cdot}171$ A., $c : a = 1{\cdot}65$, density $= 4{\cdot}790$; $MgBr_2$, $a = 3{\cdot}815 \pm 0{\cdot}005$ A., $c = 6{\cdot}256$ A., $c : a = 1{\cdot}64$, density $= 3{\cdot}876$; $MnBr_2$, $a = 3{\cdot}820 \pm 0{\cdot}01$ A., $c = 6{\cdot}188$ A., $c : a = 1{\cdot}62$, density $= 4{\cdot}549$. Cadmium bromide, however, exhibits a rhombohedric cell of the magnesium chloride type, with the dimensions, $a = 7{\cdot}72 \pm 0{\cdot}01$ A., $\alpha = 61° 40'$; this cell contains four molecules and the calculated density is 5·36, the observed value being 5·192.—**M. Fenoglio**: Petrographical studies on the Canavese zone: Belmonte granite.—**A. Bianchi**: Petrographical notes on the region of the Aurine Alps and of the Vedrette Giganti (Upper Adige) (1).—**L. Bucciante**: Duration of survival of the different tissues of hens' embryos with which incubation has been interrupted.—**L. Bucciante and E. De Lorenzi**: Correlation of the number and magnitude of single types of retinic neurones in animals of different body size.—**G. Lentati**: Investigations on the histogenesis of the islets of Langerhans in *Ovis aries L.*—**G. D'Anneo**: A plurisegmental central preparation of *Bufo vulgaris*.—**A. Galamini**: Further investigations on the food value of the potato for albino rats. While a daily ration of 50 gm. of boiled potato and 4 gm. of butter keeps albino rats alive, it is insufficient for normal growth in a growing rat. The addition, after 120 days, of 1-2·5 gm. of fibrin caused normal increase in weight. Alcohol or Osborne's salt mixture also improves the food value of the diet, the adult rat then increasing in weight; if these additions are discontinued, the gain in weight is lost.—**S. Ranzi**: Embryonic growth of the cephalopods.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 8, Aug. 15).—**E. B. Babcock and J. L. Collins**: Does natural ionising radiation control rate of muta-

tion? (see NATURE, Aug. 10, 1929, p. 227).—**R. J. Anderson**: Chemical investigation of biologically active lipoids of tubercle bacilli. Lipoid fractions from tubercle bacilli all give rise to tubercular tissue, due apparently to the presence of certain new liquid saturated fatty acids. The most active acid is dextrorotatory and has been named phthioic acid; its formula is $C_{26}H_{52}O_2$, and it is thus an isomer of cerotic acid.—**Th. Dobzhansky**: A homozygous translocation in *Drosophila melanogaster*. Certain of the progeny of flies treated with X-rays, though normal in appearance, show linkage of genes of the third group with those of the fourth.—**Francis Bitter**: Magnetic susceptibility of nitric oxide at 296° K. and 216° K. Four parallel pyrex cylinders were suspended in a cluster by a quartz fibre; two opposite tubes were filled with air (paramagnetic) and the other two and the surrounding space with nitric oxide. The displacement of the system in an inhomogeneous magnetic field was measured.—**R. C. Gibbs, H. E. White, and J. E. Ruedy**: Hyper-fine structure in spectral lines—especially those of singly ionised praseodymium.—**Alexander Goetz and Maurice F. Hasler**: A method of producing long single-crystals of metal and a study of the factors influencing crystal orientation and perfection. Molten metal (bismuth) was sucked into a carefully cleaned glass tube 15-20 cm. in length, through the fine-pointed end from which crystallisation started. The tube and metal crystal are then reheated above the melting-point of the metal, and sufficiently to soften the glass, and the whole drawn out to the required length and diameter, the conditions of cooling being maintained as constant as possible. The orientation of the crystal axes seems to be such that the strains imposed by crystallisation are a minimum.—**J. C. Boyce and K. T. Compton**: Higher spark spectra of neon and argon in the extreme ultra-violet. An electrodeless ring discharge was used.—**Gerald L. Pearson**: Relative probabilities of the ionisation of K and L electrons of equal ionisation energy.—**J. B. Scarborough**: The invalidity of a commonly used method for computing a certain probable error.—**Miguel A. Basoco**: On certain Fourier series expansions of doubly periodic functions of the third kind.—**G. A. Miller**: Automorphism commutators.—**John D. Elder**: Arithmetised trigonometrical expansions of doubly periodic functions of the third kind.—**Worth H. Rodebush**: The entropy of hydrogen. The data previously obtained at low temperatures must have referred to a non-equilibrium mixture of the two molecular species now recognised.—**P. W. Bridgman and J. B. Conant**: Irreversible transformations of organic compounds under high pressures (Preliminary paper). Pressures up to 12,000 atmospheres were used for periods up to 56 hours. Certain substances were partially polymerised; isoprene and dimethyl butadiene became jelly-like solids which, on standing in air, shrunk by evaporation of the liquid hydrocarbon, leaving a rubber-like solid. Carboxyhæmoglobin under pressure gives a precipitate resembling the 'denatured' substance obtained by the action of alcohol.—**Elery R. Becker and Ralph C. Everett**: Progress report on weight increases in lambs with and without rumen Infusoria. Lambs freed from rumen Infusoria showed considerably bigger increases of weight.—**Elery R. Becker and T. S. Hsiung**: The method by which ruminants acquire their fauna of Infusoria, and remarks concerning experiments on the host-specificity of these protozoa. Infection is spread by mouth contamination. Infusoria from the stomach of goat, cow, or sheep show no host-specificity within these hosts, but those from colon or fæces of horse will not develop in the rumen of goats.

Official Publications Received.

BRITISH.

Journal of the Royal Microscopical Society. Series 3, Vol. 49, Part 3, September. Pp. xvi+211-318. (London.) 10*s.* net.

Report for 1928 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. No. 37. Edited by Prof. James Johnstone and R. J. Daniel. Pp. 182+4 plates. (Liverpool.)

The Year's Photography, 1929–1930. Pp. 25+xlix+90 plates. (London: Royal Photographic Society.) 2*s.* 6*d.*

Hull Museum Publications. No. 158: The Evolution of the Miners' Safety Lamp, and Record of Additions. Edited by T. Sheppard. Pp. 24. No. 159: Archery Medals and Memoranda. By T. Sheppard. Pp. 16. No. 160: Illustrated Guide to the Facsimile of the Bayeux Tapestry. Edited by T. Sheppard. Pp. 19. (Hull.)

Dominion Museum. Bulletin No. 13: The Whare Kohanga (The 'Nest House') and its Lore; comprising Data pertaining to Procreation, Baptism and Infant Betrothal, etc.; contributed by Members of the Ngati-Kahungunu Tribe of the North Island of New Zealand. By Elsdon Best. Pp. 72. (Wellington, N.Z.: W. A. G. Skinner.) 4*s.*; paper, 2*s.* 6*d.*

Chelsea Polytechnic, Manresa Road, Chelsea, S.W.3. Prospectus of Day and Evening Classes for Men and Women, Session 1929–30. Pp. 68. Chelsea College of Physical Education. Prospectus, Session 1929–30. Pp. 10. Chelsea School of Art. Prospectus, Session 1929–30. Pp. 8. Chelsea School of Cookery, Housecraft and Dressmaking. Prospectus, Session 1929–30. Pp. 8. Chelsea School of Pharmacy. Prospectus, Session 1929–30. Pp. 18. Chelsea School of Chiropody. Prospectus of Day and Evening Classes, Session 1929–30. Pp. 8. (London.)

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 54, Part 2, September. Pp. iv+253-460+lxxxv-cxliv+xxii+49 plates. (London.) 7*s.* 6*d.*

Royal Commission on National Museums and Galleries. Final Report, Part 1: General Conclusions and Recommendations, dated 20th September 1929. (Cmd. 3401.) Pp. 93. (London: H.M. Stationery Office.) 2*s.* net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1224 (Ae. 379): On the Flow of Air adjacent to the Surface of an Aerofoil. By Dr. N. A. V. Piercey and Dr. E. G. Richardson. (T. 2694.) Pp. 23+15 plates. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 2: The Glacial Retreat in Iar Connacht. By Prof. J. Kaye Charlesworth. Pp. 95-106+1 plate. (Dublin; Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

FOREIGN.

U.S. Department of Agriculture. Farmers' Bulletin No. 1582: Protection of Log Cabins, Rustic Work and Unseasoned Wood from Injurious Insects. By R. A. St. George. Pp. ii+20. 5 cents. Farmers' Bulletin No. 1601: Collection and Preservation of Insects for Use in the Study of Agriculture. By Margaret C. Mansuy. Pp. ii+20. 5 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 147: Archeological and Historical Investigations in Samaná, Dominican Republic. By Herbert W. Krieger. Pp. iv+91+27 plates. (Washington, D.C.: Government Printing Office.) 40 cents.

Department of Commerce: Bureau of Standards. Research Paper No. 81: Note on a Mercury Spark Gap for Instantaneous Photography. By L. F. Curtiss. Pp. 53-55. 5 cents. Research Paper No. 89: The First Spectrum of Krypton. By William F. Meggers, T. L. de Bruin and C. J. Humphreys. Pp. 129-162+4 plates. 15 cents. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 89: The Natural Crossing of Cotton Flowers in Egypt; its Distribution in Time and Space, and its Cause. By Dr. W. Lawrence Balls, assisted by Dr. J. Templeton, C. H. Brown, M. Kilani and others. Pp. 27. (Cairo: Government Press.) 5 P.T.

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 478: An Economic Study of Farm Buildings in New York. By I. F. Hall. Pp. 87. Bulletin 481: The Clover-Flower Midge (*Dasyneura leguminicola* Lintner). By Lawrence Paul Wehrle. Pp. 35. Bulletin 485: Farm-Property Taxation in New York. By Irving J. Call. Pp. 49. Bulletin 488: A Study of some Factors affecting Seed-Stalk Development in Cabbage. By Julian C. Miller. Pp. 46. (Ithaca, N.Y.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1928. Pp. 25. (Weltevreden: Landsdrukkerij.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 1: Absorption Lines of the Infra-red Solar Spectrum. By C. G. Abbot and H. B Freeman. (Publication 3026.) Pp. 17+5 plates. (Washington, D.C.: Smithsonian Institution.)

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State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 18, Article 1: The Native and Naturalized Trees of Illinois. By Robert Barclay Miller and L. R. Tehon. Pp. 339 (98 plates). (Urbana, Ill.)

CATALOGUES.

Fine Filtration and Ultra Filtration. Pp. 32. Catalogue of Scientific Text Books. Pp. 19. (London: A. Gallenkamp and Co., Ltd.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 11.) Pp. 199-274. (Paris: Libr. Adrien-Maisonneuve.)

The Librarians' Catalogue of Periodicals, Journals and Transactions of the Learned Societies, Library Editions and Standard Books in all Departments of Literature, English and Foreign, including Books for the Collector and Student. (Catalogue 334.) Pp. 98. (Cambridge: W. Heffer and Sons, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 25.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—Prof. R. Stenhouse Williams and Members of the Staff of the National Institute for Research in Dairying, Shinfield, Reading: The Scope of the Work of a Research Institute in Dairying.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—F. C. Connelly: Some Additional Lines in the Secondary Spectrum of Hydrogen.—Dr. E. G. Richardson and E. Tyler: The Transverse Velocity Gradient near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established.—B. K. Johnson: Resolving-power Tests on Microscope Objectives used with Ultra-violet Radiation.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Dislocations of the Hip-joint—Congenital and Acquired.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Col. E. Briggs: The Chemist in Industry (Chairman's Address).

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. W. H. Hatfield: The Fabrication of Acid-resisting Steel Plant (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Annual General Meeting) (at Newcastle-upon-Tyne), at 6.30.—L. E. Smith: Presidential Address.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—R. P. Wagner: Some New Developments in the Stephenson Locomotive Boiler.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—P. C. Dewhurst and others: The Requirements of Overseas Locomotive Engineers in Respect of Locomotive Design and Details.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—The Work of the British Electrical Development Association.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. Bruff: Electric Welding as applied to Bridges and other Structures on the L. and N.E. Railway.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. S. P. James: Modern Aspects of the Epidemiology, Prevention, and Treatment of Malaria.

SATURDAY, OCTOBER 26.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—R. S. Anderson: Presidential Inaugural Address.—Dr. W. Hopkins: The Distribution and Sequence of the Non-Marine Lamellibranchs in the Coal-Measures of Northumberland and Durham.—Discussion on Paper by R. G. Carruthers on Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne.

MONDAY, OCTOBER 28.

INSTITUTE OF ACTUARIES, at 5.—H. Freeman: Notes on a Short Method of Valuation of Pension Funds.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens of Calculi.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Discussion on Systematic Research by Industrial Undertakings.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—B. A. Robinson: Chairman's Address.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—J. McK. Ackland: Oral Sepsis in its Relation to General Disease (Presidential Address).—F. N. Doubleday: Two Cases of Hypertrophy of the Jaw.

MEDICAL SOCIETY OF LONDON, at 8.30.—A. E. H. Pinch, Prof. S. Russ, and others: Discussion on Radium Therapy.

TUESDAY, OCTOBER 29.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—T. Roles: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. Guild: Colour and its Measurement (Traill Taylor Memorial Lecture).

SOCIETY OF DYERS AND COLOURISTS (Huddersfield Section) (at Huddersfield).—M. le Blin Desbleds: Colour Measurement.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at College of Science and Technology, Leicester).—Hon. Sir Charles A. Parsons and J. Rosen: Direct Generation of Alternating Current at High Voltages.

WEDNESDAY, OCTOBER 30.

INSTITUTION OF MINING ENGINEERS (at Geological Society), at 11 A.M.—Annual General Meeting.—At 2.15.—Discussion on Paper by R. Clive: The Underground Conveying and Loading of Coal by Mechanical Means.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Derby Technical College), at 7.30.—D. L. Pellatt: The Manufacture of Viscose Rayon.

INSTITUTION OF THE RUBBER INDUSTRY (Birmingham Section) (at Grand Hotel, Birmingham).

THURSDAY, OCTOBER 31.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—H. C. Dent: The Use of Books in the School and Home.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Prof. W. Morgan: The Member and the Institution.

COKE OVEN MANAGERS' ASSOCIATION (at Hotel Great Central).—Annual Meeting.

FRIDAY, NOVEMBER 1.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion on Cyclonic Disturbances of Sea Level. Chairman, Sir Richard Gregory. Speakers, Dr. Doodson and Prof. Proudman.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Spinal Deformities in the Sacroiliac Region.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Burn: The Development and Performance of the Richardsons-Westgarth Oil Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. W. Hill: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Alfred Herbert, Ltd.: Technical Film: The Age of Speed.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. E. Weekley: Words and Names.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. J. Blomfield, Sir Francis Shipway, and others: Discussion on Avestin Anæsthesia.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—J. W. Berry: Cold Working of Metals.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Chemistry, Society of Dyers and Colourists, and Manchester Literary and Philosophical Society) (at Manchester).—Dr. F. A. Freeth: Industrial Research.

SATURDAY, NOVEMBER 2.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—A. H. Allcroft: The Significance of Circular Churchyards.

PUBLIC LECTURES.

FRIDAY, OCTOBER 25.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinate Biochemistry of the Cell and Tissues: The Ministers of Metabolic Change (Harben Lectures) (2)

UNIVERSITY COLLEGE, at 5.30.—C. S. Elton: The Future of Animal Ecology. (Succeeding Lectures on Nov. 1 and 8.)

SATURDAY, OCTOBER 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Faces and Finger Prints.

MONDAY, OCTOBER 28.

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. F. Baker: Physics and Geometry.

TUESDAY, OCTOBER 29.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Prof. J. Boeke: The Tissues in Youth and Age (Chadwick Lecture).

KING'S COLLEGE, at 5.30.—Prof. J. S. Mackenzie: The Conception of a Cosmos.

WEDNESDAY, OCTOBER 30.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. F. Hurst: The Asthma Problem.

SCHOOL OF ORIENTAL STUDIES, at 5.15.—Dr. Alice Werner: Kingdom of Congo.

KING'S COLLEGE, at 5.30.—Prof. E. V. Appleton: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: The Physical Sciences.—Dr. F. A. P. Aveling: Personalism: a Psychological Approach to Reality—The World of Ideal Experience.

FRIDAY, NOVEMBER 1.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Tissue Anarchy (Harben Lectures) (III.).

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Prof. J. Boeke: The Nervous System in Relation to Health (Chadwick Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic), at 5.30.—Prof. G. Elliot Smith: The Evolution of Man.

SATURDAY, NOVEMBER 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Sculpture in Relief.

CONFERENCES.

OCTOBER 25.

INSTITUTE OF FUEL (at Institution of Mechanical Engineers).

Friday, Oct. 25, at 10.15 A.M.—J. S. Atkinson: The Installation and Operation of Gas Producer Plants for Industrial Furnaces.—E. C. Evans: The Economics of Coke-oven Gas Utilisation in Industry.

At 2.30.—E. H. Lewis: Heat Insulation.—A. J. Dale and A. T. Green: (*a*) Fuel Control in the Ceramic Industry; (*b*) Refractories in Application to the Fuel Industries.

OCTOBER 30 TO NOVEMBER 2.

NATIONAL COUNCIL FOR MENTAL HYGIENE (at Central Hall, Westminster).—Subjects to be discussed include Sex Education, the Personal Equation in Industry, the Child and the Parent, and Delinquency, and there will be group discussions on the Working of the Juvenile Courts, the Relation of the Work of Public Health Nurses and Social Workers to the Mental Health of the Community, and the Problem Child at Home and in School.