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National Museums and Galleries.[1]

THE Royal Commission on National Museums and Galleries has now presented its general conclusions and recommendations in Part I. of a final report, leaving to a further part specific proposals relating to the several institutions that come under consideration. In the interim report of a year ago, the Commission dealt with certain urgent practical needs and the recommendations were endorsed in their entity by the Government, doubtless stimulated thereto by the public spirit of Sir Joseph Duveen. The Commission has taken additional evidence and examined special problems by sub-committees, of which that on publicity and contact with the public dealt with a subject of vast importance. It has not been concerned solely with the twenty national institutions named in the terms of reference, but has attempted to suggest the directions of policies designed to make all exhibited collections of more value in national life. "The immediate need", as it remarks, "at the present time is for a more active use of the magnificent resources at the disposal of the nation. The potentialities of artistic and scientific education, partially dormant in our museums and galleries, extend to every domain of knowledge, and can be set in motion to influence all classes and sections of the community. But there is to-day inadequate contact, and an absence of dynamic and co-ordinated effort."

A certain individuality and self-controlled growth is a characteristic of most of the great galleries and museums in Great Britain, and each has its devoted, if small, band of adherents who work therein, and never let slip an opportunity to enrich each his own love. There are sixteen governing authorities for twenty institutions, trustees being commonly appointed from such 'lovers', formerly for life, but we trust, as now suggested, for periods not exceeding seven years. There must be competition between some institutions, and it is suggested to seek co-ordination by the formation of a 'Standing Commission' to secure such, to advise on questions relevant to effective development and annually to review draft estimates. This Commission is to have no executive power, but to effect the desired ends "through its central position and prestige". Any such authority to possess prestige higher than that of the Trustees of the British Museum must consist solely of experts in art and science. Its

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

success will depend on its persuasive powers, and clearly its chairman will have to be a full-time officer, while it will require a secretariat which includes specialists in several lines, not least in questions of finance. Each institution in relationship with this Commission is to formulate broad lines of policy, which will avoid overlapping, though, as remarked, often the same objects are treated in science from different points of view. No example of co-operation between the science institutions themselves or with other bodies is given beyond that of the purchase of science books, and the practical results attained on this side are likely to be negligible. Indeed, no Commission will really affect them unless its members have been themselves trained in the scientific ideas that Plato terms 'permanent', founded on the intelligible world with which science deals.

The relations between national institutions and provincial museums and galleries, together with the further development of circulating collections, are subjects of national interest. Local authorities might be induced to provide a room or gallery of reasonable size, and collections of art objects might quite well be transferred monthly from town to town. Many towns have already collections illustrating natural history, and perhaps the best aid here would be the loan from national institutions of experts in display. Loans for exhibition overseas must necessarily be permitted, if the knowledge of British art is to be maintained. This is usually unnecessary in science, but liberty should be secured to allow the loan of any specimen the study of which may enrich knowledge. Experts come to work in every museum, and it is the product of research that, in science at least, is attractive to the public. It is clearly the function of our science museums to encourage such visitors by providing them with reasonable rooms for their often minute and laborious examinations of the collections. Their work reinforces and vastly increases that of the expert staffs, and they form a class of voluntary workers of great importance, always welcomed by their staff colleagues so far as space allows.

In the view of the Royal Commission, immediate efforts should be made to dissipate public apathy. All admission fees should be abolished. The use of museums and galleries in the education provided by public and other secondary schools must be stimulated. Evening lectures should be encouraged. The extension of the hours of opening, so as to include certain evenings up to 10 o'clock, should be tried in all the institutions concerned for two or three years. These changes must be accompanied by drastic rearrangements and simplifications of the contents of galleries so that 'exhibition terror' and fatigue may be avoided. Popular printed guides are necessary everywhere and guide lecturers might become part of permanent organisation. Guide attendants—men of technical training and experience—are employed in the Science Museum, and it should not be beyond the wit of directors to extend their use. Congestion is general; in the science museums, the Commission would clearly prefer part of the present exhibition space to be devoted to students and experts, thereby freeing other areas for selected exhibits.

To make the above effective, the Commission does not hesitate to recommend the most modern advertising methods, including posters. It refers with approval to the work of the Underground Railways in this direction—and perhaps it might also have commended those of the Empire Marketing Board, which certainly excite imagination in the provinces. The only attempt in this direction that we have seen is that of the L.C.C. in respect to the Geffrye Museum in the carriages of the Underground, the advertisement giving particulars of its specialities in exhibition. Contact with the Press is capable of great improvement, so that publicity should not be lost by inadequate handling of information. Guides, photographs, and publications dealing with the collections are to be encouraged, and we would add that they must be supplied to booksellers, who stock any of them, on the same terms as given by any publisher. The staffs of science museums are largely recruited for their knowledge and potentialities in research. As such they may not be the best people to write practical guides, to give popular lectures, to direct publicity and to arrange exhibitions, but we may safely trust the Commission to have considered the employment of specialists on these sides in the final report.

The Commission concludes by indicating what it characterises as "outstanding deficiencies in the National Museum service of the country", which it suggests as eminently suitable for those who desire to be public benefactors. Of these a Museum of Ethnography is long overdue, and a Folk Museum might well form a feature in one of the London parks. The building of new galleries and museums in centres of population will follow any awakening of the public to the immense value of its collections. Meantime, we heartily endorse the Commission's appeal for immediate and dynamic efforts to make our galleries and museums part of the life and heritage of the whole community.

Three Aspects of Light.

(1) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 20, Teil 1: *Physiologische Optik.* Von Dr. A. König. Pp. vii + 241. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 23·60 gold marks.

(2) *Lezioni di ottica fisica.* Per Vasco Ronchi. (Pubblicazioni dell' Istituto di Ottica di Firenze, No. 1.) Pp. ii + 494. (Bologna: Nicola Zanichelli, 1928.) 80 lire.

(3) *Le spectre infrarouge.* Par Dr. Jean Lecomte. (Recueil des Conférences-Rapports de documentation sur la Physique, Vol. 14.) Édité par la Société *Journal de Physique.* Pp. 468. (Paris: Les Presses universitaires de France, 1928.) 80 francs.

(1) THE name of the author of this volume of the comprehensive "Handbuch der Experimental Physik" is sufficient guarantee of the excellence of the treatment. Dr. König succeeded Prof. Pulfrich, the author originally appointed, whose work was so unfortunately cut short, when he had framed only a few fragments. These are an introductory chapter on the sense of vision and the other senses, with sections on the motions of the eye, its protective arrangements, the field of vision, and Fechner's law.

The scope of the whole treatise as an introduction to the wide subject of physiological optics is apparent from the fact that the complete range is treated in eighteen chapters which are included in 231 pages. Nevertheless, the entire discussion is very complete; and, being clear, it will serve the more usual purposes of the student better than if detail had been greater.

One chapter deals with the structure of the eye, and another with rod and cone vision. Fundamental phenomena of colour mixture and colour perception are treated in another chapter along with the duplicity theory. Fechner's law and the thresholds of perception are discussed in Chap. v., while Chap. vi. deals with contrast and irradiation. Time relations, accommodation, and after-images occupy the next two; and the following chapter is devoted to the leading theories. Heterochromic photometry and the measure of colour are the subjects of the next two chapters. Then, in a group of three chapters, visual acuteness, judgment of spatial relations, and vision of moving objects are treated. In the following group of three, the subjects discussed involve binocular vision—retinal correspondence, localisation in depth, and the mutual action of the two retinas. In a concluding chapter, the empiristic and nativistic theories of visual perception receive a brief review. Good subject and name indices follow.

The discussion of theory is of special interest in that it includes a brief account of Schrödinger's recent extension of the trichromatic theory on Helmholtz's lines. With only Fechner's law as a guide, Helmholtz succeeded wonderfully in his attempt to obtain an expression for differential sensitivity which would sufficiently comply with observation. It is true that his fundamental stimulations, deduced in this way, are not in accord with Abney's law. But Abney's law had not been found when Helmholtz worked; and Schrödinger himself expressly says that his own procedure, identical in essence with that of Helmholtz with the added inclusion of Abney's law, leads to a result no better than that of Helmholtz in the matter of differential sensitivity. It follows that differential sensitivity cannot furnish a very delicate test regarding the 'absolute' fundamentals in view of the uncertainty of observation. Helmholtz's argument against spectrum red as an absolute fundamental is sound. The addition of Abney's law to the basal data for theory enabled Schrödinger to obtain expressions for saturation and hue in addition to that for brightness. If Helmholtz had made that discrimination, it would have been a guess of most astounding penetration.

The brevity of the account of Schrödinger's work, due to the exigencies of space, is regrettable; for it goes far, and will be extendable whenever experiment supplies the needed data regarding the dependence of the threshold values on the component stimuli.

Hering's theory is detailed, along with the so-called zonal theories. All must be trichromatic in the sense of reducibility to three fundamental variables. The necessary relationship has been given for that of Hering by Helmholtz and Schrödinger; and it is suppliable for all others, including even that of Edridge-Green. This fact, however, does not detract from the value of these theories. For, through *simple* correspondence of their results to various phenomena, they may lead to recognition of the manner of the mechanism of vision.

(2) This is the first of a series of publications projected by the Optical Institute of Florence. In it the treatment of physical optics is developed to an unusually complete extent. There is an introduction of philosophical type, which is generally absent from English text-books, but should be

mentally satisfying to the thoughtful student. Even wave dynamics comes into notice.

In the first chapter the kinematics and dynamics of oscillatory motion are treated in the normal analytical manner; and, in the second, the results are extended to wave propagation, Huygens' principle being applied to reflection and refraction. The clear and logical method of presentation adopted throughout the book is well exemplified in the following chapter on interference. Restrictive postulates are first imposed, and the question of their removal is discussed later. Unidimensional propagation is first taken up, and the results are then extended to suit the cases of two and three dimensions. In the treatment of diffraction, in Chap. v., Cornu's spiral is introduced, and great use is made of it afterwards. The usual cases of diffraction are taken up in detail, and the chapter ends with a discussion of gratings, linear and circular. The results are applied in the following chapter, with great clearness and elaboration, to the discussion of the various forms of apparatus used in interferometry, beginning with Young's and ending with the interferential use of circular and radial gratings. The superposition of effects when two near sources are used with Young's apparatus is considered.

The next three chapters deal with the formation of images: the first with mirrors, prisms, and lenses; the second with vision of luminous bodies; and the third with vision of illuminated bodies. The formulæ for mirrors, prisms, and lenses are deduced; and the problems of achromatism and direct vision are also discussed. The general question of resolving power is dealt with, including that of immersion objectives. The diffraction image of a point source (star) is discussed and figured, and so also are the images of a double point source for the cases in which the central displacement is 1, 2, 3, and 4 times the minimum displacement which gives practical resolution. This leads directly to the determination of the angular separation of the components of a double star, and the angular diameter of a single star, on the principle of Young's interferometer used in conjunction with Michelson's device for increasing the resolving power of a telescope. The analogous use of the biprism, the rectilinear grating, and the circular grating is discussed. The advantages and defects occasioned by the use of the interferometer are carefully stated. In the chapter on vision of illuminated bodies, the question of the formation of shadows and images is treated in similar detail, and is finally applied to the problem of ultra-microscopy.

Chaps. ix. and x. deal with spectroscopy; the former being devoted to the measurement of wave-length, and the latter to the question of the resolving power, the well-known modern methods of attaining high resolution by the use of images of high order being discussed fully.

Chap. xi. is devoted to the discussion of wave aberration, spherical and zonal. The limiting conditions for practical physical perfection are dealt with; and the mode of its attainment in the case of the eye, notwithstanding the coarseness of its solid structure, is described. In the following chapter detail is given to the problem of diffraction and interference when aberration is prominent. Here the illustrations, excellent throughout the book, are specially striking. This is also the case in the next chapter, which deals with the determination of the nature of aberrational peculiarities from observation of their effects. The present deficiency in the development of theory is emphasised.

Two short chapters, on polarisation and photometry, respectively, complete the volume.

The treatment throughout is comprehensive and clear, so that the book is well adapted to the needs of a student who desires a more complete discussion of the subject than that supplied generally in text-books.

(3) This volume deals with the extension of research into about ten octaves of infra-red radiation. The subject is so vast that full treatment is impossible even in a book of nearly five hundred pages. A very full bibliography serves to overcome defects in this direction. Attention is directed to the subject mainly as an extended field for the methods which characterise observation in the visible spectrum, and as a supplier of tests for empirical formulæ or theoretical results—the electromagnetic theory, the theories of black body radiation, of dispersion, of quanta, etc. The practical difficulties overcome in the investigations are those of invisibility, and, still more, of feeble intensity.

Dispersed radiation alone is dealt with, and the author aims chiefly at an experimental treatment, theory being considered when the experimental results bear directly upon it. Some of the subjects are treated briefly in order that, within the limitations of size of the volume, a unified treatment of the whole field, hitherto non-existent, may be supplied. After a brief historical introduction, the various instruments employed are described, and a comparison is furnished. Methods (prism and grating) of separation of radiations follow; and then polarisation and formulæ of dispersion are discussed. Then reflection spectra are detailed

with their dependence on various physical conditions. Later, and even more fully, absorption spectra are treated. Both types of spectra are then discussed with reference to salts of the same, and of different, acids; and theory, classical and quantic, is applied to the discussion of the absorption and reflection bands and their characteristic frequencies, so as to obtain tests of the bases upon which theory rests. Other theoretical relationships and their tests are also detailed.

A chapter is devoted to absorption by gases and vapours in the infra-red spectrum, and its dependence on temperature and pressure. Resonance spectra are also discussed. Discussion of emission spectra, metallic and gaseous, selective and non-selective, with, in the latter case, the verification of the radiation laws (including grey body radiation), occupies another chapter. The volume concludes with a chapter on qualitative and quantitative proofs of the electromagnetic theory, and one on the astrophysical phenomena of planetary, solar, and stellar infra-red radiation.

The book, standing alone as it does in breadth of treatment of its subject, will be a great boon to students and those engaged in research.

W. PEDDIE.

Systematic Zoology and Evolution.

Das Prinzip geographischer Rassenkreise und das Problem der Artbildung. Von Bernhard Rensch. Pp. iii + 206. (Berlin: Gebrüder Borntraeger, 1929.) 14·50 gold marks.

IT has been apparent for a long time that an analysis of the vast assemblage of species and varieties that is the province of systematic zoology would be of first-class importance in evolutionary studies. In performing his task of providing the forms of animal life with names, the systematist was obviously collecting data on which important generalisations might be founded. The description of species and varieties and the recording of the minutiæ of variation, distribution, and nomenclature have always been viewed with some mistrust and disdain by the worker in other branches of zoology. We find even early students like Spallanzani and Gilbert White voicing such disdain. Nevertheless, Darwin, Wallace, Bateson, and others fully realised the value of systematics. They drew liberally on the data and were aware that certain general principles were becoming clearer in the growing mass of systematic descriptions.

During the past hundred years, systematists and faunistic zoologists have made attempts to formulate such general principles. Gloger, M. Wagner, Kleinschmidt, the Sarasins, Gulick, Allen, and Jordan had all, from one point of view or another, made important contributions. It has, however, remained for Dr. Rensch to gather together these earlier essays, to co-ordinate them and in a general survey of specific and racial divergence to present us with a comprehensive principle. Whether we accept Dr. Rensch's results as the only interpretation of the facts, or whether we consider that there are other explanations, is for the moment of secondary importance. We have in his book a working hypothesis and a starting-point.

Dr. Rensch's main thesis may be briefly stated as follows. The most significant systematic unit is the *Rassenkreis*, that is, a complex of geographical races developed directly one from another. The races forming such a *Rassenkreis* replace each other geographically and the adjacent races are fertile *inter se* (though members of a *Rassenkreis* remotely situated one from another may not be so).

Dr. Rensch is careful to point out that the concept of the *Rassenkreis* is not new. In general it is identical with the *Formenkreis* of Kleinschmidt and the 'species' of Hartert and Jordan. Analysis of such groups of animals as are well known systematically shows that the units of and below the rank of species are in a very high percentage members of such *Rassenkreise* and that possibly 70-80 per cent (p. 79) of the described forms occupy this position. He is careful to insist that at present we can only speak with certainty for groups like mammals, birds, and insects. In some groups a high frequency of *Rassenkreise* is to be expected, but it is obscured by individual and 'ecological' variation.

From the purely systematic and nominal point of view we may anticipate that objections might be lodged against Dr. Rensch's categories. He points out (p. 14) that his *Rassenkreise* are not identical with 'species', because, according to the current view, all the individuals of a species are fertile *inter se*, a condition not always found among the members of a *Rassenkreis*. Whether his categories cannot be after all accommodated in our current terminology is arguable. But this question is not the main issue. The significant facts are that homogeneous non-varying groups of the status of species are comparatively rare and the series of linked-up geographical races, the most widely separated members of which assume the morphological status of species, are of general occurrence.

This conception may not strike the zoogeographer as novel, though Dr. Rensch's statistical presentation of the facts introduces a new note. It is the

inferences that may be derived from this apparently universal occurrence of *Rassenkreise* that form the essence of his work. We may present this most simply by quoting two passages verbatim. "Das Studium geographischer Rassenkreise lehrt nun aber dass in zahlreichen Fällen, wahrscheinlich sogar in der Mehrzahl der Fälle, ein ganz allmählich gleitender Übergang von einer Rasse zur benachbarten Rasse zu konstatieren ist" (p. 118). . . . "So lässt also der gleitende Übergang der Rasse auf einer direkte äussere Bewirkung der Rassenbildung schliessen" (p. 126). In other words, there is a general tendency for a graded transition to be found between geographical races, and this tendency is an index of the influence of environmental forces in producing races and ultimately species. On this subject much might, of course, be said. The evidence in support of this thesis (pp. 118-171) is drawn from facts illustrating various distributional 'laws' (Allen's, Bergmann's, Gloger's), the highly significant occurrence of 'parallel variation' and the similarity in cause, distribution, and manifestation between phenotypic and genotypic variation. This part of the work is very ably presented. If the experimental proof that geographical variation is largely of a fixed heredity is somewhat deficient, Dr. Rensch produces enough evidence to make it very likely that an important part thereof may be heritable. 'Mutation' and natural selection seem to be negligible factors in the instances which he discusses.

Dr. Rensch's book is admirably planned. His periodical summaries serve to keep the main issues apparent and his argument is developed by clear and logical steps. It is an impressive statement of the case for modern Lamarckism from the point of view of a student of geographical distribution. Dr. Rensch's statistical treatment of the frequency of *Rassenkreise* would have perhaps been better had he taken one group, for example, birds, and analysed it more fully instead of giving a selection of cases. Evidence as to the selective value of inter-racial and inter-varietal differences might have been sought out more fully, as such evidence does exist and is by no means negligible. It is a little curious to find no account of Harrison and Garrett's work on the origin and inheritance of melanism in Lepidoptera in the various sections in which the origin of this phenomenon is discussed.

Finally, Dr. Rensch does not combat the difficulties raised by accepting the environment as the chief cause of inter-racial and inter-specific divergence. Among these difficulties we may mention the frequent occurrence of related species and varieties in the same habitat, and of species and varieties living unmodified in a diversity of habitats. Dr. Rensch grants the existence of 'individual variation', but surely an estimate of the intensity of correlation of racial divergence with habitudinal divergence is necessary before we assert that environmental difference is the most important factor in racial divergence. G. C. R.

Philosophy of Anthropology.

Anthropology and Modern Life. By Prof. Franz Boas. Pp. 246. (London: George Allen and Unwin, Ltd., 1929.) 10*s*. net.

THOUGH opinions may, and undoubtedly do, differ as to how far it is incumbent upon a science to justify its *raison d'être* by its practical value, it would indeed be remarkable if in the case of anthropology, the science of man, its application to the problems of society were ignored. Yet there are few subjects in which the general public is less informed as to the trend of the results of investigation in relation to the conduct of life, whether for the social group or for mankind as a whole. For this anthropologists themselves may be to blame in some degree; but in a science of so vast a scope, each is concerned with his own special branch of investigation, to the neglect of the more general philosophical problems of the subject as a whole. Those anthropologists who are interested in the practical application of their science have for the most part confined themselves to the question of the administration of the affairs of backward peoples in contact with European civilisation; but few have attempted to direct attention to its bearing upon the problems of the more advanced races.

Prof. Boas is to be congratulated on his attempt to meet a very real need—also upon his courage, for he attacks some cherished conceptions. Thus, for example, he shows a degree of scepticism as to the value of the aims of eugenics which will scarcely commend itself to the more ardent advocates of the proposals for racial betterment associated with that subject. In this, as in other branches of anthropological investigation, Prof. Boas shows a common sense and clarity of judgment which refuse to accept the idols of the market-place at current valuation. He is cautious in regard to generalisation and tenacious as to facts. Hence he holds equally that the arguments of the eugenist are neutralised by the variability in family heredity, and that generalisations as to racial character, both

physical and mental, are usually vitiated by concentration on a selected type within the group.

The author's criticism on this latter aspect of anthropological argument applies perhaps to the writings of publicists and popular authors who have used ready-made conclusions without a knowledge of the facts, rather than the anthropologists themselves. The latter, at any rate for the most part, are more than cautious at the present day in the care with which they refrain from attributing homogeneity to any specific national or geographical group.

As regards the author's own views on his subject, much might be said, though perhaps he is inclined to be more critical than constructive. His examination of the trend of social development from the simpler forms of social unit is at least logical in its forecast of the ultimate predominance of the larger group, which will inevitably tend, in his view, to internationalism.

Industrial Waste and its Treatment.

The Recovery and Use of Industrial and other Wastes. By John B. C. Kershaw. Pp. xvii + 212. (London: Ernest Benn, Ltd., 1928.) 25*s.* net.

TO the pessimist, the waste material of his factory is something of no value which must be got rid of as cheaply as possible. Unless prevented by government restrictions, he is content to discharge it into the sky or into neighbouring streams, or to dump it upon the surrounding land. To the optimist, all waste material is potentially valuable, if only the right method can be obtained for converting it profitably into something useful.

To a large extent the facts have so far justified the optimist. Many waste-treatment plants, which were originally installed to prevent a nuisance, have turned out to be profitable undertakings. The recovery of hydrochloric acid from the waste gases of alkali works, as the result of the Alkali Act of 1863, led to the foundation of a new branch of industry. During the present century, metalliferous dust has been recovered profitably in large quantities from the fumes discharged by copper smelters in America and elsewhere. The recovery of sulphur from alkali waste by the Chance process, the utilisation of blast-furnace slag, and the recovery of tin from tin-plate scrap, are typical of the methods which have been developed for converting useless waste material into a profitable source of income.

Mr. Kershaw is clearly an optimist, to whom every waste-heap is a potential Tom Tiddler's ground. His book is a challenge to the chemist and the chemical engineer to make all this hidden wealth available.

The book is a collection of articles which have appeared in various technical journals, and gives a fairly complete survey of the various channels through which power, heat, and materials are wasted in a number of different industries. In some cases the methods adopted successfully for the prevention of waste, or for the profitable utilisation of waste materials, are clearly described. After four chapters devoted to waste in the chemical industry, in engineering shops, metallurgical works, and mines, a very interesting account is given of the methods which are employed by different municipalities for the collection and utilisation of the contents of dust bins and garbage pails. Other chapters deal with the waste from paper mills, sugar factories, tanneries, slaughter-houses, fish-curing yards, rubber factories, and sawmills.

The book should interest those who are concerned with the management of industrial undertakings, and should also prove stimulating to the young scientific worker seeking fresh fields to conquer.

W. E. G.

Our Bookshelf.

Recent Advances in Neurology. By W. Russell Brain and E. B. Strauss. (The Recent Advances Series.) Pp. xii + 412. (London: J. and A. Churchill, 1929.) 12*s.* 6*d.*

THE authors' purpose is to persuade fundamental principles to emerge from a wealth of detail concerning the important neurological contributions of recent years, and they "can confidently assert that the book contains matter of direct concern to the student of medicine, physiology, therapeutics, pathology and (indirectly) psychology". Chief among the authors' intentions is that all the subjects treated should have a clinical bearing; "in other words, that the book should be an auxiliary text-book of *applied* neurology". It may, of course, be that advances in applied neurology bear more eloquent testimony to the state of the parent science than could any book; but it is doubtful whether "the qualified student of medicine reading for higher examinations" and the seeker after fundamental principles can be satisfied at one and the same time.

The misleading title apart, the authors have done exceedingly well, and candidates for membership of the Royal College of Physicians are certain, until the subject matter of the book becomes too widely disseminated among them, to derive very practical benefit from its use. An eminently practical discussion of cistern puncture, lumbar puncture, sub-dural and epidural injection of

lipiodol and radiography follows appropriately on the cerebro-spinal fluid and hydrocephalus. The next fifty pages deal with intracranial tumour and some related topics. Four and a half pages deal with the problem of the control of the cerebral circulation adequately if the conflicting and contradictory nature of the evidence at present available is taken into account. It is difficult to know how such a subject as posture and tonus should be handled in a book dealing with 'advances': the fourteen-page survey here given is fair. It is to be hoped that the student reader will prefer to think that something still eludes investigators rather than to be cynical concerning the display of disagreement. Three chapters are devoted to the disorders of movement, one to the pituitary and the hypothalamus. Pavlov's work, "The Conditioned Reflex", is abstracted at some length because "the demonstration that 'functional' nervous disease has a physiological basis . . . is a great practical advance". Brief as it is, the chapter on sleep, normal and pathological, is a welcome addition to the accessible literature. A longer chapter on sensation fairly reviews the essential features of Head's work and opinions. Thereafter the work is chiefly of medical interest.

The Spectroscopy of the Extreme Ultra-Violet. By Prof. Theodore Lyman. (Monographs on Physics.) Second edition. Pp. vii + 160. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 10*s.* 6*d.* net.

In 1914, when the first edition of this book appeared, the ultra-violet frontier of spectroscopic territory was at about 900 A. Nothing was known of the region lying between this and the X-rays; it was even uncertain whether there was anything to know, although it seemed probable that the gap in question was attributable to experimental difficulties rather than to an actual absence of radiation. Further, the exploration of the extreme ultra-violet had been carried on almost entirely by two men, Schumann and Lyman. The gap has long since disappeared, the vacuum spectrograph has become a commercial product, and numerous workers are engaged in the survey of these spectral regions. Prof. Lyman therefore had no easy task in preparing the second edition which is the subject of this notice. Technique has advanced to such a degree, and our knowledge is so much more extensive, that much of the book had to be entirely rewritten. In addition to the new data presented, some account is given of the more important recent developments, as, for example, the discovery of the part played by ozone in atmospheric absorption, the use of gratings at grazing incidence, and the exploration of the 'Millikan region'.

The wave-length tables have been completely revised, and now include data for H_2, He, He^+, C, N, O, Al, and CO. The book is throughout purely experimental in outlook, which possibly explains, although it does not excuse, the omission to replace out-of-date series designations such as $OS - mP$ and $OS - 1\pi$ by their modern equivalents. Apart from this, the only noticeable slip in the book is a remark about the "Blaethswood machine at the National Research Laboratories in England", but most English readers will have no difficulty in interpreting this correctly. Numerous references to original papers are given in the text, but it is doubtful whether any very useful purpose is served by repeating them all in a bibliographical appendix. This, however, is scarcely matter for complaint or criticism, and need not diminish our gratitude to Prof. Lyman for this exceedingly valuable contribution to spectroscopic literature.

The A B C of Psychology. By C. K. Ogden. Pp. x + 279. (London: Kegan Paul and Co., Ltd., 1929.) 4*s.* 6*d.* net.

Written to afford a brief account of "the nucleus of accredited opinion" from which the growing science of psychology is tending to develop, this short work is everything it should be; intelligible, easy almost to the point of flippancy (but not quite), impartial, detailed, crowded with information to a degree which must be measured to be believed, critical and yet individual, succeeding as a personal contribution unmistakably but without bias or excess. Half a dozen pages suffice for the presentation of matters pertaining to the core of psychology from the author's point of view, yet the book, which is dominated by them, maintains its balanced character.

A better name than 'double language hypothesis' may soon be coined as a label for the view of the mind-body relationship defined in a few pages of Chapter ii. Language is essentially 'linguistic' (Ogden) or 'grammatical' (Head), and the suspicion is growing that so far from its "saying it another way", the linguistic or logical method does not say anything at all concerning what we do when we think. The author says every statement is translatable. Behind the neurological point of view is scepticism of language as an appropriate system of symbolic representation of either itself or similar neuro-psychological events. The phrase thus invites hostility. Is it true that the psychologist can translate his language into symbols free from the bondage of words? If he can, a bi-representational solution of the mind-body problem may be possible. Why does Mr. Ogden on p. 1 cast aside ontology as useless to psychology?

Patent Law and Practice. By A. W. Griffiths. Pp. xxvii + 174. (London: Stevens and Sons, Ltd., 1928.) 7*s.* 6*d.* net.

At a time when several of the standard works on patents are out-of-print, there should be a good demand for this clear, concise, and inexpensive account of the present state of the law. The author, it is true, bases his discussion on the highly debatable theory that "a manner of manufacture is essentially an operation", but the principles which he enunciates are far less dependent on the validity or otherwise of this theory than might seem to be implied by such a statement. (By the way, it is to be regretted that lawyers still persist

in using the phrase "*manner of* manufacture" when they mean simply "manufacture"—an error due to a misunderstanding of the archaic English used in the Statute of Monopolies.)

Compactness has been obtained by the use of a very direct style, in which words are economised, and by the omission of such padding as the Acts and Rules, which can be purchased for a small sum from H.M. Stationery Office. The selection of leading cases is judicious, and is presented in a form which enables their relevance to be readily understood. The book contains, in addition, a number of sensible suggestions, put forward with becoming modesty, as to the right determination of various unsettled points of law. It can be recommended with confidence not only to students, but also to manufacturers and others who may be interested in the movement for the reform of the patent system which was inaugurated by the British Science Guild's recent report on this subject.

Mechanical Aptitude: its Existence, Nature, and Measurement. By John W. Cox. (Thesis approved for the Degree of Doctor of Science in the University of London.) Pp. xiii + 209. (London: Methuen and Co., Ltd., 1928.) 7*s.* 6*d.* net.

THE object of this research was to inquire into the existence and psychological nature of what has been variously called 'mechanical ability', 'mechanical ingenuity' or 'mechanical sense'. A clear understanding of this would certainly be of great value in vocational guidance and selection and in certain branches of educational practice. The general lines of the research, method of treatment, and argument follow those already laid down by Prof. Spearman in his studies of intelligence. A number of tests demanding ability to handle and interpret mechanical models, diagrams, etc., was given to different groups and the results subjected to detailed statistical treatment. The author draws the conclusions that there does seem to be evidence in favour of the reality of a special mechanical ability not dependent on general intelligence alone and that this can be measured. If this work should be substantiated, the consequences will be very valuable, for it will be possible to select those children with the ability and give them every opportunity for its development, while those lacking it can be diverted from occupations where success depends upon it. The research is a very valuable piece of pioneer work and its conclusions may be pertinent to psychological theory.

Einleitung in die physiologische Zoologie (*Physikalische und chemische Funktionen des Tierkörpers*). Von Prof. Dr. Hans Przibram. Pp. vi + 182. (Leipzig und Wien: Franz Deuticke, 1928.) 10 gold marks.

THE increasing tendency of zoology to turn from the more purely morphological towards the functional aspects of the subject, and to utilise the data of chemistry and physics in their study, has induced Prof. Przibram to write an introduction to physiological zoology which can act as a companion to his introduction to experimental morphology, and enable the student to gain a comprehensive outline of the subject before turning to one of the larger treatises. The work is divided into some thirty short chapters arranged in pairs, and dealing respectively with the physical and chemical properties of the different organs of the body: numerous references are given throughout the text: notes on the chemical composition, including formulæ, of substances referred to in the text are collected together in an appendix. In a small space the author has succeeded in covering a very large field and in giving an excellent outline of the subject of general physiology. The work could be read with profit by all students of physiology or zoology, but in the short time at their disposal will probably be found to range the field too widely to appeal to those studying within the narrower limits of human physiology. However, for all those who wish to know something of how animals of different species live, of their varying types of respiratory apparatus, of their modes of digesting and assimilating their food, of their secretions and excretions, their sense organs, or their reproduction, this short treatise can be thoroughly recommended for perusal.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 9: *As, Sb, Bi, V, Cb, Ta.* Pp. xiv + 967. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 63*s.* net.

THE ninth volume of Mellor's "Comprehensive Treatise" covers the tervalent and quinquevalent elements, arsenic, antimony, bismuth, vanadium, columbium, and tantalum. These elements do not possess the exceptional interest of the earlier homologues, nitrogen and phosphorus, which were described in a separate volume, but they are very fertile in producing chemical compounds of the type of vanadium heptabromo antimonite, VBr_4, $SbBr_3$, $7H_2O$, which are vouched for by chemical analysis but have not yet been provided with satisfactory structural formulæ. In these circumstances the volume is likely to pass more quickly than would otherwise be the case to the bookshelf which contains the earlier members of the series, there to await trial by usage as a work of reference.

Even so, there are sections which can be read with interest and pleasure, since arsenious oxide has a lurid history as a poison, and the sulphide has played a large part in the development of our knowledge of the laws which govern the behaviour of colloidal suspensions: the allotropy of the elements also presents an interesting problem, as the term 'explosive antimony' reminds us, and finally, these metalloids have given rise to some of the best examples of compound formation in alloys. These details are, however, unimportant compared with the main fact that the author has completed another section of this task, and thereby increased proportionately the obligation of his fellow chemists to him.

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.*]

Electron Collisions with Molecules and Resultant Quantum Losses.

FOR several years I have been conducting experiments on inelastic collisions of electrons with molecules, observing the quantum losses so sustained. The method has been described in the *Proceedings of the Leeds Philosophical Society*, January 1926, p. 65 (Brett and Whiddington), and in the *Philosophical Magazine*, November 1928, p. 899 (Jones and Whiddington). It consists in producing electrons of known speed by accelerating from a hot filament to a grid or slit, thereafter passing them through the gas and then analysing by a magnetic spectrum method. This is a specially powerful method, in that on one photograph is recorded the energies possessed by the electrons over a very wide range.

The kind of spectrum obtained is indicated in Fig. 1,

FIG. 1.

which is only a moderately good example of its kind. In the middle of the strip is the sharp edged 'full velocity' line (corresponding to $eV = \frac{1}{2}mv^2$, where V is the potential applied between filament and grid); on the right and fairly close to the full velocity line are clear indications of lines or heads of lower velocity and corresponding to the losses above mentioned. Still further on the right is a much lower velocity band or wide line, to which I now wish to direct particular attention.

This band is always present in photographs of this kind and it has been a puzzle to explain. Its position is variable, its intensity considerable, usually very much more intense than the full velocity line which it accompanies; occasionally the full velocity line is even absent entirely, or at any rate present very faintly.

Quite recently, a modified form of the apparatus has been in use, the chief change being the introduction of an 'electron gun' of the type employed in the Western Electric oscillograph. Much the same kind of electron spectrum was obtained. This led to a very simple experiment in which the gun was mounted in a glass flask and made to produce (in argon) the luminous beam, which was then deflected by a uniform magnetic field. It was immediately noticed, however, that keeping V fixed and the field constant, the radius of curvature of the beam diminished very rapidly with reduction of pressure.

Fig. 2 shows this effect very clearly. In this photograph the pressure for the least curved beam is about 0·001 mm. and for the most curved beam is about 0·0003 mm., the potential and field being constant.

Calculation of the electron volt velocity of these extreme beams varies, of course, from experiment to experiment, but in a particular case was found to vary from 40 volts to 150 volts, the applied voltage being 260 volts.

It is clear, therefore, that in an 'electron gun' used in this manner the velocity of the beam may often be much less than that calculated from the simple formula.

One possible explanation I believe may be found in considerations based on the discharge which is probably occurring within the gun. If the electrons forming the luminous beam be supposed to come not from the filament but from the edge of the dark space or its

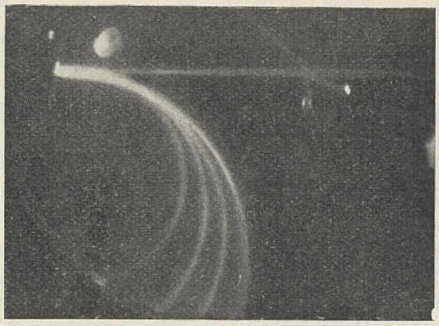


FIG. 2.

equivalent within the gun, then everything is qualitatively explained. With reduction of pressure, for example, the dark space widens, the source of supply moves nearer to the anode, and the effective eV consequently falls in value.

There are other interesting matters in this connexion which for reasons of brevity must be omitted now, but the examination is being continued further.

R. WHIDDINGTON.

The University, Leeds,
Oct. 23.

The Quantum Theory of the Absorption of Light.

IT is well known that some years ago Smekal introduced the notion of 'double quantum switches' which are responsible for both coherent and incoherent scattering of light. These double switches consist in a transition from a given state of the atom k to some 'intermediate' state n, and back either to k or else to some other state l, the result being the emission of a light quantum $h(\nu - \nu_{lk})$ instead of the absorbed $h\nu$. This theory has since been justified by the new mechanics. Now it seems to me that its implications have not been fully realised, and it is my purpose to apply them to the problem of absorption of light by the conversion of light energy into heat.

The main point is that the intermediate states n of the double switch $(k \rightarrow n \rightarrow l)$ have a definite *duration*, although a much shorter one than that of the two end states. This is contrary to the usual assumption, which does not regard the state n as 'really' occurring, and it involves a temporary breach of the conservation of energy, though this is an objection that can be easily overcome formally. The mechanism of the switch requires the use of *two* probability coefficients B'_{kn} and the much greater B''_{nk}, which are a generalisation of Einstein's well-known B.

Turning now to our main object, the explanation of absorption, this is produced when the atoms in the state n undergo collisions of the 'second kind', so as to turn their internal energy into heat. The method of perturbations of the quantum theory yields N_n, the number of atoms in state n, as

$$N_n = N_k \frac{E_0^2 |p_{nk}^0|^2}{h^2} \frac{\nu_{nk}^2 + \nu^2}{(\nu_{nk}^2 - \nu^2)^2}, \quad . \quad . \quad (1)$$

where E_0 is the incident electric force and p_{nk}^0 the appropriate matrix element of electric moment. If

ν' represents the probability per second of a collision of the second kind, then heat is developed at a rate

$$Q_n = \nu' N_n \cdot h\nu = N_k \frac{E_0^2 |p_{nk}|^2}{h} \frac{(\nu_{nk}^2 + \nu^2)\nu\nu'}{(\nu_{nk}^2 - \nu^2)^2}. \quad (2)$$

This may be compared with the classical expression given by the 'collision damping' theory of H. A. Lorentz. Taking the case of a single elastically bound electron, if $\pi\nu''$ denotes the number of collisions per second, that theory gives as the heat produced

$$Q = \frac{N}{2} \frac{e^2}{4\pi^2 m} E_0^2 \frac{2\pi\nu''\nu^2}{(\nu_0^2 - \nu^2)^2 + \nu^2\nu''^2}, \quad (3)$$

or, replacing the quantity e by its quantum equivalent and omitting the small term in the denominator,

$$Q = N \frac{E_0^2 |p_{nk}|^2}{h} \frac{2\nu^2\nu_{nk}(\pi\nu'')}{(\nu_{nk}^2 - \nu)^2}, \quad (4)$$

which only differs slightly from (2). The reason for the difference is not clear to me, but it scarcely seems to discredit the theory that absorption of light is effected by atoms in intermediate states undergoing collisions of the second kind, with a temporary violation of the law of energy.

It would perhaps be possible to test the theory experimentally by observing the presence of atoms or molecules having large kinetic energy of order $h\nu$. The presence of such atoms in relatively small numbers is characteristic of the quantum theory, whereas in the classical theory of Lorentz the absorption is the result of a small amount of internal energy transformed into heat at each collision of every molecule.

J. FRENKEL.

Physico-Technical Röntgen Institute,
Leningrad, Oct. 13.

Adaptations and the Influence of Light on Animal Tissues.

PROF. MEEK, in his letter to NATURE of Oct. 5 on "Adaptation", has used in illustration of his views instances of crustacean races (of the amphipod *Gammarus duebeni* and the copepod *Canthocamptus pygmæus*) residing in pits and mines which had lost their colour and eyes without losing the power of reproducing those features on becoming once more acquainted with light. In Prof. Meek's opinion, more prolonged exposure to environmental strain might make this restoration more difficult by impairing the reversibility of the reaction, and he suggests that this sort of adaptation to life in the dark is 'psychogenetic' in origin. In addition to the many eyeless Crustacea of purely cavernous habit, *Cyclops agilis* Koch has been found underground with degenerate eyes, but the same and four other species of *Cyclops* as well as *Canthocamptus staphylinus* Jurine have often been found in the dark with normal eyes; loss of pigment has been observed in certain Ostracoda in similar situations (Moniez, *Bull. biol. N. France*, **1**, p. 176; 1888).

Prof. Meek's observations become additionally interesting in the light of the famous experiment by Kammerer when eyes were regenerated by the blind newt *Proteus* on exposure to red light, or pigmentation restored in full light (NATURE, May 1923, p. 237), and it may be useful to place on record here certain notes made by myself this summer.

The amphipod genus *Niphargus* of 'well-shrimps', blind and colourless, makes a not infrequent appearance in quite recently dug wells, which is still an unsolved problem in spite of certain species found in caverns or deep in lakes. Among twenty forms two have been described with degenerate (lemon-yellow) eyes, one with small eyes, two with pale body colour (Stebbing, 1906—"Amphipoda Gammaridea"—in "Das Tierreich", Lief. 21). The Île d'Arz in the Morbihan, south Brittany, is entirely devoid of natural water; the inhabitants have dug numerous shallow wells to a little below sea-level in which the depth of water is affected by the tide as if the main supply were filtered from the sea, though it is perfectly sweet. Cattle are rationed with water by pailfuls poured into shallow stone troughs beside the wells, in the largest of which (not dry with August sun like the others) I found a fine male *Niphargus* swimming on its back quite undisturbed by the strong sunlight, much resembling a 'fairy-shrimp' in its motions. The specimen was one inch in length, of a yellowish-brown colour, with well-marked red-brown eyes which have faded in alcohol; there are curious deeply melanic areas at the apices of the peduncles of the second antennæ and at the tip of the right first antenna, also at the injured point of left first antenna which is broken near the base. The specimen does not agree with any of the 'good' species, but many prove to be the partly described *N. rhipidiophorus* (Catta, 1878), also with small eyes and found in a brackish well at the mouth of the Rhône.

Another well contained many small *Asellus aquaticus* L., fully pigmented and with eyes; A. *aquaticus* v. *freiburgensis* Schneider, found in mine-water, was colourless with well-developed eyes, and blind species have been found in caves or deep in lakes (Moniez, loc. cit., p. 254).

The Triclad Turbellaria include many blind and colourless subterranean forms, one of which—*Polycladodes cavatica* (Fries)—may develop pale colours and regenerate eyes in springs which emerge to the surface. Colourless (v. *corsica* Arndt and v. *bathycola* Steinmann) and eyeless (v. *anophthalma* Mrazèk) races of *Planaria alpina* (Dana) have been discovered; indeed, in its normal situations a varying small proportion of individuals are grey or white instead of black, while the young worms are quite colourless when hatched, so that failure of the pigment should be relatively easy; moreover, the frequent reproduction by eyeless tail-buds might favour the formation of blind stocks in the dark. In the Leith Hill district of Surrey I found a colony of *P. alpina* breeding (sexually) in a stony bed fourteen inches below meadow land, the exit of the stream being by filtration through the overlying soil. The worm avoids mud on account of its toxicity for the species, and, since it is also found at the mouth of nearly every underground field-drain in the neighbourhood, the impression obtained was that this colony must be the relic of one originally living in its typical home at the head of one of the local stony or rheocrene springs, some of which have become overlaid with alluvium in the course of time. Yet, although the individuals of this subterranean colony must have been long deprived of light, they were deep black and perfect in eye. Moniez (loc. cit., p. 143) has recorded the finding of normally pigmented *Polycelis nigra* (Ehrenberg), *Planaria polychroa* Schmidt, and eyed specimens of *Dendrocœlum lacteum* (Müller) in underground situations.

On the other hand, keeping *Planaria lugubris* Schmidt (a river species very near to *polychroa*, which normally obtains much light) in the dark, I have repeatedly observed marked reduction of the dark brown extra-enteric colour without any deterioration of eye. In another species—*Planaria vitta* Dugès—which is colourless, I have examined (by courtesy of Dr. H. A. Baylis of the British Museum) a local race from subterranean water in Devonshire, the eyes of which are perceptibly smaller than in races from open streams in south Devonshire or at Aberystwyth.

It would seem that the loss of pigment and eyes in subterranean species is by no means immediate, and is effected much more slowly than their restoration with the light. This is perhaps less surprising on reflection that the swift physiological response to light in higher animals includes a persistent effect—the 'after image'—which is longer in duration than the latent period of response to the stimulus; application and deprivation of light are here not of equal value when considered as environmental strains potent to disturb the constituents, and if they are not equally able to alter a temporary balance it may be they are also not equally able to alter the permanent architecture of animal cells. We should also recall that the effects of radiations, when affecting protoplasm, obey the rule required of any physiological stimulus that there be sufficient intensity applied for a specific minimum of time. This holds good in the physiology of vision and is well seen in the production of heritable effects by X-rays, as well as in therapeutic experience, both with radiations and radium; it may therefore be equally applicable in the case of such genetic modifications as may conceivably be produced by the prolonged effect of light (or its deprivation) on gonadial cells.

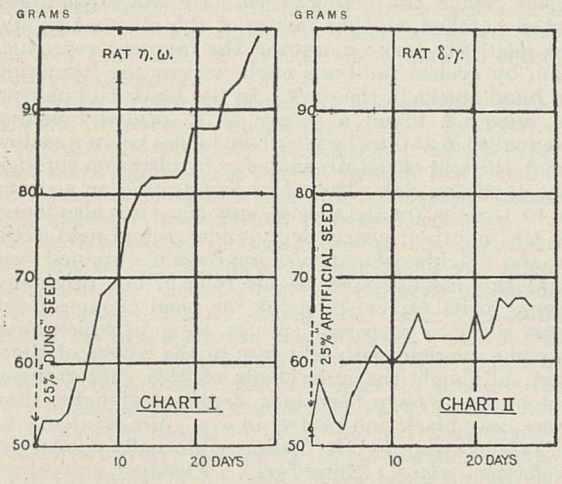
MICHAEL PERKINS.

5 Little Cloisters,
Westminster Abbey, S.W.1, Oct. 22.

Vitamin Contents of Grass Seeds from Treated Plots.

I HAD noted on my farm for many years the animals, especially pigs, that had been fed on home ground and home grown wheat and barley thrived better than those fed on purchased barley meal and 'cake'.

Following upon this, I pegged out in one of my fields two areas: one area was dressed with dung from animals to which foods containing a high content of vitamin B had been given; the other area of grass in



the same field received artificial manure. The spreading of the dung on the grass was at the rate of twenty loads to the acre, and the spreading of the artificial manure was at the following rate: basic slag 10 cwt. to the acre, kainit 3 cwt. to the acre, and sulphate of ammonia 1 cwt. to the acre.

In July of this year the grass was cut by hand and the seeds from the grasses of each area were kept absolutely separate. The seeds from these grasses were threshed out by hand and were fed to rats with the view of demonstrating the vitamin content of those grass seeds which had been grown on the dunged area and that grown on artificial manure.

Chart No. 1 demonstrates the growth curve of rats fed on dunged grass seeds, and chart No. 2 demonstrates the growth curve of rats fed on the artificial manured grass seeds. I attribute the increased growth, as shown in Chart No. 1, on the dunged grass seeds, as due entirely to the vitamin B present in the excreta of the animals which had been fed on a high vitamin B content diet. This raises an extremely important point that vitamin B is present in the embryo of grass seeds and is entirely dependent, or certainly to a large extent, on the food consumed by the animal the excreta of which is used for the manufacturing of dung.

Further details will be published at a later date.

M. I. ROWLANDS.

1 Knightsbridge Court,
12 Sloane Street, S.W.1,
Oct. 12.

Handling Molten Lead.

SEVERAL letters were published in issues of NATURE during September and October 1928 (vol. 122, pp. 349, 507, 610) under the title "Can the Hand be thrust in Molten Lead without Injury?" In reply to the inquiry, two correspondents testified from personal experience to the safety of the demonstration. As few people seem to have done the experiment even in these days, it may be of interest to publish the following description of it which has just come under my notice in a volume published so long ago as 1594 entitled "The Jewell House of Art and Nature". By Hugh Plátte. (Printed by Peter Short, dwelling on Breadstreet Hill, at the signe of the Star and are to be solde in Paules Churchyard.)

"How a man may safely put his finger and hand into molten lead, without danger of burning."

"Take of quicksilver one once, Bole Armoniack of the best two ounces, Camphire half an onnce, common Aqua vitae two ounces, first beate, and then mingle all these well togither with a pestle in a brazen morter, then annoint your hands al ouer thrughly well with this ointment, and be sure that your hands are cleane without itch or scabbe. I did see a Dutchman called Haunce, a prety nimble Chimist, who after he had set some lead on the fire in a melting pot, till it became blewish and exceedingly hot, hee stirred the same first with his forefinger vp and downe, pretending to see whether it were not too hot to endure in the palme of his hande, and afterwards telling his fellow that it was of a good temper, he caused him to poure the same out being some half a pound in weight into the palme of his hande, first prepared as before, and presently he poured it into his other hand, and so out of one hand into another fiue or sixe times together, till in the ende he threw the same cold upon the ground. This hee did for a pot of the best Beere in a garden in Southwarke about ten or twelve yeeres sithence, in the presence of myself and diuers others."

E. H. GREGORY.

Rothamsted Experimental Station,
Harpenden, Herts.

Regeneration of Spines in *Echinus esculentus*.

REGENERATION of the spines in *Echinus esculentus* is considered worthy of record, and is of importance with regard to the short fine spined forms which are sometimes obtained in the trawl or dredge. It seems probable that such natural, fine spined individuals, which are sufficiently strange to be regarded, not unreasonably, as a different species, may have been

damaged in some way, as by rubbing and exposure during a previous capture, and have afterwards recovered as in the case of the specimen observed. The observation is also of interest in indicating that the species possesses unsuspected powers of regeneration, and may be a favourable subject for experiments on regeneration under suitable conditions.

The accompanying photograph represents, on the left, a specimen of *Echinus esculentus* which lived for some weeks in one of the tanks of the Marine Biological Station at Port Erin and, after apparent death, produced a second crop of spines. The original spines first lost their erect condition and lay, as is usual in moribund specimens, scattered irregularly over the

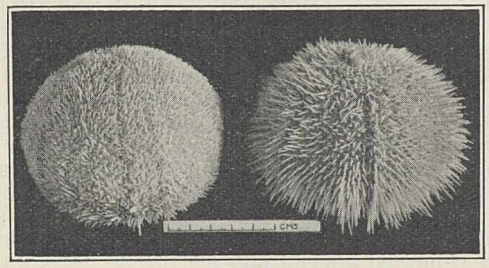


FIG. 1.

surface at the test. The specimen lost its hold upon the side of the tank, on which it had migrated to the surface of the water. Owing to decomposition of the capsular muscles the spines became detached and fell to the bottom of the tank. The specimen was, apparently, dead. My attention being directed to other matters, the specimen was not at once removed, and my surprise was great when, some days later, a new crop of minute spines had made their appearance all over the surface of the test. These were allowed to remain until some growth had taken place, then, being anxious that the specimen should not be lost, I preserved it in spirit.

The dimensions of the specimen and of the new spines are as follows :

Diameter of test at ambitus . . .	9·5 mm.
Height ,, ...	7·5 mm.
Length of major spines around peristome .	8 mm.
,, ,, ,, at ambitus . .	4 mm.

The photograph on the right represents a normal specimen from the same locality as the above.

H. C. CHADWICK.

Marine Biological Station,
Port Erin.

Sexual Behaviour in Birds.

WHAT Dr. Marshall is so good as to say in NATURE of Oct. 26 in regard to my advocacy of the principle of inter-sexual selection makes it, I think, incumbent upon me to point out that I did not originate the idea of this, any more than of sexual selection in the ordinary sense. Darwin had considered the possibilities here also, but unfavourably, which I attribute myself to the want of sufficient evidence at that time. He indeed makes prominent mention of certain cases in which the usual order of courtship, as between the sexes, is reversed, but does not say anything (unless I am mistaken) in regard to mutuality in this respect, or of another factor which seems to me to have a profound bearing on the question. I allude to functional hermaphroditism in birds which, in so far as alternate preparation is concerned, I recorded in the *Zoologist* (May 1902) in the case of the great-crested grebe, and, later, in *Wild Life* (July and August 1915) in that of the little grebe, where such preparation was carried into action under conditions not admitting of doubt. Thus the common ideas as to the profound psychological and temperamental differences between the 'ardent' male bird and the 'coy' female would seem to be based on error, to the consequent weakening of any argument so arrived at. The erotic foundations being similar on either side, the superstructure raised on them might very well also be, and this, I think, as tending to dispose of an initial difficulty, makes the class of fact above mentioned my principal contribution to evidence in a case which had been opened and still remained *sub judice* at a time when I had nothing about it in my notes.

Now, however, I have much there which I believe to be quite *as* important, at any rate, from an evolutionary point of view as well as, in many cases, going, if not beyond that root principle, at least farther back in it and pointing to other things as well—observations, in short, which it is, I think, in a high degree the duty of any field observer to place upon record (*in extenso*) *if he can*. Should there be any channel through which he can, without being put to the expense of personal production, he would, in this instance, be very glad to know of it, since otherwise, owing to the little interest taken by any but a very small section of the general public in original field observation, some half-dozen volumes *in posse*, of that description, seem less likely to be awaiting publication than the posthumous waste-paper basket.

EDMUND SELOUS.

Wyke Regis Castle,
near Weymouth, Dorset.

The Homogeneous Oxidation of Acetylene.

FOR many years the slow oxidation of hydrocarbons has been thought to be a reaction taking place at a surface. We have succeeded in demonstrating the wholly homogeneous character of a hydrocarbon oxidation and have obtained conclusive proof of the chain nature of the reaction. Just as this work was completed, Mr. C. N. Hinshelwood, of Oxford, informed us privately that he had obtained similar evidence for hydrocarbon oxidation, which is to be published shortly.[1]

The oxidation of acetylene by oxygen proceeds at 250°-315° through the stages of glyoxal, formaldehyde, formic acid, carbon dioxide, and water. Schematically, the reactions are :

$$\left.\begin{matrix}CHO\\|\\CHO\end{matrix}\right\rangle \longrightarrow CO + HCHO \xrightarrow{+O_2} HCOOH \xrightarrow{+O_2} CO_2 + H_2O$$

$$\left.\begin{matrix}CHO\\|\\CHO\end{matrix}\right\rangle \longrightarrow 2CO + H_2 \qquad\qquad \searrow\ CO + H_2O.$$

All these reaction products have been isolated.

Kinetically, the behaviour of the reaction is abnormal in that the rate of reaction is proportional to the square of the acetylene concentration and is almost independent of oxygen.

In packed vessels the rate of the homogeneous reaction is reduced manyfold. Instead, a heterogeneous oxidation direct to carbon dioxide and water takes place, the rate of which is proportional to the product of the acetylene and oxygen concentrations.

A paper describing these results in full will appear shortly in the *Journal of the American Chemical Society*.

G. B. KISTIAKOWSKY.
S. LENHER.

Experimental Station,
E. I. du Pont de Nemours and Company,
Wilmington, Delaware.

[1] The paper is "The Kinetics of the Oxidation of Ethylene", by Thompson and Hinshelwood, and was published in the *Proc. Roy. Soc.* for September.—EDITOR.

Raman Effect and Electrolytic Dissociation.

A STUDY of the Raman effect in nitric acid at various concentrations has revealed two interesting features which have a bearing on the phenomenon of electrolytic dissociation. In concentrated nitric acid (about 65 per cent acid), nine Raman lines have been found, three of which correspond to water. Of the others, three lines showing wave number differences of 958, 1312, and 3319 cm.$^{-1}$ seem to belong to the HNO_3 molecule. The other three, which are also found in nitrates, with wave-number differences of 630, 689, and 1050 cm.$^{-1}$ belong to the NO_3^- ion. Photographs taken indicate that the Raman lines belonging to the HNO_3 molecule gradually disappear with increasing dilution. On the other hand, the lines belonging to the NO_3^- ion increase in brightness up to a certain dilution and then diminish with still further dilution. The dilution corresponding to the maximum brightness of the NO_3^- lines is not far from that at which the HNO_3 lines just disappear. This is clear evidence of the dissociation of the HNO_3 molecule.

Water, which gives three diffuse bands at 3208, 3419, and 3582 cm.$^{-1}$ wave number differences, shows a peculiar behaviour. Not only do the three bands become sharper with increasing concentration of the acid, but the band corresponding to 3208 cm.$^{-1}$ gradually diminishes in intensity until it becomes very faint in the concentrated acid. The band 3582 cm.$^{-1}$, which is the weakest of the three in pure water, gains rapidly in intensity and becomes in the concentrated acid the strongest of the three bands.

It is expected that intensity measurements, which are in progress, will throw light on the current theories of electrolytic dissociation.

I. RAMAKRISHNA RAO.

Wheatstone Laboratory,
King's College,
London, Oct. 9.

Molecular Spectra and Molecular Structure.

THOSE who contributed to the recent Faraday Discussion on molecular spectra and molecular structure have now sent their written versions to the secretary for publication. Instead of the report we gave of Prof. Barker's explanation of the double Q branch of ammonia at 10·3 μ and 10·7 μ (NATURE, Oct. 12, p. 587), we should like to substitute Prof. Barker's own written version :

" The ammonia molecule probably has the form of a triangular pyramid of small altitude. Two of the four fundamental modes of vibration involve an oscillation of the N atom along the axis of symmetry, *i.e.* normal to the plane of the three H atoms. The band at 10·5 μ is associated with a symmetrical motion of the H atoms such that the distance between them increases when the N atom approaches the plane in which they lie. The equilibrium position of the N atom may be upon either side of this plane ; hence the potential energy function exhibits two minima separated by a relatively low maximum. Two *eigenfunctions* must therefore be associated with each vibration state, one being symmetrical and the other anti-symmetrical. Because the two equilibrium positions are not far apart these two functions involve slightly different amounts of energy, and the vibration levels are all double. Finally, since transitions are always between states of opposite symmetry character, *e.g.* $1_a \rightarrow 2_s$ or $1_s \rightarrow 2_a$, two absorption bands appear with slightly different frequencies."

W. E. GARNER.
J. E. LENNARD-JONES.

The University, Bristol.

New Cellulose Methylene Ether.

SYMMETRICAL dichlorodimethyl sulphate isolated by Fuchs and Katscher (*Ber.*, **60**, 2288 ; 1927) has been found to react with soda cellulose (using Haworth's technique) giving monomethylene cellulose of maximum OCH_2 content 17·2 per cent and corresponding with the formula $C_6H_7O_2(OH)(O_2CH_2)$.

Other methylene inorganic and organic esters give somewhat similar results. This reaction is evidently exactly analogous to that between soda cellulose and dimethyl sulphate, except that only two of the three hydroxyl groups of the $C_6H_{10}O_5$ unit take part in it.

Hitherto, all work on the reaction between cellulose or starch and formaldehyde has given either the so-called ' absorption compounds ', or with acid catalysts only partially methyleneated products. Two recent papers on this subject deal with these aspects of the reactions (Blanksma, *Rec. Trav. Chim.*, 361 ; 1929, and Meunier and Guyot, *Comptes rendus*, 188, 506 ; 1929). It is hoped to be able to establish the structure of monomethylene cellulose now described for the first time, and particularly to apply the reaction to many of the sugars and starches.

Monochlorodimethyl sulphate reacts with soda cellulose giving a mixed methyl methylene cellulose ether of limited interest only.

FREDERICK C. WOOD.

21 Egerton Road, Fallowfield,
Manchester, Oct. 18.

Influence of Particle Size on Diamagnetism.

IN a recent note to NATURE (July 13, p. 53), Sir C. V. Raman referred to some experiments made with me which showed that the diamagnetic susceptibility of graphite falls off steadily with increasingly fine subdivision of the substance. A single crystal of graphite gave a specific susceptibility ($\times -10^6$) equal to 18·1 parallel to the hexagonal axis, and 2·7 perpendicular to it, the average over all directions being 7·8. With powdered graphite this number diminishes to 5·1, while for finely divided colloidal graphite it falls so low as 2·2.

Further experiments by me have disclosed a similar effect with metallic antimony, though not of such a striking character. Massive antimony has a specific susceptibility ($\times -10^6$) equal to 0·78, which diminishes to 0·71 with colloidal antimony when the average particle size is 6 μ and further drops to 0·54 with particles 150 $\mu\mu$ in size. It is known that the diamagnetic susceptibility of antimony falls off with rise of temperature, or on fusion, and that it is considerably less for antimony in chemical combination than for the free metal. It appears that mechanical subdivision or ' colloidalisation ' influences the diamagnetism in the same way.

V. I. VAIDYANATHAN.

Annamalai University,
Chidambaram, South India, Oct. 1.

Periodic Precipitations and Diffusion.

IN a recent communication (*Proc. Roy. Irish Acad.*, 38 B, p. 445) we classed Prof. Wolfgang Ostwald's theory of periodic precipitations amongst those in which precipitation should occur at or near the " head of the diffusion column ". In reality, as Prof. Ostwald has kindly pointed out to us in a private communication, according to his theory the " critical mixture ratio ", which determines the formation of a precipitate, should always lag behind the head of the diffusion column. This objection to Ostwald's theory is therefore not valid.

HUGH RYAN.
R. J. DOYLE.

University College, Dublin.

The Shannon Hydro-Electric Power Development Scheme.

By Dr. BRYSSON CUNNINGHAM.

ALTHOUGH not quite equal in capacity to the leading modern hydro-electric installations of the North American continent, some of which have been noticed in previous issues of NATURE,[1] the Shannon undertaking, which is now at the point of effective operation for partial development, is a notable enterprise for a country of the size and resources of the Irish Free State. Indeed, it may justifiably be described as a national adventure, ambitious in scope and fraught with momentous economic consequences. On one hand, its promoters and advocates expect it to rehabilitate the industrial activities of the country; on the other hand, doubts have been, and continue to be, freely expressed as to the possibilities of its financial success. The boldness of its conception in unpropitious circumstances and the importance of the rôle which it is designed to play in the resuscitation of Irish industry, entitle it to attention as a remarkable engineering achievement of modern times.

Actually under consideration and execution for the past six years or so, the inception of the scheme really dates back to the year 1918, when the British Government became anxious about the shortage of coal supplies, and, searching for other sources of power, appointed in June of that year a committee to report on the water power resources of the United Kingdom. In the following November a sub-committee for Ireland was nominated with the same terms of reference. As the reports and findings of these committees have already been published and commented upon in NATURE, there is no occasion to say more here than that the Irish Sub-Committee selected four rivers (the Shannon, the Erne, the Bann, and the Liffey) for investigation, and made them the main theme of their Report of Dec. 6, 1920, together with a number of important recommendations on water power development generally.

The matter was further considered by a Commission of Inquiry into the Resources and Industries of Ireland which reported in 1922. The next step appears to have been taken on the initiative of the German firm of Siemens-Schuckwerke, which in February 1924 placed before the Irish Free State Government certain proposals for developing the hydro-electric capacity of the Shannon. In September of the same year the Free State Government referred these proposals to four continental experts (Messrs. Waldemar Borgquist, of Stockholm, Eugen Meyer-Peter and Arthur E. Rohn, of Zurich, and Thomas Norberg Schulz, of Christiania (Oslo)) for consideration. The report of these engineers was favourable, subject to some suggested modification of the plans in detail. The Irish Government thereupon adopted the scheme and initiated legislation in order to give it effect. Passed by Dail Eireann in April 1925 and by the Oireachtas in the following June, the Shannon Electricity Act duly became law, and the execution of the necessary constructional works was forthwith entrusted to the German company.

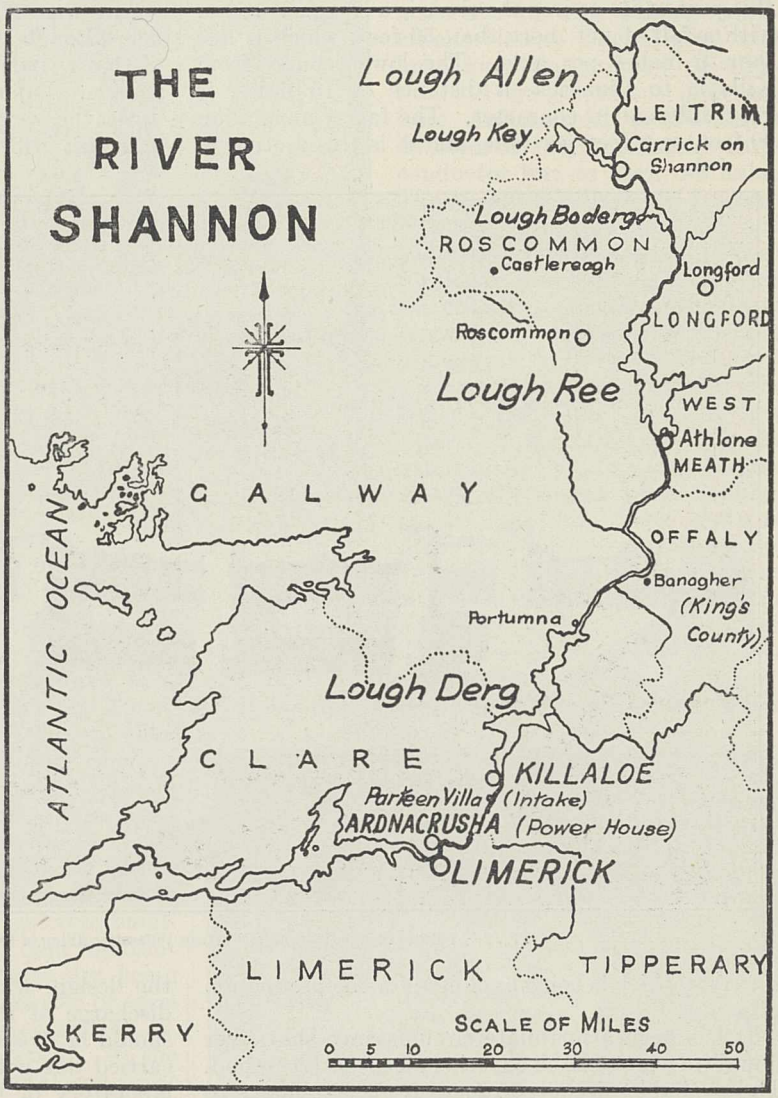


FIG. 1.—The basin of the river Shannon.

The Shannon is the longest river in Ireland, and, indeed, in the British Isles. Its total length from

[1] NATURE, Aug. 27 and Sept. 3, 1927, and July 27, 1929.

source to mouth is 240 miles; its main stream, exclusive of the tidal estuary below Limerick, is about 160 miles. The catchment area above Killaloe is some 4500 square miles, nearly one-sixth of the area of the Free State. The upper course of the main stream for a length of 125 miles lies mainly on the great central plateau of Carboniferous limestone, running through three great lakes (Lough Allen, Lough Ree, and Lough Derg) which have an aggregate surface area of 65,000 acres. For this part of its course the river is a sluggish stream with a fall of not more than 55 feet, which is less than 6 inches per mile. The lower course from Killaloe to Limerick, a distance of 15 miles, is very different in character. The fall is more than 90 feet, or 6 feet per mile, and it is this section of the river which is being exploited for the production of power.

It has been a fortunate circumstance that river flow data were to hand covering an extensive period. The available discharge ranges from 900 cusecs to 32,000 cusecs, the former being minimum dry weather flow, and the latter, discharge during flood in the winter season. With a rainfall of 946 mm., the average discharge in the lower part of the river is 8500 cusecs.

The Shannon project in its entirety envisages three successive stages of development for the whole river, involving in the later stages impounding works at the lakes in order to increase their storage capacity. As a complete account would take more space than is available at the moment, attention will be confined in this article to the first stage or "Partial Development", which is the extent of the present undertaking. This consists of works below Killaloe and comprises a weir across the river bed to maintain the water level and divert the required amount of flow into the head race, an artificial channel about $7\frac{1}{2}$ miles in length, which conducts the stream at constant level to the power station at Ardnacrusha, with its penstocks and turbines; and finally the tail race, $1\frac{1}{4}$ miles long, which conveys the discharged water back into the bed of the Shannon at a level of about 100 feet below the point of intake.

The weir is situated at Parteen Villa, $5\frac{1}{2}$ miles below Lough Derg, on a site consisting of an outcrop of hard red Devonian sandstone covered with shingle. Lake conditions will be continuous right up to the weir, so that it is anticipated that very little silt will be formed. Before deciding upon the design, which had to make provision for full discharge of the river in case the power station should be closed down, a series of experiments was carried out with various models at the hydraulic laboratory of the Technical High School, Berlin, under the supervision of Prof. Dr. Ing. Ludin. The experiments, in which the effects and characteristics of the flow of the river, taken at its maximum of 920 cub.m. per sec. (32,000 cusecs), were carefully studied, resulted in the selection of an arrangement of six openings, the two central apertures being each 10 m. wide, and two pairs of side openings, each 18 m. wide. The central openings are provided with low sills 10·9 m. below upstream water level, and the other four at first with high sills, or crests, at 2·70 m. below the same datum. Afterwards, the two 18 m. wide openings on the left bank of the river were replaced by two 10 m. wide openings with low sills

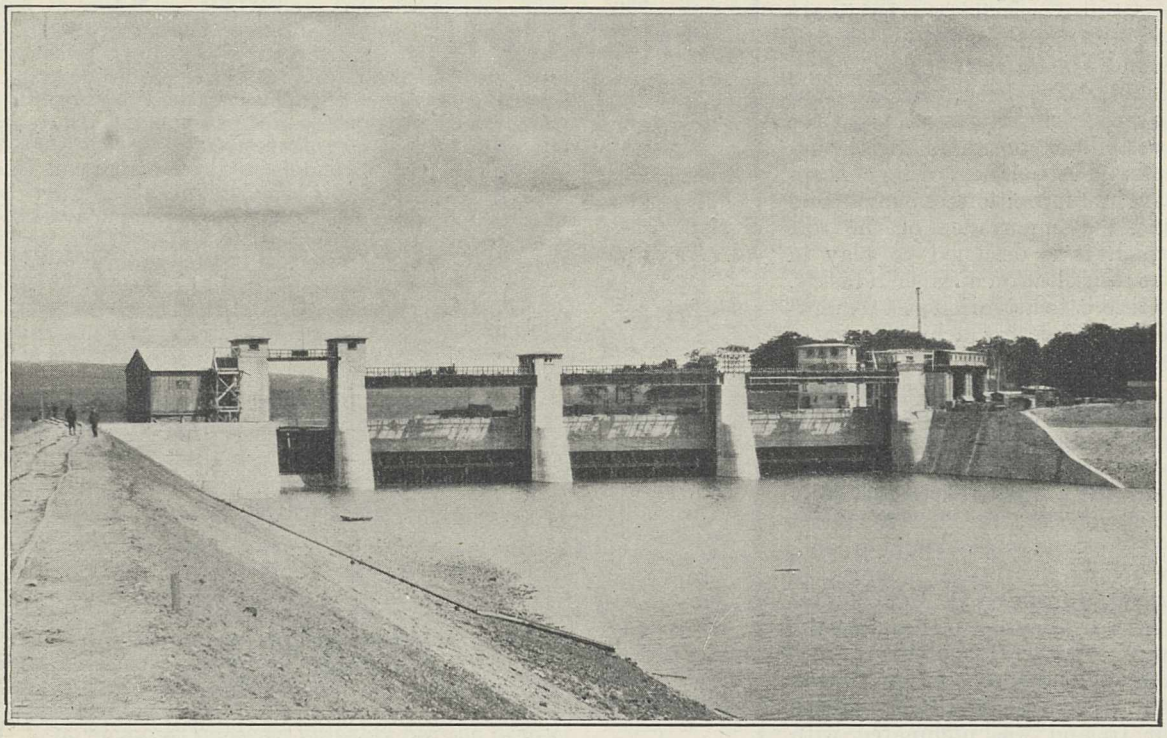


FIG. 2.—View of intake building at Parteen Villa after filling of head race had begun.

similar to the two central openings, thus making four deep sluices and two shallow sluices. A fish-pass is also provided.

The intake works at the entrance to the head race comprise three sluice gates each 25 m. wide and 5·7 m. deep, operated by mechanism from a bridge gangway, and a ship's pass 10 m. wide and 5·9 m. deep. This last is required for navigation purposes, since the old Shannon Navigation Canal will no longer be available. Under the new conditions, boats from Limerick will traverse the Abbey River, then the Shannon for a short length, then the tail race as far as the power house, where a couple of locks rising 100 feet and capable of taking 150 ton craft, will give them access to the head race, whence they can pass into the upper river channel.

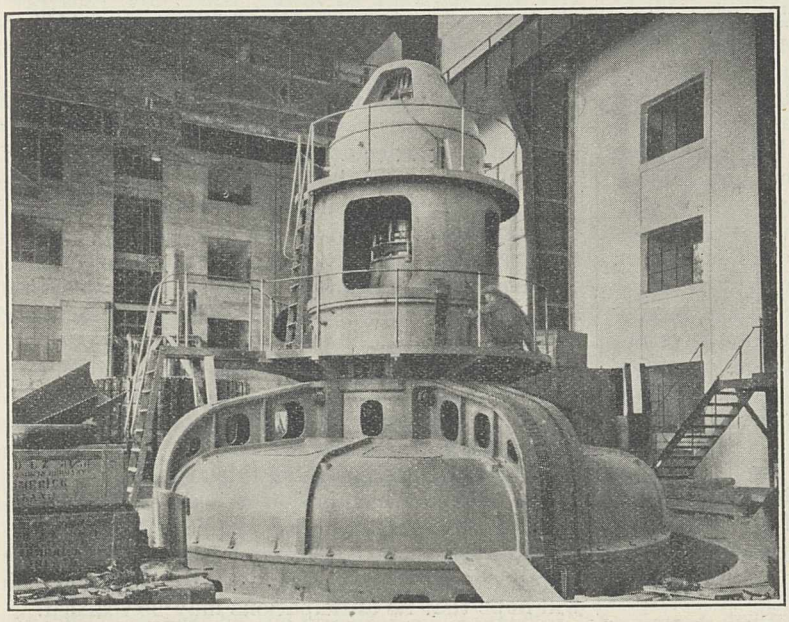


FIG. 3.—Generator I. completely erected.

The power house is at Ardnacrusha, a few miles above Limerick. It is a reinforced concrete building with six openings in the base or dam to admit the flow. For the present, only three are being utilised, and these lead to three penstocks or steel pipe conduits, each 6 m. in diameter and 40 m. long, set at an angle of 59° to the vertical. At the foot they are deflected to the horizontal and taper gradually to a diameter of 4·8 m. as they enter the special casings of the turbines. These are of the Francis type, set vertically and designed to develop from thirty to forty thousand horse-power each, according to the available head, which varies with the tidal level in the estuary, from 86 feet to 115 feet. At normal inner water and mean tide levels the head is 94 feet. The turbines are geared directly to 30,000 k.v.a., 10,500 v. generators running at 150 revolutions per minute with a power factor of 0·7. The three turbines will thus develop some 90,000 horse-power, which is considered sufficient for the demands of the Irish Free State for the present and the immediate future. At a later date, three more turbines can be installed, and the output doubled.

The intention is to supply electricity over the whole countryside by means of a network of transmission lines running north, south, east, and west. The electrical energy generated at 10,500 volts in the power station at Ardnacrusha is there 'stepped up' to voltages of 110,000 and 38,000. At these respective potentials, it is transmitted over three main sets of high tension transmission lines. The 110,000 volt lines form the primary distribution. A six conductor line runs from Ardnacrusha to Dublin, a distance of 116 miles, and a three conductor line to Cork, 59 miles. The 38,000 volt lines are designed to effect loop transmissions, and the 10,000 volt lines are to be used for local distribution, conveying the current to 10,000/380/220 volt transformer stations in towns and villages.

Current was supplied over the transmission lines for the first time in an operating sense on the evening of Oct. 21 last to practically all centres of population in the Irish Free State south of a line drawn between Galway and Dublin. The area north of Dublin will be connected up by the time this article is in print, and, finally, the capital itself within a few weeks will be included in the service controlled by the Electricity Supply Board.

It is this widespread national service which constitutes the serious economic aspect of the question. The scheme contemplates the creation of a universally electrified Free State. But Ireland, at any rate at present, is almost wholly an agricultural country; its manufactures, except in some few detached areas, are of negligible account. Is it possible to create a demand throughout the country which will reimburse the national exchequer

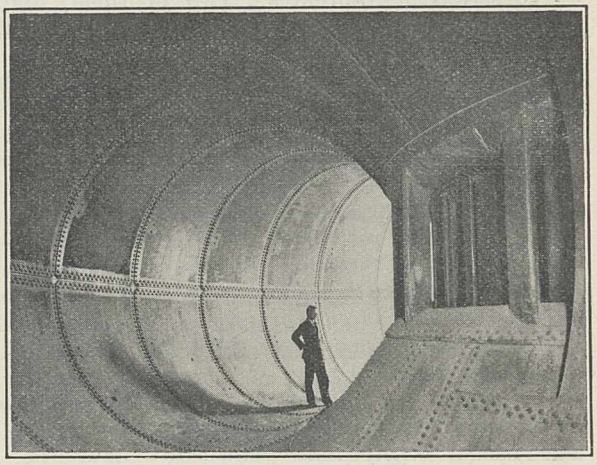


FIG. 4.—Spiral casing of a 36,000 h.p. turbine.

for the eight millions or so of expenditure on the scheme, or, at any rate, meet the capital charges on the outlay, together with expenses of operation? For the moment, the supply is greatly in excess of the demand, which depends almost entirely on consumption for civic and domestic purposes. Even in regard to domestic application, the proposition is not very attractive to the potential consumer, who, as an Irishman, is notoriously conservative in his habits and unlikely to be won over to new methods unless they are accompanied by palpable saving in expense. The idea at first entertained of supplying current to the Dublin switchboards at a cost of about ½*d.* per unit has long since been abandoned, and critics of the scheme now hint at the imposition of rates which may well be considered prohibitive except to the well-to-do householder. Dublin, indeed, will be the chief customer; at present it takes something like four-fifths of the electric current produced in the Free State, largely for its tramways. But the Dublin tramways are already suffering from the competition of motor omnibuses, and the fate of tramway undertakings in Great Britain is not reassuring for a lengthy continuance of this channel of consumption. Practically, the question resolves itself into the problem of the creation or resuscitation of Irish industries requiring large supplies of power and the establishment of manufactories throughout the country; and on this issue few will dare to speak confidently.

Considered as an engineering enterprise, the scheme is a definite success, in that it has undoubtedly been carried to the point of effective realisation, and great credit attaches to those whose duty it has been to work out the manifold technical details associated with an undertaking of this magnitude. Not least among the difficulties have been the problems of transporting and handling heavy pieces of plant and huge quantities of material in localities not altogether favourable for such purposes. The total equipment for the electrical and mechanical part of the installation weighed 34,000 tons, and about 6000 tons of this had to be shipped from Germany, unloaded at Limerick or the vicinity, and transported to the power station and weir with rather inadequate facilities for handling. Excavation operations at the power station involved the removal of a quarter of a million cubic yards of earth and 200,000 cubic yards of blue limestone rock. The concrete dam at the base of the building contains 80,000 cubic yards of concrete. Constructional operations were in the hands of the Siemens-Bauunion, associated with the Siemens-Schuckwerke A.-G., the main contractors for the entire undertaking, to whom we are indebted for the photographs accompanying this article.

The Shannon installation is a convincing manifestation of the confidence of the Free State Government in the future commercial development of the country, and all well-wishers of the Emerald Isle will hope that its anticipations may be realised.

Graptolite Centenary, 1829–1929.

By Dr. HENRY M. AMI, Laboratory of Geology and Palæontology, Ottawa, Canada.

IT was in 1829 that Adolphe Brongniart first described 'graptolites', two of them, and both from the black carbonaceous shales of the Point Levis cliffs opposite the city of Quebec, Canada. Brongniart was a botanist, and although graptolites are marine animals of the hydroid type, these two forms went the rounds of the different museums of natural history in the Jardin des Plantes, Paris, and at last were described in the *Prodrome* for 1829 as plants. Plants they do certainly appear to resemble, giving leaf-like expansions, venations, moss-like characters, etc., all of which led early palæontologists to ascribe generic and specific names to the graptolites they described —*Phyllograptus angustifolius*, *Dipl. folium*, *Tetragr. bryonoides*, etc.

Graptolites are all extinct forms of life; they abounded all over, and in the waters of the Palæozoic ocean, when that continent 'Laurentia' first exposed its gneissic and granitic mass above the level of the waters, and graptolite remains, by tens of millions, in certain strata of palæozoic age comprising part of the earth's crust which was subjected to intense folding and accompanying distortion and dislocation. The very presence of graptolites in those rock-formations has helped so materially to unravel some of the knottiest problems in stratigraphy and chronological geology which presented themselves to the human mind in many countries, that some notice of the rôle which they played might be considered timely. Thus, graptolites settled the age of the Bendigo goldfields of Australia; they settled the succession of the highly folded Shropshire and other rocks in western England, Wales, etc.; the 'Highland controversy'; the 'Quebec Group' of Logan in Canada; the 'Taconic controversy' of the New England states; and of similar problems in Scandinavia, Bohemia, France, and in the two Americas, north and south, all along that belt of Andean and Cordilleran mountain chains in which palæozoic strata, also carrying graptolites, occur from Patagonia (Argentina and Chile) to Alaska and the Yukon.

Canada is *par excellence* a paradise for graptolites; and graptolites in a remarkably fine state of preservation have attracted British and other palæontologists, whilst Hall's graptolites from Quebec are famous the world over. Canadian species are recognised in Australia, Europe, Africa, and the Americas. Sir Wm. Logan, T. Sterry Hunt, Elkanah Billings, Sir Wm. Dawson, Spencer, and others in Canada; Emmons, Vanuxém, Hall, Walcott, Weller, Ruedemann, and others in the United States, all attacked the difficult problems of the Lower Palæozoic, and graptolites had their say. The 'knights of the hammer' in Great Britain and Wales: Hicks, Ramsay, Aveline,

Jukes, Sir Archibald Geikie, Peach, Horne, Lapworth, Marr, and Watts, had many swords to cross before the true decipherings of the lower and upper zones of graptolites in the highly contorted strata were effected and orderly sequence recognised.

Of all the men, however, who threw light upon graptolites and their value as horizon-markers, there came one—Charles Lapworth—as if sent in the nick of time, who, with his assistants in Mason College and the University of Birmingham, Prof. W. W. Watts, Miss E. M. R. Wood (now Dame Shakespeare), and Miss Gertrude Elles, established a school for studies in graptolites, completely revolutionising the situation the world over. Lapworth's discovery of the 'sicula', the remains of the old free-swimming zoïd, and the part it plays in the economy of the group was a revelation. The modes of budding, the precise angles and directions taken, was a key which opened the door to rational interpretation of this remarkably useful type of life in deciphering difficulties in tectonics. Suffice it to say that Lapworth has left behind him many monuments, but his contributions to science in his systematic and satisfactory classification of the graptolites and their contemporaries, the *Rhabdophora*, his monographs in the Palæontographical Society's memoirs, together with whole volumes of as yet unpublished manuscripts on the graptolites and graptolite zones of Canada, mark him out as a great 'light', a true naturalist in the highest sense of the word. In her "Evolution of the Graptolites", also, Miss Elles, of Newnham College, Cambridge, on whose shoulders Lapworth's mantle naturally fell, has co-ordinated the development of graptolites in time with the zones of their occurrence in the earth's crust. In critical regions of great geological complexity, the very presence of a graptolite was and is the signal for great rejoicing among structural geologists.

The greatly folded strata of Scotland, western England and Wales, of the St. Lawrence Valley in Canada, or of the Hudson River Valley in the United States, or those of the Scandinavian palæozoics (where Linnarsson, Brögger, Törnquist, Tullberg, Holm, Wiman, and others have wrought), or of other parts of the earth which held many 'nuts to crack', have been the witnesses of intensely interesting discussions in which graptolites played a most conspicuous part, humble yet important types of life, the centenary of which is marked by the present year 1929.

News and Views.

HIS MAJESTY THE KING has approved of the following awards this year by the president and council of the Royal Society in respect of the two Royal medals: A Royal medal to Prof. J. E. Littlewood, for his work on mathematical analysis and the theory of prime numbers. A Royal medal to Prof. R. Muir, for his contributions to the science of immunology. The following awards have also been made by the president and council: The Copley medal to Prof. Max Planck, of the University of Berlin, for his contributions to theoretical physics, and especially as the originator of the quantum theory. The Davy medal to Prof. G. N. Lewis, of the University of California, for his contributions to classical thermodynamics and the theory of valency. The Hughes medal to Prof. Hans Geiger, of the University of Kiel, for his invention and development of methods of counting alpha and beta particles.

THE following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on Nov. 30:—*President:* Sir Ernest Rutherford; *Treasurer:* Sir Henry Lyons; *Secretaries:* Dr. H. H. Dale and Dr. F. E. Smith; *Foreign Secretary:* Lord Rayleigh; *Other members of council:* Dr. E. J. Allen, Dr. C. Bolton, Prof. A. E. Boycott, Prof. C. G. Darwin, Dr. C. G. Douglas, Sir Alfred Ewing, Prof. E. W. Hobson, Sir Frederick Hopkins, Dr. W. H. Mills, Prof. E. A. Milne, Sir Peter Chalmers Mitchell, Prof. J. C. Philip, Dr. A. B. Rendle, Mr. A. A. C. Swinton, Prof. W. W. Watts, Prof. C. T. R. Wilson.

DISQUIETING news concerning the conditions of scientific workers in Russia have again reached Great Britain in the shape of newspaper reports to the effect that Prof. S. F. Oldenburg, the well-known orientalist and the second oldest member of the Leningrad Academy of Sciences, who has been its permanent secretary for twenty-five years, has been dismissed by the Soviet Government. The reason for this extraordinary action is purely political; for Prof. Oldenburg is officially charged with concealing from the Government, on the premises of the Academy, some important documents, in particular, the original act of abdication by the Tsar, and accounts of several pre-revolutionary political organisations, thus wilfully depriving the Government of material that could be helpful in tracing counter-revolutionary plots. It is stated that a police-raid has been carried out on the premises of the Academy on the information supplied by one of the new 'red' academicians, elected by order of the Government some months ago. Several of the old academicians then protested against this order, but Prof. Oldenburg, always one of the most loyal supporters of the present Government, insisted on carrying it out to the letter. The effect of admitting politicians into a scientific institution on a party basis has soon become apparent.

IN the House of Commons on Nov. 6, Lieut.-Col. Fremantle had down the question, "To ask the Prime Minister if it is the intention of His Majesty's Government, in appointing the Royal Commission on the Civil Services, to review the status and functions of the large body of scientific and technical experts engaged in the Civil Services, with a view to the furtherance of scientific knowledge, methods, and research of those services; and if, seeing that there is no representative of science nor anyone engaged in the application of science to the needs of the community, he will consider the addition to the Royal Commission

of a due proportion of such representatives". The answer given by the Chancellor of the Exchequer was: "The Royal Commission has been appointed to inquire into and report on the structure and organisation of the Civil Service, conditions of employment of Civil Servants, and conditions of retirement from the Civil Service. Its terms of reference have been widely drawn, and it will be for the Commission itself to determine the extent to which the various subjects within the scope of the reference can profitably be reviewed. I am satisfied that the Commission as now constituted is well adapted to the purposes of the inquiry and I am not prepared to enlarge its numbers."

As often occurs in Parliamentary replies, the main point of Col. Fremantle's question is evaded. The first sentence merely summarises the terms of reference, and the second asserts that the Commission is capable of determining their scope. When, however, it is stated that the Commission "is well adapted to the purposes of the inquiry", we dissent most strongly. In the selection of its members no consideration seems to have been given to the necessity of including anyone who understands what science and research mean in the State service. Such subjects as relative rates of pay for men and women, position of ex-Service men, and so on, will no doubt be well represented in evidence and carefully judged by the Commission, because no special knowledge is required to comprehend them. We have far less confidence, however, in the ability of the Commission to appreciate the significance of the scientific and technical sides of the Civil Service and to place them in such correct adjustment with the administrative branches as is demanded by modern conditions.

By cultivating the tubercle bacillus through a long series of generations on a bile medium, Calmette, in association with Guérin, has succeeded in rendering the organism non-virulent though still possessing protective and immunising powers. A preparation containing this modified tubercle bacillus under the name B.C.G. (that is, 'Bile-Calmette-Guérin') is now being tested on the large scale as a preventive vaccine against tuberculosis both in man and in animals. According to reports which have appeared in the daily Press, Prof. Cantacuzène, of Bucharest, has carried out tests with this preparation in Rumania during the past three years, involving the inoculation of 17,535 persons, which incontrovertibly show the value of the preparation. Out of more than 1000 children living in surroundings favourable to the development of tuberculosis who had been vaccinated, not a single case had been recorded, and no ill effect had followed vaccination or re-vaccination with B.C.G.

In Australia, Prof. Woodruff and Mr. Gregory have carried out experimental work with the B.C.G. vaccine as a preventive of tuberculosis in cattle (*Jour. of the Council for Scientific and Industrial Research*, vol. 2, 1929, p. 137. Melbourne: H. J. Green). A number of calves were inoculated with amounts of B.C.G. up to 100 mgm. None of the animals showed any ill effects, the only lesion produced being a small nodule which in course of time generally disappeared. Twenty vaccinated calves were afterwards tested by intravenous inoculation of virulent tubercle bacilli to determine their resistance towards virulent infection. Six of these animals died as a result of extensive tuberculosis in about the same time as unvaccinated control animals. The remaining fourteen showed some clinical symptoms but later became normal, and on slaughter, although some lesions of tuberculosis were found, in the majority these did not appear to be progressing. It is concluded that B.C.G. vaccination confers some degree of resistance towards infection with virulent tubercle bacilli.

There has recently been issued, as a White Paper, the Report of the Departmental Committee on the Royal Veterinary College appointed last year by the Minister of Agriculture and Fisheries (London: H.M. Stationery Office, 1*s.* 3*d.* net). The Committee, which sat under the chairmanship of Sir C. J. Martin, was asked to consider and report generally on the reconstruction of the Royal Veterinary College and the probable cost, and to advise what arrangements should be made in respect of the Animal Pathology Research Institute now situated at the College. After referring to the deplorable condition to which the College has been reduced both as regards buildings and finance, the Committee states that this "has not been due to any lack of enthusiasm on the part of those few members of the Governing Body who for many years past have been sufficiently public-spirited to devote attention to the affairs of the College, or to the small staff who, despite their meagre salaries and wholly inadequate facilities, continued loyally at their work. It is nothing less than extraordinary that the College has been able, in spite of the most depressing circumstances, to turn out year by year a regular flow of qualified students." A possible way out of the difficulties was offered after the War when the Ministry made a definite suggestion to the Governors for the transference of the College to Cambridge, but the Committee reports that "For reasons which, on consideration, we are bound to say appear to us to have been adequate, the Governors could not see their way to accept the suggestion", and later, "We are of the opinion that a transfer to another city would be inimical to its best interests". The Report contains considerable detail of the course of training necessary for the scientific attainment desirable for a veterinary surgeon and the status of the veterinary profession, and passes on to deal with the accommodation and equipment needed to meet the increasing demand for adequately trained veterinarians, not only as veterinary practitioners but also by the State and public authorities at home and in the colonies.

The principal conclusions of the Committee may be briefly summarised as follows. The condition of the Royal Veterinary College is a national disgrace; it needs rebuilding and re-equipping. For reasons detailed, a rural site is undesirable. The College should be situated in the vicinity of a centre of population and should be closely associated with a university. It would be in the best interests of the College to remain in London and to secure recognition as a

School of the University of London. A building as planned could be erected on the site at Camden Town where it has been since its foundation in 1791. The estimated approximate cost of the suggested new buildings, including equipment and freeholds, may be put at £300,000. The cost of staffing and maintaining the new College would involve an additional charge on the College funds which may be roughly estimated at £21,000 per annum. It would be unwise to embark on the erection of new buildings unless such additional income were in sight. The Research Institute should remain where it is, but should be provided with a Field Station in the vicinity of London for the purpose of experimental work with the larger animals, and a sum of £25,000 should be made available for its purchase and equipment. The government of the College should be reconstituted under a revised charter. Exclusive responsibility should be in the hands of a small body of men, selected for their personal qualities and acquaintance with the needs of veterinary education.

ON Nov. 8, an important meeting was held at the Caxton Hall, Westminster, to further the fund for the establishment of a school of archæology in Iraq. It will be remembered that this was a cause which the late Miss Gertrude Bell had much at heart, as was shown by the letters, previously unpublished, written by her, which appeared in the *Times* that morning. The chair was taken by Major-General Sir Percy Cox, who read a letter of support from the Prime Minister, who was unable to be present. Among the speakers were the Archbishop of Canterbury, Mr. L. S. Amery, Lady Astor, Sir Frederic Kenyon, and Sir Francis Humphreys, the newly appointed High Commissioner, who, assuring the meeting of his sympathy, undertook to make another attempt to induce the British Treasury to contribute. Of all the tributes to the work of Miss Bell, that of Mr. Amery was most striking, informed as it evidently was by a knowledge of all she had done in Iraq, both as an archæologist and as a government officer during and after the War. Significant, too, was his expressed hope that recognition of the effect of achievement in the sphere of culture as affecting a nation's international standing might lead to the establishment of a ministry for these matters. The Hon. Secretary of the Fund, Sir Edgar Bonham-Carter, stated that the fund now stands at £6000 and that the Trustees of the British Museum have agreed to devote to the School the income from the £6000 left by Miss Bell in her will. It is hoped to raise a sum of £44,000.

SOME points of general interest to archæologists were put forward by Sir Rennell Rodd when presiding over the annual meeting of the subscribers of the British School of Archæology in Athens, which was held in London on Nov. 5. Pointing out that our knowledge of the ancient world is growing rapidly, and that, moreover, there is so much to be done that it is beyond the resources of a single nation, he suggested that some projects of archæological research might be made a matter of international effort. He considers that this might be a function of the Committee for Intellectual Co-operation of the League of Nations. He went on to indicate as a further activity the identification and classification, according to priority of interest, of sites for ultimate exploration and protection. While opinion may differ as to the suitability of this Committee as at present constituted to undertake the work, there can be no two opinions that international organisation and co-ordination are greatly to be desired. Those who know something of the inner workings of archæological exploration since the War are well aware that it has been hampered and also that effort has been wasted through lack of such international co-operation. We hope the matter may not be allowed to rest here.

WE have received from a correspondent, W. W. L., a letter in which, referring to notices of works on witchcraft which have appeared recently in NATURE (see especially Oct. 5, p. 521, and Nov. 2, p. 678), the question is raised as to the attitude of modern writers on this subject. It is suggested that they assume tacitly that European religion and modes of thought are superior to ' pagan ', thus taking up the attitude of the early Jesuit writers and at the same time ignoring the results of modern research, which has shown how far Christian symbolism, ritual, and dogma were pagan and taken over from other religions. Our correspondent evidently has in mind references which have been made from time to time to the question of the existence of witchcraft as an organised religion opposed to the Church. It should, however, be obvious to those who have followed the recent literature that to seek for evidence of something more in witchcraft than either a mere ' survival ' or hysteria and delusion does not necessarily involve either acceptance of the view of the medieval, or later, Roman Church or ignorance of the primitive or pagan elements in Christianity. Miss Murray, in " The Witch Cult in Western Europe ", and other writers, working on anthropological lines, have built up the theory of a fertility cult which survived among the people. It extended to some of the ruling classes, who used it for their own ends ; for example, Bothwell and Gilles de Rais. Miss Murray thinks that such individuals as these were the leaders who embodied the fertility god in an organised religion. In other words, Miss Murray thinks she has found the real facts which underlie the accusations of the Church. In a sense, then, she is ' orthodox '. If from time to time our reviewer has referred to evidence which might be held to support her view, it is rather because he must confess himself as, on the whole, a sceptic.

AT a meeting of the Section of Psychiatry of the Royal Society of Medicine, held at the Wellcome Historical Medical Museum on Tuesday, Nov. 12, the president, Sir Robert Armstrong-Jones, gave an address on superstition. Superstition, he said, is the encroachment of faith on the rights of reason. It is most often founded on ignorance and it is difficult to explain it among educated people. Psychologically, it is suggestion based upon the instinct of fear, although curiosity and the instincts of reverence and awe enter into it. In the sixteenth and seventeenth centuries it was heresy not to believe in witchcraft. Omens were

sought for everywhere, in the flight of birds, in the power of numbers, in rivers, and in the heavenly bodies. Many who admitted the influence of witchcraft were undoubtedly insane and were the victims of cerebral disorders, but were regarded as in the control of and possessed by demons. Some of those possessed suffered from a form of insanity described as *folie à deux* or communicated insanity, which spread like an epidemic of mental influenza all through Europe. In healing, the help of precious stones was elicited. There were healing stones—some with holes for the patient to pass through and some to be worn as talismans, or carried on the person as amulets or charms. The Royal 'touch' also had healing virtues. Probably the expectation and pleasurable hope of cure helped to raise the bodily resistance to disease by increasing the activity of the vital functions. Ancient customs and maxims have to-day lost their cogency, and Pavlov's experiments, with other researches, have shown that an idea can cause changes in the blood just as the secretions of the ductless glands can vary ideas. With the passing of superstition, the treatment of insanity has been revolutionised.

IN a recent lecture at Oxford, General Smuts spoke hopefully of the settlement of areas in tropical Africa by the races of Europe. In this connexion the conclusions on acclimatisation reached by Prof. R. de C. Ward, after a prolonged study of the evidence, are of interest. Prof. Ward discussed the subject in a lecture which is published in part in the *Scientific Monthly* for August 1929 and in full in the *New England Journal of Medicine* for Sept. 26, 1929. Prof. Ward pointed out that true acclimatisation concerns not the individual alone nor even one generation. The real problem is the maintenance through generations of the physical, mental, and moral standards of their former homes; in short, the maintenance of civilisation on a plane no lower than that of the home countries. This entails the continuance of a birth-rate higher than the death-rate. Prof. Ward concludes that though many tropical diseases may be fought and mastered, the ill-effects of the climate still remain. He foresees life in the tropics becoming more comfortable as well as safer for the white race, but maintains that in the light of our present knowledge true acclimatisation is and will remain impossible.

SINCE the publication of Dr. F. Sherwill Dawe's letter, "The Comma Butterfly in England", in NATURE of Oct. 26, 1929, p. 653, we have received other communications on the subject. Mr. J. Evershed, Highbroom, Ewhurst, Surrey, states that he knew the comma butterfly in North Wales so long ago as 1874, but during a motor tour, including the Wye valley, towards the end of July of this year, he did not see a specimen. On Sept. 11, however, he discovered a perfect comma in his garden on the south-east slope of Pitch Hill. Mr. Ernest J. Lay, Jesus College, Oxford, records that he has taken specimens of the comma butterfly in recent years, and notably in Wychwood Forest on Easter Monday 1927. He has also taken it in the north of Berkshire, and about the middle of August 1928 and 1929 in Dorset near Lyme Regis. Mr. G. T. Harris, Splatt Hayes, Buckerell, Honiton, Devon, refers to the appearance in his garden during September 1928 of two commas in perfect condition.

ONE of the problems of modern life which is becoming more and more important is the invention of methods to diminish the noise sometimes emitted by machinery and electrical apparatus. It is necessary, however, if scientific progress is to be made, to be able to measure the 'noise' emitted by a machine. The measurement of 'street noise', for example, has been spasmodically attacked by scientific workers for many years with the object of fixing limits to these noises and securing definite evidence in any particular case of its magnitude. Some progress seems now to have been made. In a paper read to the Institution of Electrical Engineers on Nov. 7, B. A. G. Churcher and A. J. King described experiments that they have carried out on the measurement of the noise emitted by stationary machinery. This is a necessary preliminary to more complete experiments on running motor vehicles. A car, for example, might be driven round a circular track at a constant speed with a central microphone always pointing towards it. In this way, noise 'pass limits' could be fixed and border line cases judged on a definite quantitative basis. The apparatus used by Messrs. Churcher and King consisted of a microphone, an amplifier, and an analyser. As sine wave generators giving frequencies up to 2000 cycles per second were available, the apparatus could be accurately calibrated. König's formula was utilised, as experiments with Rayleigh's disc shows that it is accurate. The dimensions of the microphone were taken into account, experimental results having been obtained in the non-reflecting room of an acoustical laboratory. Numerical examples were given of tests on a small motor, on a large turbo-alternator, and on a horn type loud speaker. An attempt has also been made to assess total noise when several tones are present.

DAMAGE caused to wild life by the rapid traffic of motor-cars has been the subject of several cursory investigations. The latest is a report by a member of the State Department of Agriculture of California, who, according to the Automobile Club of Southern California, counted 255 dead bodies during a trip of 632 miles. Twenty-nine species were represented, and the animals included 43 mammals, 144 birds, 40 reptiles, and 28 domestic fowl. Though the numbers seem large, they are but an insignificant fraction of the wild life in the region traversed, and the motor-car can scarcely be said yet to have gained a place in the ranks of the species exterminators.

THE Report of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne for 1928–29 marks the passing of one hundred years since the Society was founded. This effort of William Hutton, the geologist, a leader among the founders, has had great influence in turning the characteristic regard of the people of the north-east for Nature, into scientific channels. One of the most important of the scientific outlets has been the establishment and

upkeep of the Hancock Museum, and the report before us shows that there the year has been marked by good progress. Rearrangement of the mammal and ethnographical exhibits has been completed, and a magnificent bequest by the late Abel Chapman adds to the collections a fine series of big game heads, birds' skins and eggs, together with a sum of £500 for their proper exhibition. The membership of the Society shows a slight decline on the year, at 596, but the local interest aroused by the centenary celebrations ought to give a fillip to the Society's interests. It is strange that the North-East Coast Exhibition, instead of attracting fresh visitors to the Museum, is said by the report to have been responsible for a slight falling off in numbers.

THE project of a tunnel under the Straits of Gibraltar to link the railways of Europe and Africa has reached the stage of preliminary investigations on the Spanish side. The scheme, in which the Spanish government is interested, was proposed by Lieut.-Col. P. Jevenois. It was recently expounded in an address ("El Tunel del Estrecho de Gibraltar") to the Real Sociedad Geografica by Senor D. Rafael de Buen, of the Spanish Institute of Oceanography. The narrowest part of the straits is eight miles wide, but the depths there are great and the nature of the rock precludes the possibility of boring. The site that has been chosen lies some eleven miles west of Tarifa at the broader western end of the straits, where a preliminary shaft has been sunk. The proposed route follows a curve to the south-west in order to avoid the deeper channel of the narrows and terminates near Punta Altares in the Spanish Protectorate. A tunnel on that course would be a little more than twenty miles in length and would dip at its lowest point to 1500 ft. below sea-level. From the preliminary shaft it is proposed to explore by means of sound waves the consistency of the rock. At the same time a detailed oceanographical exploration of the straits is to be undertaken.

THE annual report of the executive council of the National Institute for the Blind for the year ended March 1929, recently issued, is a publication calculated to stimulate interest in work for the blind. The task of supplying sightless readers with books is undertaken by the Institute, and the Braille presses—capable of printing 24,000 sheets an hour—have been working to capacity, and blind readers now have at their disposal works in almost every class of literature. When special books on a particular subject are required, for example, by a student, a band of voluntary workers undertake the task of transcribing by hand into Braille. Maps, music, games, and writing and other appliances are also issued by the Institute. It is to be regretted that the income for the year is less by £7000 than that of the previous year, and additional donations and subscriptions are needed to continue, and if possible expand, the present work.

IN the November number of *The Realist*, under the title of "Meteorological Science To-day", Sir Napier Shaw contributes an interesting review of the general history of meteorology from the earliest known times up to to-day. This article has all the breadth of outlook and refinement of expression that we have been accustomed to expect from the former director of the British Meteorological Office, and, as is the case with nearly all his writings, the reader is left with the feeling that meteorological research is worth while and is leading somewhere. The following landmarks in meteorological history are noted: (1) The appearance of Aristotle's "Meteorologica". (2) Toricelli's invention of the barometer. (3) The first synoptic weather maps about the middle of last century. (4) The organised study of the upper air by means of kites and balloons. (5) The recent extension of upper air research to frequent direct personal observations, made possible by the rapid progress of aerial navigation.

SIR NAPIER considers that of these five landmarks the third is the most important, but beyond an extension of the area covered by such maps and an increase of their accuracy and of the amount of detail that they include, they have not advanced much in nearly eighty years, and we are asked to consider carefully whether the maps that the meteorologist draws are the most informing that can be drawn. It is pointed out that Prof. V. Bjerknes and others have for many years doubted it, and would prefer to work with lines of flow at the surface, with lines of equal real pressure—as distinct from the imaginary pressure obtained by reduction of real pressure to sea-level—and with lines of equal density, which give information about the energy of the air.

SIR NAPIER SHAW'S hopes of more rapid advance in meteorology, and presumably in weather prediction, appear to centre round the possibility of effective use in synoptic weather maps of the 'entropy' of the air. Followed sufficiently far back, we doubtless come to communication of heat by radiation as the initial factor controlling weather processes, and as the entropy of any element of the atmosphere cannot be changed without an actual transfer of heat, we have here a quantity that is clearly of fundamental importance in the scientific treatment of the thermodynamics of the atmosphere. But, as the author points out, entropy is not everybody's toy, and he does not expect the appearance of the Kepler of atmospheric movements until much more has been done to foster meteorological study in the universities.

THE Croonian Lecture of the Royal Society will be delivered on Thursday, Nov. 21, by Prof. J. P. Hill, professor of embryology at University College, London. Prof. Hill will take as his subject "The Developmental History of the Primates".

PROF. H. FREUNDLICH, of the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry, will deliver the second Liversidge Lecture of the Chemical Society on Dec. 12, taking as his subject "Surface Forces and Chemical Equilibria". The lecture will be given in the hall of the Institution of Mechanical Engineers.

AT the anniversary meeting on Nov. 5 of the Mineralogical Society, the following officers were elected:—*President:* Dr. G. T. Prior; *Vice-Presidents:* Sir John Flett, Dr. G. F. Herbert Smith; *Treasurer:*

Mr. F. N. Ashcroft; *General Secretary*: Mr. W. Campbell Smith; *Foreign Secretary*: Dr. J. W. Evans.

AT the annual general meeting of the Cambridge Philosophical Society the following elections were made:—*President*: Mr. G. Udny Yule; *Vice-Presidents*: Prof. H. Lamb, Prof. S. J. Hickson, Prof. A. Hutchinson; *Treasurer*: Mr. F. A. Potts; *Secretaries*: Mr. F. P. White, Mr. W. B. R. King, Dr. J. D. Cockcroft; *New members of the Council*: Mr. E. B. Moullin, Dr. F. H. A. Marshall, Mr. J. A. Ratcliffe, Dr. E. K. Rideal.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant works manager of the Metal and Steel Factory, Ishapore, near Calcutta (an Indian Ordnance Factory)—The Secretary, Military Department, India Office, S.W.1 (Nov. 23). A lecturer in botany in the University of Edinburgh—The Secretary, The University, Edinburgh (Nov. 26). Assistant lecturers in, respectively, electrical engineering and commercial subjects at the Belfast Municipal College of Technology—The Principal, Municipal College of Technology, Belfast (Nov. 26). An Andrew Simons research scholar in science at the University College of the South-West of England—The Registrar, University College of the South-West of England, Exeter (Nov. 29). A temporary assistant lecturer in geography in the University of Manchester—The Registrar, The University, Manchester (Nov. 30). An assistant lecturer (agricultural engineering) in the Department of Agriculture of the University of Leeds—The Registrar, The University, Leeds (Dec. 4). A lecturer in electrical engineering at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 6). An assistant director of examinations under the Civil Service Commission—The Secretary to the Civil Service Commissioners, 6 Burlington Gardens, W.1 (Dec. 6). A professor of physics in the Transvaal University College—The Principal, Transvaal University College, Pretoria, South Africa (Jan. 23). A Martin White professor of sociology at the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 24). A marine biologist in the Coastguards and Fisheries Service of the Egyptian Government—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. A lecturer in mathematics at the Warrington Training College, Liverpool—The Principal, Warrington Training College, c/o St. John's College, Battersea, S.W.11. A lecturer in mathematics at the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan. A full-time lecturer in the Electrical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. An appointment on the technical staff of the Imperial Bureau of Animal Health—The Deputy Director, I.B.A.H., Veterinary Laboratory, New Haw, Weybridge. A county veterinary officer under the Somerset County Council—The Clerk of the County Council, Ashcombe House, Milton Road, Weston-super-Mare.

Our Astronomical Column.

Apparent Recessional Velocity of Distant Objects.—In view of the large spectral shifts found at Mt. Wilson and elsewhere for the spiral nebulæ, which appear to increase with distance, Prof. A. Belopolsky examines in *Astr. Nach.*, No. 5662, how far the spectra of stars in our own sidereal system exhibit the same phenomenon. He has divided the stars into three groups according to spectral type: 1000 stars of types *FGK*, the mean distance of which was 50 parsecs, gave a mean recessional speed of 0·1 km./sec.; 700 stars of type *A-M*, mean distance 100 parsecs, gave a speed of 1·4 km./sec.; 300 stars of type *B*, mean distance 200 parsecs, gave a speed of 5 km./sec. Since the spirals indicate a recession of 500 km./sec. at a million parsecs distance, the values found for the stars are too large in proportion, but they are in the right direction. It had already been noticed by others that the *B* stars show a general recession (the so-called *K* term); the value given above is probably too large to be wholly due to the 'distance-effect'. If Belopolsky has correctly estimated their distance, the effect, if it varies as the distance, would be only 0·1 km./sec., instead of 5.

A Catalogue of Dynamic Stellar Parallaxes.—It has long been the custom for computers of the orbits of binary stars to give at the conclusion of their work a statement of the parallax of the system on the assumption that its mass was equal to that of the sun, or alternatively that each component was of that mass. But until recently so little was known of stellar masses that the resulting parallax was not regarded with any confidence. However, since the recognition of the close correlation between a star's mass and its output of light, and the publication of Prof. Eddington's curve of the one as a function of the other, it was recognised that this is really quite a powerful method of determining stellar distances.

No. 930 of the *Astronomical Journal* contains a catalogue of the dynamical parallaxes of 1777 double stars by Prof. H. N. Russell and Charlotte E. Moore; Eddington's curve is used for calculating the mass. Since it is the cube root of the mass that enters into the parallax, it is clear that approximate values of the mass suffice to give parallaxes of fair accuracy.

The method can be applied even where the data are insufficient for an orbit, provided the curvature of the relative path can be measured; Prof. Russell considers that even in these cases the parallax is comparable in accuracy with the spectroscopic one; where a good orbit can be deduced, the dynamic parallax is entitled to considerable weight. 136 of the stars in the catalogue have had orbits computed; since those with large parallaxes were already used in deducing Eddington's curve, naturally their parallaxes reproduce the accepted values. The values given for Castor and Gamma Virginis are 0·081″ and 0·080″. Among the stars lacking computed orbits the following may be quoted: Polaris, 0·0041″; Aldebaran, 0·049″; Gamma Leonis, 0·021″; Alpha Herculis, 0·0057″; 61 Cygni, 0·36″. The results are given to two significant figures whether the parallaxes are large or small. The relative uncertainty does not greatly increase with the distance; but it does so to some extent, since distant objects have shorter arcs and the curvature is more difficult to measure.

Research Items.

A 'Basket-Maker' Site in New Mexico.—An unnamed village in Chaco Canyon, New Mexico, discovered by the Pueblo Bonito Expedition in 1926 while investigating Pueblo culture, was explored by Mr F. H. H. Roberts in 1927 (*Bull.* 92, Bureau of Amer. Ethnol.). It obviously belonged to a cruder and less highly developed culture than that of the Pueblos. From the proximity of a Navajo sun symbol and the customary mode of reference of the Navajo workman to "sun picture place", the site has been called "Shabik'eshchee Village". The village as uncovered consisted of the ruins of 18 dwellings, a kiva, court, and 48 storage bins. The houses had been substantial, though crude. They consisted of a pit, circular, oval, or rectangular, roofed with a pole, brush, earth, and plaster superstructures. The earth walls of the pit had been covered with plaster or stone faced, in the latter case the stone being covered with plaster. Four posts supported the superstructure, against which had rested small poles with lower ends embedded in the earth and forming the sloping upper wall of the house. Near the centre of the house was a fire-pit, and near by was a small circular hole, which is thought to be analogous to the mythical place of emergence of the ancestors from the under to the upper world of the earth. Most of the houses had a doorway from the main room opening on to a passage or antechamber. Not all the houses were contemporary, and there appears to have been a break in occupancy after a conflagration in the ceremonial chamber. The methods of construction show signs of a transition period. The material culture is represented by objects of pottery, bone, stone, and a little shell. The pottery is crude and is of grey, brownish white, white, or orange-red. Ornamentation is confined to painted decoration on bowls and table-ware. The patterns are simple and suggest basketry. The bone implements show considerable variety—awls, punches, bodkins, and scrapers. There was no definite cemetery. Bodies were placed on the back, head to west, with knees flexed. Mortuary offerings were found in three graves only. The inhabitants belonged to a long-headed group, and agree in physical type with that of the Basketmaker period.

Unusual Northward Movement of Marine Life in Pacific Ocean.—During the season of 1926, certain kinds of fishes and marine invertebrates occurred well north of their usual range on the north-west coast of North America. Amongst the latter were specimens of *Velella*, and the former included American species of sun-fish, anchovies, hake, Jack smelt, and others. By far the most telling evidence of northern movement, however, was furnished by the fishery statistics of the albacore. Carl L. Hubbs and Leonard P. Schulze show that whereas in normal years the fishing off southern California yields from 13 to 29 million pounds of albacore, that off Central California once gave 5000 pounds, and generally produces nothing (*California Fish and Game*, vol. 15, 1929; p. 234). In 1925, however, the latter fishery yielded roughly 450,000 pounds, and in 1926, 118,000 pounds. The authors think that the unusual northward occurrence of these southern forms of marine life along the Pacific coast in 1926 may be attributed to the warmth of the preceding winter and spring, following the rather warm summer of 1925. The southern forms which had wandered northward in 1925 were probably able to maintain themselves to an exceptional degree over the unprecedentedly warm winter of 1925–26, and then rapidly spread northward during the spring, when the ocean temperatures were verily summer-like. The occurrence has some resemblance to the drift of warm Atlantic water which in certain years brings representatives of the Atlantic fauna into the northern North Sea.

Parasites and Periodicity of Locusts.—The part played by viviparous flies in regulating the periodicity of locusts was discussed for the first time by an American entomologist, Riley (1878). It was assumed that infected locusts undertake lengthy migrations to get rid of these parasites and thus preserve the continuity of the species. Although this problem has never been made the subject of really serious study, this view was supported by several other authors. A Russian entomologist, N. G. Olsoufiev, has now made a careful study of the balance of the parasites and hyperparasites of *Locusta migratoria* L. (*Reports on Applied Entomology*, **4**, No. 1, Leningrad, 1929). As a result of researches extending over two years, and in the course of which 14,387 specimens of locusts were dissected, he comes to the following conclusions: The part played by parasites is of no significance to dense and large migrating swarms of either adults or hoppers, owing to a low percentage of infection, and the parasites can act as efficient controlling agents only in cases of swarms that have been thinned out by other agencies. During the period of oviposition, a high percentage of infection of female locusts by flies may be observed (up to 48 per cent). This fact, however, has no practical significance, since the presence of parasites diminishes the productivity of females by not more than 14 per cent. The error of ascribing to parasites the part of principal stimulating agents in the migration of locusts is shown by the fact that many species of Acrididæ regularly parasitised do not migrate at all. Again, *Blœsoxipha lineata* is specially adapted for parasitising flying locusts. Finally, the migrations do not enable the locusts to escape the parasites, for the latter migrate with them. The viviparous flies cannot be regarded, therefore, as a factor regulating the periodicity of outbreaks of *Locusta migratoria* L., and the problem of periodicity should evidently be approached from other viewpoints.

Pelagic Freshwater Cladocera.—Dr. R. Woltereck, who has worked much on the Cladocera of lakes, gives a long survey of researches relative to specific environment, zoning and migrations, and the significance of certain body outgrowths in the freshwater forms (*Biologische Zentralblatt*, Bd. 48, Heft 9, 1928). The natural food of these Cladocera is the nannoplankton, especially algæ. Specifically different races live in different lakes, and each lives in a specialised zone which may be defined both vertically and horizontally, making diurnal migrations to a definite extent. Various factors influence the migrations—phototropism, geotropism, temperature, the chemical nature of the water, sex, and age; also the food supply is probably to a certain extent the cause of such movement. Thus it is important to study the migrations, if any, of the consumed as well as of the consumers, and, as the present author points out, much more research is needed in this direction. The function of certain outgrowths in these freshwater Cladocera has been the cause of much disagreement among the various workers. Short-headed Daphnias live in the deeper water layers, the helm-bearing races in the shallower and surface layers. The helm and the horns in certain *Daphnia* and *Bosmina* species, according to some authorities, serve for suspension organs;

according to Dr. Woltereck they are stabilising and steering organs, which are usually present in addition to suspensory outgrowths. In his opinion, for example, the feathery bristles of the antennæ of *Daphnia* serve for suspension, the spine and helm for stabilising, the latter also for steering. We might quote as an analogous case the dorsal and rostral spines in the crab zœa, which have been shown by Wheldon to be used for directive purposes. In the last part of the paper the author discusses the relations between food algæ, Cladocera, and young fishes. The Cladocera which eat the nannoplankton algæ are themselves eaten by the young fishes and a definite system is established, the numbers of each being kept at a certain average; any alteration in numbers in any part causing a corresponding alteration in the rest.

Life-histories of Marine Trematodes.—Some very suggestive notes are made by Mr. O. R. McCoy on the hosts of marine trematodes (Year Book No. 27 of the Carnegie Institution of Washington, 1928, "Studies on Marine Trematode Life-Histories"). Little is known about the final and intermediate hosts of the many cercariæ described chiefly from the marine molluscs in the neighbourhood of the Tortugas Laboratory. In spite of the work already done, mainly by Prof. E. Linton, on adult trematodes, the author of these notes remarks that probably nearly half the fish trematodes of the Tortugas are still undescribed, many of them occurring in the small reef fishes. Feeding some of these latter with cercariæ from the molluscs resulted in many of them encysting in the fishes. Ten species of cercariæ were obtained from *Astrœa americana* and *Cerithium litteratus*, the commonest gastropods on the reef. Eight of these were already known, two are new. Experiment failed to persuade any of these to encyst in invertebrates, but four species entered the small reef fishes. One from *Astrœa*, designated Cercaria *A*, developed in the gray snapper *Neomœnis griseus* into the trematode *Hammocreadium mutabile*. This worm was found to encyst in small fishes known locally as 'grunts', 'snappers', 'slippery dicks', and 'parrot fish'. These small fishes were fed to gray snappers, and the growing trematode identified in the intestine and pyloric cœca. The life-history of *Hamacreadium mutabile* is thus—first host *Astrœa americana*, intermediate host the small fishes mentioned above, final host the gray snapper. Three other cercariæ were found to penetrate small fishes.

A New Terrestrial Amphipod.—*Orchestia kokuboi* is the name given to this interesting new species described by Mr. Maruzô Uéno (*Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol. 4, No. 1, fasc. 1; 1929). Four females and one male were collected by Prof. S. Kokubo on a hill in Yu-no-shima, a small island off Asamushi (latitude about 40° 70′ N.). "This spot is far above the tide-marks; and the animals were found living in burrows in soft damp soil under dead leaves." The species closely resembles *Orchestia grillus* but with distinct differences in antennules, gnathopods and other features, especially in its long antennules, and in its gnathopods it resembles *Orchestia humicola*, another terrestrial Japanese amphipod, which is, however, much smaller and differs from the present species in other features also. *Orchestia kokuboi* is of fairly large size, measuring 18 mm. in body length in the male, 17 mm. in the female, exclusive of the antennæ.

Asphalt Emulsions.—The use of asphalt emulsions in bituminous road construction has been greatly extended in recent years, both in Europe and America. Although ordinary dry oils and asphalts are suitable under many conditions, they sometimes lack capacity to spread over wet surfaces or to adhere readily to broken stone. The problem is obviously accentuated by wet weather, and operators have been forced to recognise the claims of emulsified dressings. The asphalt emulsion generally employed is that of a fine suspension of the bitumen in water. It is found that the asphalt content of bituminous sands, for example those of Alberta, western Canada, is particularly susceptible to emulsification, so that with the growth of this process considerable impetus to this department of the oil industry should result. The asphalt emulsion is far more easily handled on wet surfaces than on dry; it is rapidly spread, and strongly coherent. Ultimately the water content evaporates, leaving behind a rigid asphalt coating, said to be as firm and lasting as if ordinary dry bitumen had been utilised. The advantages of using emulsions in this way are many, chief of which is the fact that the materials are fluid at ordinary temperatures whatever the viscosity or hardness of the asphalt employed in the first place; heat treatment is dispensed with, and thus one of the most objectionable factors to the commercial use of asphalt is overcome. Further work on these emulsions has shown that they are also valuable for water-proofing concrete structures; the question of adherence between asphalt and concrete is one of importance, but the main difficulties have been concerned with 'green' or damp concrete, on which it has always been hard to get adequate spread of the bitumen. The emulsion does away with this difficulty, and, as K. A. Clark shows in his recent report on the "Bituminous Sands of Alberta" (*Sci. Ind. Research Council Alberta*, No. 18, part 3, 1929), it can be applied cold just like paint, any number of coatings being feasible.

Origin of Helium-rich Natural Gas.—Helium is remarkable for its unusual facility in diffusing through glass and other materials. Williams and Ferguson have shown that at 500° C. the permeability of quartz-glass to helium is nearly thirty times that to hydrogen. R. C. Wells has pointed out the application of this and similar results to the problem of the origin of helium concentrations in natural gas (*Jour. Wash. Acad. Sci.*, Sept. 19, 1929). He writes, "We may suppose that when deeply buried rocks become heated, as they evidently have been during certain geologic epochs in some localities, helium would have a particular and special tendency to escape at one stage of the heating, say 200°, and if then collected and trapped by overlying impermeable barriers in a cooler environment, would constitute helium-rich gas". Wells directs attention to another process that similarly contributes to helium concentration. He has investigated the diffusion of hydrogen and carbon dioxide through the pores of ball-clay, and finds, in accordance with the principles first established by Graham, that in every mixture the first fraction that passes through is richer in hydrogen than the original mixture. He suggests that it is reasonable to suppose that helium will behave like hydrogen and that the process of diffusion is worthy of consideration as a preferential means of concentrating helium. Thus for the first time a reasonably satisfactory explanation is forthcoming for the presence of relatively abundant helium in natural gases from mines, springs, and earth-vents generally.

The System: Leucite-Diopside.—With the thermal investigation of mixtures of pure leucite and pure diopside, Bowen and Schairer have made a beginning in the theoretical study of the leucite-bearing igneous rocks (*Amer. Jour. Sci.*, October 1929, pp. 301-312).

They find the system to be of the simple eutectic type, both liquidus curves, however, being convex downwards instead of upwards, as is more usual. The eutectic is at 61·5 per cent diopside and the temperature is 1300° ± 2° C. Natural leucitites are much more complex and will be completely liquid at considerably lower temperatures. They will, moreover, on account of a notable content of soda, be affected to some extent by the complex reaction relations exhibited in the diopside-nephelite system. The inversion temperature of pure leucite is found to be 603° C. Grossmann has given that of Vesuvian leucite as 620° C. We have here a good indication of the minimum temperature of crystallisation of natural leucite, since the latter has always passed through the inversion. The internal strains set up during this passage may be a material aid to the thorough transformation of leucite to the intergrowth of orthoclase and nephelite known as pseudoleucite.

Natural Gas.—In the October issue of the *School Science Review*, Mr. J. Kewley, of the Asiatic Petroleum Company, gives an interesting account of natural gas from petroleum wells, which consists essentially of hydrocarbons of the paraffin series, methane predominating. This is produced in enormous amounts, and is not always utilised. At present 32 million cubic feet per day are uselessly burnt in Persia. New applications of the gas are, however, being found. In the United States this gas is supplied for heating purposes to industry and for making carbon black, which is obtained by the incomplete combustion of the gas and is used as a pigment and in the manufacture of motor tyres. The modern tyre contains about 30 per cent of carbon black incorporated with rubber, and this very greatly increases its resistance to wear. Another use of the gas is the extraction of volatile liquid constituents from it for blending with motor spirit. Ten per cent of this now comes from the natural gas. The very volatile constituents are stored in spherical tanks of large capacity, up to 1000 tons, called Horton spheres, and Mr. Kewley states that there is some prospect of the introduction of these tanks into Great Britain for the storage of coal gas under pressure. He considers that there is likely to be a considerable utilisation of natural gas in making synthetic chemical products, such as formaldehyde, alcohols, and acetone, for use in the rapidly developing cellulose paint and other industries.

Philips' Handy Theodolite.—This is a useful little instrument designed by Mr. G. C. Sherrin and made by Messrs. George Philip and Son, Ltd., and sold in a leatherette case at 17*s.* 6*d.* It consists of a strong moulded ebonite disc 4½ inches in diameter, around the centre of which moves a sighting arm with a pin-hole and V notch on both vertical ends. The rim of the disc is graduated to degrees. A link, attached to the circumference, allows the instrument to be held vertically for taking levels or in measuring heights. A movable counterweight makes it easy to adjust the centre of gravity. When the instrument is to be used horizontally, it stands on three firm feet or it can be screwed on to a stick or tripod by means of a simple ball-and-socket joint which is provided. The theodolite appears to be strong and well made and should prove useful in school work or any purpose connected with survey, levelling, measuring areas, etc., where extreme accuracy is not required.

Bunsen Flames of Unusual Structure.—The ordinary Bunsen flame consists, as is well known, essentially of two cones, the chemical reactions in which were investigated some time ago by Prof. Smithells. In a paper in the *Bureau of Standards Journal of Research* for July, F. A. Smith and S. F. Pickering describe some interesting experiments on flames of mixtures of oxygen or air with acetylene and propane burning in secondary air. The paper is accompanied by beautiful plates showing photographic reproductions of the flames, and these show clearly that in some cases complex structures make their appearance. When secondary air is excluded, the primary zones of some of the flames show a polyhedral structure. Flames having 3, 4, 5, 6, and 7 sides were observed, which rotated under some conditions and remained stationary in others. The number of sides is a function of the size of the burner tube and of the composition of the gas mixture.

Effect of Water on Chemical Reactions.—It has been known for some time that certain chemical reactions take place very slowly, if at all, in the absence of traces of water. The earlier experiments of Dixon and of H. B. Baker provided several interesting examples of this phenomenon. For example, a well-dried mixture of carbon monoxide and oxygen does not explode with a weak electric spark, and dry ammonium chloride does not dissociate on heating. In other cases, such as the union of mercury and chlorine, the presence of moisture has little effect. In *Science Progress* for October there is an article on this subject by G. R. Gedye in which recent work is summarised, and the theories proposed to explain the effects are discussed. It is concluded that effects of ionisation and of the surface of the vessel may both play a part, although in some cases, such as the union of carbon monoxide and oxygen, there are special mechanisms of a chemical character.

The Equilibrium $CO_2 + C = 2CO$.—A certain amount of evidence exists that this important equilibrium is in some respects dependent on the particular type of carbon with which the two gases are in contact. In the September issue of the *Journal of the Chemical Society*, Prof. J. W. Cobb and F. E. Dent describe some experiments which support this. They used graphite, coke, and charcoals, both with and without sodium carbonate, the latter being a catalyst for the reaction. The results show that the percentage of carbon dioxide in the equilibrium gas at 800° C. may vary from about 7 to nearly 14, the higher figure corresponding with graphitic carbon and the lower figures with carbons containing some active unsaturated atoms of carbon. Since charcoal containing unsaturated atoms is slowly converted into graphite on heating, the figure for the apparent equilibrium will vary according to the extent to which this change has occurred. The reverse reaction is expected to vary in the same way.

Optical Isomers.—An X-ray examination of the *d*-, *l*-, and racemic forms of phenylaminoacetic acid has been made by Clark and Yohe, whose results are described in the September number of the *Journal of the American Chemical Society*. The *d*- and *l*-forms were shown to crystallise in the orthorhombic system, in a lattice and group admitting of no molecular symmetry. This confirms the fundamental theory of van 't Hoff and Le Bel connecting molecular asymmetry with optical activity. Only X-ray measurements by the rotation method were used, and these gave a possibility of the crystal analysis without any crystallographic or optical data. It was not possible to distinguish between the *d*- and *l*- forms by means of X-ray diffraction methods. The crystal modification of the racemic form differs from that of the optically active forms.

Egyptian Medicine.[1]

By WARREN R. DAWSON.

IF we wish to go back to the very beginnings of the great science of medicine that to-day can almost achieve miracles in the prevention and cure of disease, it is to Egypt that we must turn, for the Egyptian medical books are by many centuries the oldest scientific writings that have survived the ravages of time. Our knowledge of Egyptian medicine is derived from a series of papyri, the oldest of which dates from the Middle Kingdom, although all of them are clearly derived from much more ancient prototypes. These papyri for the most part are miscellaneous collections of prescriptions and incantations for the cure of diseases of many kinds, and they contain but little information to enlighten us on Egyptian conceptions of anatomy and physiology.

The ancient practice of mummification, which began probably so early as the time of the First Dynasty, has had an enormous influence on the growth of anatomical knowledge, for the complex manipulations to which the body of an Egyptian was subjected in the course of its embalming afforded opportunities for many centuries for its practitioners to become acquainted with the nature and mutual positions of the internal organs of the body—opportunities that were denied to all peoples who inhumed or cremated their dead. Mummification, involving as it did the removal and handling of the internal organs of the body, provided the first opportunities for observations on comparative anatomy, for the Egyptians did not fail to perceive the essential identity between the organs of the human body and those of animals, the latter long familiar from the time-honoured custom of cutting up animals for sacrifice and food. The effects of these observations are seen in the fact that the Egyptians had a very extensive anatomical vocabulary. They were able to distinguish and name a great many organs of the body that a more primitive and less enlightened people would have grouped together or failed to perceive. They were consequently able to localise many diseases and ailments, since they knew the positions and general character of the internal organs.

Of all the viscera the heart was regarded as the most important. The Egyptians apparently attached no importance to the brain, but the heart was regarded as the seat of life and consciousness and of the emotions. It was further recognised as being the centre of a complex series of ' vessels ', although the Egyptians failed entirely to understand the vascular system and the nerves and muscles; yet they understood the pulse and diagnosed any irregularities of its beat as being caused by affections of the heart. It is further significant that the heart was always carefully left in its place in the thorax, attached to its great vessels, when all the other viscera, both of the chest and the abdomen, were removed in the process of embalming. The presence of the heart was believed to be as important to a mummy as it was to a living man.

The Egyptians shared with many other primitive peoples the belief that death and disease are unnatural and abnormal. Disease had a cause that was impalpable and invisible, and it was generally laid at the door of supernatural influence. The paramount belief that illness was due to possession is clearly expressed in the Egyptian papyri. Many of the diseases are expressly stated to be " the assaults of a god, the assaults of a goddess, of a dead man or a dead woman, of an enemy, male or female ", etc. In the papyri the idea of possession is evident from the fact that the diseases are often treated as if personified, and they are addressed and harangued by the magician. The titles of the prescriptions clearly embody the same idea, for we find, instead of the simple phrase " prescription for *curing* " such and such a disease, the words " prescription for banishing ", " driving out ", " expelling ", or " terrifying " the disease.

There cannot be the slightest doubt that Egyptian medicine had its origin in magic, and that magic never lost its hold upon medicine, even when the latter was becoming more and more rational. The earliest doctors were magicians and the earliest forms of treatment were magical rites. Some of these rites were merely oral; the magician recited a spell and bade the possessing devil to be gone. Others combined with the oral rite a manual rite, in which the spoken formula was recited to the accompaniment of some gesture or manipulation. Spells were recited over amulets, and the amulets were then placed upon the affected part. Sometimes, again, the recitation was made over some herb or mixture of substances, which, when charged with magical power, was administered to the patient either as an external or internal medicine. Thus arose the practice of giving the patient a prescription of drugs, often nauseous in character, the primary object of which was not so much to relieve the sufferer as to expel the demon of disease.

It is characteristic of the magician that he should have more than one string to his bow: if one remedy should fail, another may succeed, and consequently the papyri are full of alternative prescriptions for the same disease. Their very multiplicity is a confession of their purely arbitrary and unscientific character; but it often happened that some of the prescriptions really did contain elements that were appropriate and rational, and these consequently would tend to supersede their worthless fellows, and, as a result, the magician who could compound effective medicines was most in request. Such magicians were, in fact, no longer magicians, but physicians.

It will thus be seen that, through a long process of more or less ineffectual experimenting, the Egyptians groped their way towards a rational pharmacopeia, and this, combined with their knowledge of anatomy, crude and unscientific as it was, enabled them to prepare prescriptions for the treatment of disease seated in various localised parts of the body centuries before other nations, that lacked such knowledge, were able even to begin to understand medicine. The other nations of antiquity borrowed from the Egyptians, ready-made, the foundations of their medical knowledge, and the early medical literature of many other countries, not excepting Greece, bears abundant testimony to the debt owed to Egypt.

Wounds and injuries were regarded by the Egyptians in quite a different light from sickness and disease. The cause of the latter was invisible and unknown and attributed to supernatural influence, whilst the foeman's axe or other human energy was the easily perceived cause of the former. Wounds were consequently treated by rational means, and with their treatment, surgery came into being. Gradually, the morbid conditions that were often revealed by wounds were observed in cases where no wounds had been inflicted, such as in cases of boils and suppurating sores, and thus rational surgical methods were adopted for the treatment of these cases. Many of the passages that describe the treatment of wounds and diseases

[1] Paper read at a reception to the president, committee, and members of the Egypt Exploration Society, held at the Wellcome Historical Medical Museum, on Nov. 11.

that had some obvious external manifestation are strikingly rational and thorough, but although rationalism and experience were enabling scientific medicine to free itself from the shackles of magic, the latter nevertheless continued, and it is by no means extinct to-day. Even when he treated disease by rational therapeutic methods, the physician could never forget that his art originated in various attempts to coax, charm, or forcibly expel the demon of disease from its involuntary host.

It is the fashion amongst students of medical history to despise Egyptian medicine as fantastic and absurd. It must not be forgotten, however, that through the thirty centuries or so that preceded the birth of scientific thought in Greece, Egypt had painfully laid the foundation upon which later investigators were to build. Throughout the jumble of magic and sorcery that plays so large a part in Egyptian medicine, a careful study of the texts reveals a modicum of correctly observed truth—the very foundations of medical science. If Egypt cannot compete with Greece in scientific knowledge and thought, she at least inaugurated what others have developed, and the time-honoured custom of mummification familiarised the popular mind for thirty centuries with the idea of cutting the dead human body, and the Greek anatomists in the time of the Ptolemies were able to begin, in Egypt, the systematic dissection of the human body, which popular prejudice forbade in all other parts of the world. Without anatomy, the scientific practice of medicine could never have been possible: civilisation and humanity owe an enormous debt to Egypt.

Origin of the Bird Fauna of the Arctic.

AN attempt to solve the problem of the origin of the bird fauna of the arctic has recently been made by Prof. A. Tougarinov ("The origin of Arctic Fauna", *Priroda*, No. 7-8, 654-680, Leningrad, 1929).

The total number of species nesting in the arctic zone is about 180, or 240 if one includes the sub-species. These can be divided into the following zoogeographical groups:

(1) The group with circumpolar distribution, comprising 26 purely arctic species, which do not nest farther south. It is interesting to note that there exists a distinct systematic affinity between some of these species and those inhabiting more southerly regions. Thus, the arctic *Buteo lagopus* is closely related to *B. hemilasius*, which inhabits Central Asia and is not found farther north than the southern regions of the Siberian steppes. Many other such examples might be quoted.

(2) The Atlantic group, consisting of 16 species, out of which 7 are truly arctic, nesting on the coast-line of the Atlantic ocean. These species are found throughout the European coasts of the Atlantic, up to the regions which are subject to the influence of the Gulf Stream, Franz-Joseph Land, Spitsbergen, Iceland, Greenland, as well as the eastern coasts of arctic America.

(3) The European-Siberian group consisting of 15 truly arctic species, which are found throughout the tundras of Europe and western Siberia so far east as Taimyr. As a general rule, these species hibernate in the Mediterranean region, not farther east than the Aral Sea.

(4) The Eastern-Siberian group, which consists of 23 arctic species and is spread throughout the tundras and islands of the Polar Sea, from the Taimyr Peninsula up to the Kalyma River. Here again there is an affinity with more southerly Asiatic species. Thus, *Leucosticte brunneinucha* living in the tundras of Yakutia belongs to the genus well represented in the mountainous regions of Central Asia. Again, *Sarcogeranus leucogeranus* found in the tundras of Yana and Kalyma is sporadically distributed throughout the South Siberian, Mongolian and Kirgiz steppes. Even more striking is the close systematic affinity between the arctic species belonging to the East Siberian group and those inhabiting the nearctic, for out of their total number of 23, 11 species are found in North America.

(5) The Tchukotsk Peninsula group, possessing a rich and varied arctic fauna. There are 34 truly arctic species alone, out of which 12 are found also in Alaska, and another 15 in Alaska and America. The bird fauna of the Tchukotsk Peninsula bears a close resemblance to that of the neighbouring regions of America. On the other hand, one is struck by the dissimilarity between the arctic bird faunas of eastern Siberia and that found west of Chaunsk Bay; however, it is somewhat difficult to decide whether the Tchukotsk group belongs to the palæarctic or nearctic zoogeographical region.

(6) The bird fauna of the coast-line and the islands of the Bering Sea deserves to be placed in a separate group. It is distinguished by the presence of numerous representatives of the family *Alcidæ*, eight species of which are found in that region. Another characteristic of this fauna is its endemic character—there are 9 truly polar species which are not found outside the coast-line and the islands of the Bering Sea (for example, *Sterna aleutica*, *Erolia ptilocnemis*, *Leucosticte griseinucha*, *Philacte canagica*, etc.).

(7) The Alaskan group, which spreads so far east as the Mackenzie River, is distinguished by its great variety; it included 66 species and forms, out of which 36 can be considered as truly arctic. The American species predominate and 22 species and sub-species are endemic.

(8) The American arctic group inhabiting the region from Mackenzie River up to Baffin Land and Labrador. Out of 45 species nesting there, 30 are truly arctic. The majority of these are found in Alaska, 3 species belong to the Atlantic group, another 3 can be considered as endemics of Baffin Land, and one, *Micropalama himantopus*, has so far been found only in the Canadian tundras.

(9) The Greenland group, which besides the circumpolar species possesses 12 arctic ones. Of these, the majority belong to the European-Atlantic group, while the nearctic is represented by *Chen nivalis* and *Limonites fuscicollis*. There are no endemics.

The above facts permit of the following conclusions:

The bird fauna inhabiting the arctic region of eastern Siberia has apparently been derived from Central Asia. The fauna of the European-Siberian part of the Palæarctic is not closely connected with that of the Atlantic region, but has a distinct systematic affinity with the fauna of eastern Siberia (for example, *Erolia*, *Branta*, *Limosa*). It can be considered, therefore, that the tundras of western Siberia and Europe are inhabited by immigrants from the East. Many American species are found in European Siberia, and although some Siberian species are found in America, they are not so numerous and have spread only so far as western Alaska.

The region of the Bering Sea, which includes the Tchukotsk Peninsula and Alaska, is inhabited by a peculiar fauna of its own, possessing numerous ancient forms. Its water fauna is original and its land fauna is connected with that of America. It is probable,

therefore, that the bird fauna of arctic America originated in this region.

A number of species inhabiting the tundras are derived from the southern Palæarctic, most likely from the modern Kirgiz steppes; their dispersion took place probably along the Turgaisk-Barabinsk plains.

It follows, therefore, that the arctic bird fauna is derived from two distinct centres, namely, eastern Siberia and the region of the Bering Sea. The species derived from eastern Siberia spread throughout the palæarctic; only a limited number reached America. The arctic fauna of America and some species found in extreme eastern Siberia have been derived from the region of the Bering Sea.

The other centres of lesser importance where certain arctic species originated and whence they spread are the coast-line of the Atlantic Ocean and Central Eurasia, probably the modern Kirgiz steppes. The Atlantic bird fauna was formed on the Atlantic coast-line simultaneously with the spreading farther north of warm ocean currents, and from there it spread over the neighbouring continents. The immigrants from southern Eurasia spread through far-eastern Siberia, which they reached by way of the west Siberian plains.

Forestry Research in India.

THE recent announcement in the *Times* of Nov. 8, that the Viceroy, accompanied by Lady Irwin, had opened at Dehra Dun the new Government Forest Research Institute, the largest in the British Empire, if not in the world, is of considerable interest. Early in 1926 it was announced that the Finance Committee of the Legislative Assembly had sanctioned a sum of £833,000 to be spent on the Research Institute. This announcement was discussed in NATURE (Feb. 6, 1926, p. 204). The new buildings just opened by the Viceroy are stated to have cost the sum of £850,000.

Dehra Dun has been the centre of forest education since 1878, when a training college for rangers and foresters was established. Towards the end of 1900 the first research work by the Forest Department was commenced, when a member of the forest staff was appointed for two years as forest entomologist to the Government of India with headquarters at Dehra Dun. This appointment was renewed in 1904, the same officer taking up the post. The question of the formation of a Research Institute was then taken up actively, the sympathy and support of Lord Curzon, the Viceroy, was secured, and the Research Institute with a sanctioned staff, but without adequate buildings or equipment, came into being in 1906.

The new department expanded rapidly and the first Institute buildings were opened in 1914. The War brought about a great opportunity and created a demand for the maximum utilisation of all kinds of Indian forest products. The buildings, deemed adequate in 1911, proved far too small, and the Industrial Commission of 1918 strongly urged the need for extending the Research Institute, its equipment and staff. Effect was given to this suggestion. The Government of India took up an area of 1200 acres of land on the outskirts of Dehra. The Central Institute, with separate buildings for mills, workshops for sawing, testing, and seasoning timber, laboratories, offices, and residences for the staff, are now complete. The main Institute building, with its already splendidly developed series of museums and its library and laboratories, is 1024 feet long and 285 feet wide, and has two stories, Indian timbers having been largely used in construction work, panelling, etc.

Preparatory to the completion of the building, the Government of India appointed a committee of business men to review the organisation of the Institute and to make recommendations for the maximum efficiency in its work. The committee reported very favourably in July last, and the Government has already discussed the proposals with the Inspector-General of Forests, Mr. A. Rodger. The latter warmly praised the recommendations of the committee. The Viceroy, in opening the new buildings, also paid a tribute to the work of the committee, and after describing some of the fine work already accomplished by the Research Institute, stated that the Government intended, within the limits of its financial liability, to give the Institute the scientific staff which it requires.

University and Educational Intelligence.

CAMBRIDGE.—The Adam Smith Prize has been awarded to R. F. Kahn, King's College, for an essay entitled "The Economics of the Short Period".

The Clerk Maxwell Scholarship for the advancement by original research of experimental physics, of the value of £210 a year for three years, has been divided equally between Mr. W. H. Watson, research student of Gonville and Caius College, and Dr. W. L. Webster, of Trinity College.

Mr. Sydney Goldstein, Smith's Prizeman 1927, Isaac Newton Student in the University 1927–28, has been elected into a fellowship at St. John's College.

LONDON.—The following doctorates have been conferred: D.Sc. in chemistry on Mr. H. J. Emeléus (Imperial College—Royal College of Science), for a thesis entitled "The Glow of Phosphorus and Allied Phenomena", and on Mr. I. Vogel (Imperial College—Royal College of Science), for a thesis entitled "Carbon Rings"; D.Sc. in medical and vital statistics on Mr. A. B. Hill (London School of Hygiene and Tropical Medicine), for a thesis entitled "An Investigation of Sickness in various Industrial Occupations"; D.Sc. (Engineering) on Mr. M. A. Hogan (Imperial College—City and Guilds College), for a thesis entitled "The Support of Underground Workings in Coal Mines"; D.Sc. (Engineering) in metallurgy on Mr. J. M. Robertson (Imperial College—Royal School of Mines), for a thesis entitled "The Effect of Variations in the Rate of Cooling on the Microstructure and Constitution of Steel".

The Sir John William Lubbock Memorial Scholarship Prize in mathematics, of the value of £30, has been awarded to Miss I. W. Busbridge, of Royal Holloway College.

READING.—Mr. James R. Matthews, lecturer in botany at the University of Edinburgh, has been appointed to be professor of botany in succession to Dr. W. Stiles, now professor of botany at the University of Birmingham.

THE Wigan and District Mining and Technical College, founded in 1857, gives particulars in its new and enlarged Calendar of the buildings opened for it last June by Lord Chelmsford. Their erection was made possible by grants amounting to £37,000, including £5000 for equipment, from the Miners' Welfare Fund. It is now in a position to offer full-time university degree courses in mining, engineering, chemistry, and general science, as well as in commerce and art.

WE have recently received the Calendar of the Heriot-Watt College, Edinburgh, which provides day and evening instruction in mechanical, electrical, mining, and oil engineering, applied chemistry, brewing, pharmacy, building, printing, commerce, and languages. It is closely associated with the University of Edinburgh, and its courses form an essential part of the training of students for the University's degrees in civil, mechanical, and electrical engineering, mining and metallurgy, and technical chemistry. The mine rescue station for Mid and East Lothian is a portion of its mining department. Continuation classes in the south-east of Scotland, affiliated with its classes, are conducted by city and county education authorities.

THE Council of University College, Cardiff, has executed a new agreement with the Cardiff Royal Infirmary regarding the Welsh National School of Medicine, and the School is therefore re-opening for students in the clinical departments this session. A joint Appointments Committee, on which the students are represented, has been set up by the Council and Senate. A course in general science, shared between all the departments of pure science and open to the public, has been arranged for the current session. Recent appointments include the following: Prof. J. F. Rees, to be principal in succession to Dr. A. H. Trow (retired); Mr. C. N. Strong to be lecturer and demonstrator in anatomy; Mr. J. B. Duguid to be acting professor of pathology and bacteriology.

"PROGRESS of Education in India, 1922–27", by R. Littlehailes, Educational Commissioner with the Government of India (Calcutta, Govt. of India Central Publication Branch, vol. 1, R. 1.10 or 2*s*. 9*d*., vol. 2, Rs. 2.10 or 4*s*. 9*d*.) is a review of noteworthy interest. This interest is the greater for the almost simultaneous publication of the report of Sir Philip Hartog's auxiliary committee appointed by the Simon Commission to present a review of the same subject (without limitation to the quinquennial period) in relation to political and constitutional conditions and potentialities of progress. This Committee's report directs special attention to the claims of girls' education, to which priority should, it says, now be given in every scheme of expansion. In this matter Mr. Littlehailes declares that the belief that "the education of women is essential to national advancement" is now widespread in India and holds that, in spite of many formidable obstacles, the outlook is brighter to-day than at any previous period. In sections on universities and intermediate education he traces the history of the attempts made to give effect to the policies advocated by the Calcutta University Commission's report of 1919. The separation of the intermediate classes (first half of the usual four years' course of higher education) from the university and the transfer of their work to 'intermediate colleges' would not, it is held, be academically sound without extension of the B.A. course from two to three years, and such extension is economically unacceptable if not impossible; the only provincial government prepared to accept the proposed separation is that of the United Provinces. The devolution policy of the constitutional reforms introduced in January 1921, with the transfer of responsibility for education from the Government of India to provincial governments, and the recent increase in the number and varieties of universities, has rendered increasingly difficult for outsiders the intelligent appreciation of Indian educational problems and especially university problems. Mr. Littlehailes' chapters on administration and control and on universities and colleges afford valuable help towards overcoming these difficulties.

Calendar of Patent Records.

November 17, 1884.—The foundation of the artificial silk industry was laid by Count Hilaire de Chardonnet, who patented his cellulose-nitrate process in France on Nov. 17, 1884. A factory was set up at Besançon, and manufacture started in 1891, and though Chardonnet's process has been outdistanced by the cheaper viscose method of production, the growth of the industry has been continuous from that time. Sir Joseph Swan's artificial thread of 1883 was used only for electric lamp filaments, and was not taken up for textiles.

November 18, 1820.—The first successful calculating machine to be manufactured on a commercial scale was patented in France by Franz Xavier Thomas on Nov. 18, 1820. The adoption of the machine was slow for many years, but by the middle of the century it was being manufactured in large quantities, and machines of the same type are still being made to-day. An original Thomas machine is in the Deutsches Museum at Munich.

November 20, 1772.—The Birmingham 'papier-maché' industry was founded by Henry Clay and was based on the patent granted to him on Nov. 20, 1772, for a process of making decorative panels, tea-trays, etc., by pasting sheets of paper together, and japanning or lacquering them. The term 'papier-maché', which had been used many years before in its real sense for articles made from moulded paper-pulp, was not applied to the articles made by the Clay process until the middle of the nineteenth century.

November 20, 1813.—The introduction of the vacuum-pan into the sugar manufacturing process—one of the most important inventions in the history of the sugar industry—was due to Charles Edward Howard, who was granted a patent for it on Nov. 20, 1813.

November 20, 1832.—The fusee match was patented by Samuel Jones of London on Nov. 20, 1832. The first friction matches were produced by John Walker of Newcastle-on-Tyne in 1826, but his invention was not patented and the fusee patent is the first for a friction match to appear in the records. Jones was the patentee also of the 'Promethean' match, one of the chemical 'instantaneous light' contrivances which preceded the friction match, and he also, in 1829, introduced the 'Lucifer', which was, however, only a copy of Walker's.

November 21, 1777.—The patent granted to Robert Stodart on Nov. 21, 1777, for "a new sort of instrument or grand forte-piano with an octave swell, and to produce various tones together or separate, which instrument will be more durable and produce finer and more variable tones than any yet made" supplies the first instance of the use of the term 'grand piano'.

November 21, 1833.—A needle-pointing machine which cuts off a length of wire sufficient for two needles, sharpens both ends, punches the eyes, and severs the wire into the two completed needles, was patented by Daniel Ledsam and William Jones on Nov. 21, 1833. Probably the machine never came into use. Apparatus of the kind was first used in Germany; its adoption in England came much later.

November 21, 1839.—The first superheater for locomotives—consisting of a chamber in the upper part of the smoke box heated by the furnace gases on their way to the chimney—was patented by Robert and William Hawthorn on Nov. 21, 1839, and was fitted to an engine supplied to the Newcastle and North Shields Railway in 1840. The locomotive superheater did not, however, come into general use until the introduction of the Schmidt fire-tube construction at the beginning of the present century.

Societies and Academies.

LONDON.

Royal Society, Nov. 7.—**H. E. Roaf**: The absorption of light by the coloured globules in the retina of the domestic hen. The transmission of light by the coloured globules of the retina of the hen has been photographed by means of a microspectroscope and the wave-length limits of the absorption measured.—**R. G. Tomkins**: Studies of the growth of moulds (1). When moulds are germinating on a substratum of soil, in equilibrium with the atmosphere, at any given temperature rate of germination decreases as humidity decreases. The rate is greatest at an optimum temperature, varying for different fungi. If the soil contains nutrients, rate of growth and range of humidity and temperature are increased. The growth of a 'colony' is similarly affected by conditions.—**R. H. Stoughton**: The morphology and cytology of *Bacterium malvacearum* E.F.S. Using a special technique, depending on staining the organisms without drying or heating, certain structures are demonstrable in the cells. One of these is a deeply staining centrally placed body of the nature of a nucleus. Two kinds of new growth-forms have been demonstrated. The first are small deeply staining granules, apparently identical with the 'gonidia' of other writers. The second are spherical coccus-like cells, produced by a process of budding from rods, in old cultures of the organism. The 'nucleation' of this coccus has been observed.—**E. C. Smith**: On the coagulation of muscle plasma. The preparation and properties of a liquid expressate of muscle, representing as nearly as possible the living plasma, are described. Gelation occurs only when a trace of a neutral salt is added to the finely divided muscle in the frozen state. Gelation of plasma and hardening of muscle in rigor mortis are the same phenomenon. Changes in hydrogen ion concentration are irrelevant to gelation.—**S. L. Hora**: Ecology, bionomics, and evolution of the torrential fauna, with special reference to the organs of attachment. Shows, from purely ecological and biological points of view, how animals become adapted to their surroundings; causes of variations and mode of their transmission are not considered. Attention is directed to the close correlation existing between 'factors' in environment and 'characters' of population, and specially to the divergence and convergence of characters, so far as influencing the course of organic evolution. Environment is the supreme master of most changes in animal organisation; organic evolution is an index of the varied conditions under which life exists.—**R. N. Mukerji**: Effect of X-radiation on the spermatogenesis of *Lepisma domestica*. The Golgi bodies in the spermatocytes approach the nucleus, swell up and fuse. Precocious formation of the acrosomic granule sometimes occurs. The mitochondria and their derivative, the *nebenkerne*, undergo various alterations in the spermatids. The vacuolar system remains unaffected, and the nurse-cells show no definite changes.—**J. B. Gatenby, R. N. Mukerji, and Sylvia Wigoder**: The effect of X-radiation on the spermatogenesis of *Abraxas grossulariata*. After 6 hours the mitochondria in many cells swell up. By 16 hours the Golgi elements approach the spermatocyte nuclei, forming caps, which later become detached as large spheres lying in the cytoplasm. These spheres contain an acrosome bead, and are absorbed by 20 hours. No very abnormal mitoses are found until after 37 hours.

Society of Public Analysts, Nov. 6.—**E. R. Bolton and K. A. Williams**: The grouping of fatty oils with special reference to olive oil. If the unsaponifiable matter be separated as described, and its iodine value determined, the oils are divided into four groups: Group 1—iodine value 64 to 70—contains the animal fats and a few vegetable fats (the coconut family); Group 2—iodine value 90 to 96—contains fish and marine animal oils and cocoa-butter; Group 3—iodine value 117 to 124—contains the vegetable oils and fats; Group 4—iodine value 197 to 206—contains olive oil only.—**Cuthbert Dukes**: The heat resistance curve. A new bacteriological test for pasteurised food. Pasteurised food differs from unpasteurised in that subsequent heating causes a large reduction in the number of bacteria only when temperatures higher than the pasteurising temperature are reached, whereas in unpasteurised food the bacteria are reduced progressively and uninterruptedly as the temperature is raised.—**W. R. Mummery and F. Bishop**: A new borax solubility test for lactic acid or natural sour casein. A new method has been based on the fact that 12·5 gm. of borax in water are required to dissolve 100 gm. of good commercial casein to obtain a solution which, when diluted, had a constant *p*H value. This value is termed the 'solubility index', and affords a means of classifying caseins.

PARIS.

Academy of Sciences, Sept. 30.—**George D. Birkhoff**: The demonstration of an elementary theorem on integral functions.—**M. Kourensky**: The integrals of the equations of motion of a solid body in a liquid.—**G. P. Arcay**: Contribution to the experimental study of the deformation of the flat spiral. The method used was a kinematographic study by condensed sparks.—**Corradino Mineo**: The orientation of the terrestrial equatorial ellipse.—**Erik A. Holm**: The state known as the *Sama-Zustand*.—**J. Calvet**: The attack of aluminium by ammoniacal solutions. Three samples of aluminium of varying purity (impurities 0·04 per cent, 0·29 per cent, and 0·82 per cent) were used in these experiments. In alkaline solutions, very pure aluminium is not more resistant to attack than ordinary aluminium.—**R. Brunschwig and L. Jacqué**: A method of testing motor benzene. Controlled oxidation by air at 100° C. is proposed: it is shown that the method gives a fair idea of the amount of resins which would be formed after storing for nine months.—**Const. A. Kténas**: The alkaline character of the volcanic lavas of Antiparos (Cyclades).—**V. Pérébaskine**: Geological observations in the loop of the Niger.—**R. Dostal**: Reproduction in *Caulerpa*. In a previous paper the author has proved the existence of zoospores of *Caulerpa prolifera*, and suggested that this might be an alternative method of reproduction. Further researches to elucidate this question have given negative results and no reproduction from the spores could be proved.—**Mlle. L. Rémy**: The etiology and therapeutics of plant tumours of a malignant type.—**Gard**: The plant disease *pourridié* and calcium carbonate. This disease may be due to *Armillariella mellea* (walnut, vine, plum), *Rosellinia necatrix* (vine) or *Pilacre pallida* (vine); it is always associated with a soil deficient in calcium carbonate.—**P. Vignon**: The wing of the Hymenoptera.—**Brocq-Rousseu, Mme. Z. Gruzewska, and G. Roussel**: The amylase of horse serum and the variations of its activity as a function of successive bleedings. The results are summarised in four curves.

Oct. 7.—**G. Bigourdan**: The measurement of the inclination of the axis of rotation of the meridian telescope, in determinations of time.—**Georges Perrier**: The international ellipsoid of reference. Its tables.

The ellipsoid of revolution calculated by Hayford in 1909 has been adopted as the international ellipsoid, but its use necessitates the calculation and publication of accessory tables. An account is given of such tables calculated by Hasse, and, over a limited range, by Väisälä.—**Ch. Achard** and **A. Arcand**: The comparative study of the proteids in blood serum and in pathological serosities.—**E. Mathias**: Contribution to the study of fulminating matter. The surface tension. Division of a globe into several others under the influence of a shock or of a rebound.—**V. Romanovsky**: Probabilities *a posteriori*.—**S. Finikoff**: Series of Laplace containing congruences of Wilczynski.—**Krawtchouk**: Characteristic numbers and fundamental functions.—**Henri Cartan**: The growth function attached to a meromorph function of two variables and its application to meromorph functions of one variable.—**Alex. Froda**: The general solution of algebraic equations.—**J. Le Roux**: The theoretical bases of the law of gravitation.—**Eligio Perucca**: A metallic resistance of 10^{10} to 10^{11} ohms. A film of gold on quartz fibre can be obtained by cathode projection in a vacuum, and the resistance can be adjusted between 10^{10} and 10^{12} ohms by stopping the deposition at the required point. After some days standing these films have the following properties: the conduction obeys Ohm's law, there is no trace of E.M.F. of polarisation, and the temperature coefficient is negligible. The possible applications of resistances thus prepared are discussed.—**Albert Levasseur**: Simple formulæ permitting in all cases the rapid calculation of ohmic resistances with alternating current. The formula gives figures which do not differ from Kelvin's table by more than 1·5 per cent as a maximum.—**E. Calvet**: The heat of hydrolysis of the amides: acetamide. A direct method with a microcalorimeter was employed instead of the usual indirect method based on the heats of combustion.—**A. Sanfourche**: The oxidisability of silicon as a function of its state of division. Reply to a criticism by Bedel. Fresh experiments in support of the influence of the state of division of the silicon on its oxidisability are given.—**Mme. N. Demassieux**: The action of alkaline oxalates on the halogen salts of lead in aqueous solution. The interaction of lead halides with solutions of sodium oxalate gives results closely resembling those previously obtained with lead halides and sodium carbonate.—**Mathieu**: The study by means of the X-rays of some halogen salts prepared by Mme. Demassieux.—**M. and Mme. Clément Duval**: The study of the cobaltipentammines and researches on a new case of isomerism.—**P. Cordier**: The dialkyloxysuccinic anhydrides.—**J. Grard**: The action of mixed organo-magnesium derivatives on propargyl acetal.—**M. Bridel** and **Mlle. C. Bourdouil**: The transformations of the glucides in the course of the ripening of bananas.—**Marc André**: An adult form of *Thrombicula autumnalis*.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 15).—**F. Loewinson-Lessing** and **O. Vorobjeva**: Contribution to our knowledge of orbicular structures in igneous rocks. Microstructure of several nuclei of spheroids in orbicular igneous rocks is described and it is concluded that the spheroids cannot be regarded as concretions; they are fragments of the same rock partly altered by resorption but still retaining their original structure in the nucleus.—**D. Beliankin** and **M. Bezborodov**: Contact-metamorphic structures in technical processes. Phenomena of the type of contact metamorphosis in eruptive rocks are repeated to some extent in certain technical processes; examples of such processes in the glass industry are described.—**P. Schmidt**: The Pacific species of the genera *Microstomus* and *Glyptocephalus* Gottsche (Pisces, Pleuronectidæ). A revision of the genera named; in each of them the author recognises only two species.—**V. I. Vernadskij**: The capillary water in rocks and minerals. Every natural mineral contains a certain amount of capillary water which may be either fresh, or represent a solution of various salts. The presence of water must be taken into account in all analyses of minerals, otherwise serious mistakes are unavoidable.

SYDNEY.

Linnean Society of New South Wales, Sept. 25.—**J. R. Malloch**: Notes on Australian Diptera (2). Deals with four Australian species of *Ommatius*, of which three are described as new.—**G. M. Goldfinch**: Revision of Australian Geometridæ (Lepidoptera). A revision of the Australian species of the two archaic groups of the family Geometridæ, s. str., in which forty-seven species are recorded. Two new genera are proposed, ten new species described, and several points of confusion settled.—**G. D. Osborne**: Some aspects of the structural geology of the Carboniferous rocks in the Hunter River district between Raymond Terrace and Scone. The Hunter Overthrust possesses some unique features, and its age is regarded as being quite different from that of the normal faults and of the folding. The diatrophism manifested in the presence of the latter developed mostly in late Palæozoic time, although the probability of some orogeny, apart from the Hunter Overthrust movement, having occurred in post-Triassic time is recognised. The nature of the folding and its analysis are given.

VIENNA.

Academy of Sciences, July 4.—**E. Beutel** and **A. Kutzlnigg**: The action of iron chloride on zinc.—**L. Moser** and **W. Reif**: The determination and separation of rare metals from other metals (16). The separation of thallium from ter- and quadri-valent metals. There are now several methods, but in all cases thallium is determined as chromate. One method depends on the precipitation of thallium chromate in the presence of ammonia and sulphosalicylic acid, another method is by the hydrolysis of the trivalent metals by ammonium nitrite and methyl alcohol.—**L. Moser** and **W. Blaustein**: The determination and separation of rare metals from other metals (17). The precipitation of tungsten with tannin and antipyrin, its separation from the ter- and bi-valent metals, from tin and from silicic acid. Colloidal metal hydroxides form with tannic acid difficultly soluble adsorption compounds. The excess of tannic acid is precipitated with antipyrin. From stannic acid the best separation is by hydrogen sulphide from a complex tartrate solution. A separation of colloidal silica from tungstic acid depends on velocity of precipitation.—**E. Steinach** and **H. Kun**: The promotion of central activities by a stimulant from the central organ. A new field of work has arisen from earlier experiments on sexual hormones. Frogs were decapitated and then injected with a brain extract. For testing irritability a series of weak acetic acid solutions (less than 1 per cent) were employed to determine the threshold or weakest solution at which a reflex whisk movement would be made. The injected animals showed a much lower threshold than the controls. The water soluble brain extract has a specific effect not shared by the extracts of other organs. The extract loses its activity at boiling-point. Brains of frog, rat, dog were tried, chiefly cattle brains,

in one case human from a post-mortem. All were active; the stimulant is not species-specific. Experiments were also made on green tree-frogs which were tested by the number of flies they could snap up in ten seconds.—A. Klemenc and E. Hayek: The dissociation constant of nitrous acid.—A. Klemenc and E. Spitzer: The solubility of nitric oxide in carbon tetrachloride, benzole, and nitrobenzole.—A. Müller and H. Wachs: Synthesis of α-ethyl-pyrrolidine.—E. Mosettig and L. Jovanovic: The action of diazomethane on aromatic ketones.—K. Fuchs and F. Breuer: Alkali organic compounds containing sulphur.—P. Gross: The theory of the action of salts.—E. Späth and O. Schmidt: The constitution of pseudobaptisin.—R. Seka, G. Schreckental and P. S. Heilperin: The synthesis of pyridanthrone and anthracumarine.—E. Zerner and H. Goldhammer: Diphenyloxy-acetaldehyde.—C. Mayr and G. Burger: The potentiometric titration of mercurous ion with ammonium oxalate and its application in the determination of chromate.—L. Schmid and M. K. Zacherl: Conductivity measurements in liquid ammonia.—F. Feigl and A. Bondi: The reactivity of iodine in organic solvents.—G. Sachs and K. Fürst: Mercury nitrobenzols.—F. Wessely and K. Sturm: The constitution of phlorrhizine.—A. Franke: Ring contraction on the formation of inner ethers from glycols.—R. Dworzak and W. Prodinger: Products of bromation of iso-butyr-aldehyde.—F. Hecht and W. Reich-Rohrwig: The determination of uranium and thorium by means of 8-oxyquinolin.—F. Sigmund: The catalytic action of platinum sponge and platinum oxide in hydration.—F. Faltis and F. Kloiber: Derivatives of hemipinic acid.—E. Philippi: The linear pentacene series (13). Nomenclature and structure problems.—F. Hernler and K. Schnürch: The linear pentacene series (14). Pentacene-quinone-6, 13.—F. Hernler and O. Sommer: The linear pentacene series (15). The 6, 13-dioxy-pentacene-diquinone-5, 7, 12, 14.—F. Hernler and T. Bruns: The linear pentacene series (16). Pentacene-diquinone-5, 7, 12, 14-disulpho acid and tetraoxy-pentacene-diquinone-5, 7, 12, 14.—G. Machek: The linear pentacene series (17). Dinitro-, diamino- and dioxy-derivatives of pentacene diquinone-5, 7, 12, 14.—F. Hernler: Oxidation products of the three isomeric tolyl-1-dimethyl-3, 5-triazole-1, 2, 4.—K. Brunner and H. Moser: A remarkable formation of 1-phenyl-5-methyl-3-pyrazole.—H. Suida and H. Titsch: Acetyl-wood, the agglutination of incrustations and a new way of separating the constituents of wood.—W. J. Müller and K. Konopicky: The motoelectric effect.—H. Meyer and K. Bernhauer: The alkylisation of aromatic compounds.—A. Skita and F. Keil: The formation of tertiary amines in the reduction of nitriles and of carbonyl compounds in basic solution.—M. Dunkel and H. Mark: Anomalies in the region of dilute absorption.—E. Moles and T. Batuecas: The mass of the normal litre of ammonia.—A. Stock and W. Zimmermann: Vapour pressures of mercury and of some mercury compounds at low temperatures.—T. Wagner-Jauregg: Racemisation of halogen substituted esters.—J. Billiter: Methods for determining absolute potentials.—F. Schembor: Results of radiation measurements on the Stolz Alp between Oct. 1, 1927, and Nov. 1, 1928.—T. Pinter: *Tetrarhynchus erinaceus*.—L. Abolins: The regeneration of legs mutilated at the fibular edge in *Triton cristatus*. The excised fibula was in 50 per cent of all cases replaced by a long bone.—I. Sciacchitano, P. Weiss, and H. Przibram: The regeneration of legs mutilated at the tibial edge or medially in *Triton cristatus* and the heteromorphosis of the long bones after excision of the fibular edge. The excised tibia was not regenerated within two months.—H. Przibram: Growth measurements in *Sphodromantis bioculata* (4). Increase in size and number of facets. The number of eye-facets in the praying mantis doubles after ten changes of skin.—E. Dittler: The question of the stage of oxidation of titanium in the silicates.—O. Halpern: Note on the phase theory in thermionics.—E. Haschek: Plane grating spectroscopes with wave-length drums. A simple mechanical arrangement determines the sine of the angle of deviation and therewith the wave-length.—G. Jäger: The velocity law of gas molecules.—H. Schober: The colouring by radium radiation of rock-salt crystals stretched under water and strained beyond normal tensile strength. It was known that rock-salt crystals are much stronger under water than in air, and it was suspected that coloration was due to small ultra-microscopic irregularities in the crystal lattice. An alteration of the interior of the crystal took place, though not so clearly as in the bending experiments.—H. Mache: The diffusion and transition of gases in liquids (1). Solution and growth of air-bubbles in water. A small air-bubble was introduced into a sphere filled with water already containing dissolved air. By means of raising or lowering a tube containing mercury the pressure on the water was changed and the size of the air-bubble observed.—E. Heinricher: Researches on the descendants of *Primula kewensis* and their diversity of form. Successful attempts to fix certain forms were made by means of homostylous and self-fertilised plants.—T. Ohnesorge: Report on geological investigations round Wald and Krimml in Upper Pinzgau.—L. Hofmann: The connexion of the problem of projection with the relations between incident straight lines and planes in R_4. With an application to photograms.—O. Sickenberg: A hot spring in the lower Pliocene in the Vienna thermal line near Leobersdorf in Lower Austria. A peculiar conglomerate containing fossil shells and also calcite and silica seems to have been formed under the influence of the spring.—A. Skrabal and A. Zahorka: The water saponification of ethyl acetate.—R. Müller: The electromotive behaviour of the metals of the rare earths and their amalgams. (1) Experiments with lanthanum.—R. Müller and H. J. Schmidt: (2) Experiments with cerium.—A. Rollett: Experiments on brein from Manila elemi resin.—F. Hölzl, T. Meier-Mohar, and F. Viditz: The alkylisation of hexacyano-cobaltic acid.—A. Pongratz and F. Griengl: The heats of combustion of perylene and some of its derivatives.—J. Lindner, O. Brugger, A. Jenker, and L. Tschemernigg: Researches on tolyl-halogen-phosphine.—J. Lindner and M. Strecker: Researches on naphthyl-halogen-phosphine and -phosphinic acid.—A. Zinke and H. Kolmayr: Researches on perylenes and their derivatives (26).—A. Musil: The saponification of methyl acetate with alkali carbonates.—G. F. Hüttig: The addition compounds of the lithium halogenides with methyl alcohol and ethyl alcohol.—G. Jantsch, H. Alber, and H. Grubitsch: The halogenids of europium.—F. Emich: The observation of flaws (*Schlieren*) in chemical work.—R. Kremann, B. Kurth, E. I. Schwarz, and W. Pivetz: Electrolysis of molten ternary alloys.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (4). The Raman spectrum of organic substances (benzol derivatives).—K. Lohberger: Some new fish forms from Lake Victoria.—H. Reschovsky: Rational curves.—G. Nöbeling: The continuous representation of the circle on regular curves.—H. Hornick: Connexion of the second degree.—W. L. Ayres: (1) Closed curves in Peano's spaces.—(2) The density of dissection points and end points.—K. Przibram: A scheme of the colouring effects in rock-salt.

Official Publications Received.

BRITISH.

Ministry of Agriculture and Fisheries. Report of the Departmental Committee on the Reconstruction of the Royal Veterinary College. Pp. 26. (London: H.M. Stationery Office.) 1s. 3d. net.

British Cast Iron Research Association. Eighth Annual Report for the Year ending June 30th, 1929. Pp. 31. (Birmingham.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part 2. Pp. v+128+3 plates. (London: H.M. Stationery Office.) 3s. net.

Journal of the Chemical Society: containing Papers communicated to the Society. October. Pp. iv+2173-2425+x. (London.)

Proceedings of the Royal Society. Series A, Vol. 125, No. A798, October 1. Pp. 393-578. 6s. Series A, Vol. 125, No. A799, November 1. Pp. 579-734+vi. 5s. (London: Harrison and Sons, Ltd.)

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 4, No. 12: A Spectroscopic Investigation of Beta Cephei. By Ralph N. Van Arnam. Pp. 171-178. Vol. 4, No. 13: Two Highly Eccentric Orbits. By W. E. Harper. Pp. 179-187. Vol. 4, No. 14: Line Intensities in Nebular Spectra. By H. H. Plaskett. Pp. 187-207. (Victoria, B.C.)

Ninth Annual Report of the Scientific and Industrial Research Council of Alberta, 1928. (Report No. 24.) Pp. 53. (Edmonton, Alba.: W. D. McLean.)

Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Septième Session, Saranac Inn, N.Y., Septembre 1928. Recueil des Travaux et Compte Rendu des Séances. Pp. 126S. (Teddington: National Physical Laboratory.) 5 dollars.

Records of the Geological Survey of India. Vol. 62, Part 3. Pp. 293-389. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

Bulletin of the Raffles Museum, Singapore, Straits Settlements. No. 2, July. Pp. 146. (Singapore.) 60 cents; 1s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1260 (Ae. 409): Flight Tests on an Atlas fitted with Automatic Slots connected with the Ailerons and some Data relevant to the Design of Auto-Slots for R.A.F.28 Section Wing. By E. T. Jones. (T. 2777.) Pp. 8+6 plates. (London: H.M. Stationery Office.) 6d. net.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 4, No. 4, October. Pp. 307-397. (Cambridge: At the University Press.) 12s. 6d. net.

Transactions and Proceedings of the New Zealand Institute. Vol. 60, Part 2, June. Pp. iv+205-378+plates 18-32. (Wellington, N.Z.)

Journal of the Society of Glass Technology. Vol. 13, No. 51, September. Pp. viii+71-296+xxx. (Sheffield.) 10s. 6d.

The Journal of the Board of Greenkeeping Research. Maintained by the British Golf Unions' Joint Advisory Committee for the Scientific Investigation of Greenkeeping Problems. Vol. 1, No. 1, November. Pp. 48+4 plates. (Bingley: St. Ives Research Station). 2s. 6d.

British Honduras. Report of the Forest Trust, 1928. Pp. 17. (Belize.)

FOREIGN.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 3, No. 4, October. R.P. No. 108: Compressive Strength of Clay Brick Walls, by A. H. Stang, D. E. Parsons and J. W. McBurney; R.P. No. 109: Determination of Manganese in Steel and Iron by the Persulphate-Arsenite Method, by H. A. Bright and C. P. Larrabee; R.P. No. 110: Determination of Fluorine and of Silica in Glasses and Enamels containing Fluorine, by J. I. Hoffman and G. E. F. Lundell; R.P. No. 111: The Heat of Formation of Sulphur Dioxide, by J. R. Eckman and Frederick D. Rossini. Pp. 507-618+20 plates. (Washington, D.C.: Government Printing Office.) 40 cents.

Bulletin of the Vanderbilt Oceanographic Museum. Vol. 1, Art. 1: Scientific Results of the Yacht *Ara* Expedition during the Years 1926 to 1928, while in Command of William K. Vanderbilt. Fishes. By N. A. Borodin. Pp. 37+5 plates. (Huntington, L.I.)

U.S. Department of Agriculture. Technical Bulletin No. 130: The Chestnut Curculios. By Fred E. Brooks and Richard T. Cotton. Pp. 24+6 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Smithsonian Miscellaneous Collections. Vol. 81, No. 15: Arthropods as Intermediate Hosts of Helminths. By Maurice C. Hall. (Publication 3024.) Pp. 77. (Washington, D.C.: Smithsonian Institution.)

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 475: The Production and Marketing of New York Market Peas. By Dilworth Walker. Pp. 137. Bulletin 476: The Utilization of Marginal Lands. By William Allen. Pp. 109. Bulletin 477: Composition and Body of Butter. By E. S. Guthrie. Pp. 34. Bulletin 480: Premature Seeding of Celery. By H. C. Thompson. Pp. 50. Bulletin 482: Soil and Field-Crop Management for Yates County, New York. By H. O. Buckman, H. P. Cooper and F. B. Howe. Pp. 83. Bulletin 484: A Comparison of the Cost of Maintenance of Large and of Small Country Boards in the United States; a Study in the Cost of Government. By M. Slade Kendrick. Pp. 41. Bulletin 486: An Economic Study of the Collection of Milk at Country Plants in New York. By Leland Spencer. Pp. 47. Memoir 124: The Rhizoctonia Damping-Off of Conifers, and its Control by Chemical Treatment of the Soil. By James Stewart Wiant. Pp. 64. (Ithaca, N.Y.)

Reports of the Conferences on Cycles. Pp. 83. (Washington, D.C.: Carnegie Institution.) Free.

Carnegie Institution of Washington. Publication No. 390: Second Bibliography and Catalogue of the Fossil Vertebrata of North America. By Oliver Perry Hay. Vol. 1. Pp. viii+916. 7.50 dollars. Publication No. 395: Race Crossing in Jamaica. By C. B. Davenport and Morris Steggerda; in collaboration with F. G. Benedict, Lawrence H. Snyder, Arnold Gesell, Inez Dunkelberger Steggerda, and many Residents of the Colony of Jamaica. Pp. ix+516+29 plates. 7 dollars. (Washington: D.C.: Carnegie Institution.)

Methods and Problems of Medical Education. (Fourteenth Series.) Pp. v+207. (New York City: The Rockefeller Foundation.)

University of Illinois Engineering Experiment Station. Bulletin No. 195: The Plaster-Model Method of Determining Stresses Applied to Curved Beams. By Prof. Fred B. Seely and Prof. Richard V. James. Pp. 33. (Urbana, Ill.) 20 cents.

CATALOGUES.

A Catalogue of Autograph Letters, Manuscripts and Documents. (New Series, No. 4.) Pp. 96. (London: Francis Edwards, Ltd.)

West Indies: a Catalogue of Books, Maps and Engravings, including Sections on Guiana, Slave Trade and Buccaneers and Pirates. (No. 519.) Pp. 60. (London: Francis Edwards, Ltd.)

S.U.P. 36 for the Treatment of Colds, Influenza, Broncho-Pneumonia, Pneumonia, Asthma and other Inflammatory, or Septic, Conditions. Pp. 16. (London: The British Drug Houses, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 15.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. G. L. K. Pringle: A Survey of 2000 Cases of Rheumatic Disease.

BRITISH INSTITUTE OF RADIOLOGY (Informal Meeting), at 5.—Discussion on Radiology in Obstetrics.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—F. Hodgkinson: Journal bearing Practice.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. B. C. Laws: The Behaviour of a Cargo Vessel during a Winter North Atlantic Voyage.

INSTITUTE OF FUEL (at University College, Nottingham), at 7.—Dr. J. W. Whitaker: Coals and their Impurities.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—E. W. Selby: Compound Locomotives.

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

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.15.—S. Dixon: Some Recent Food Investigations.

ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—G. E. Sharp: Selling Time Switches.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. T. Griffiths: Nickel and its Uses in Engineering.

ROYAL AERONAUTICAL SOCIETY (at St. Ermin's Hotel), at 7.30.—Discussion: That this Meeting is of the opinion the Present Rules for the Schneider Trophy Race and the High-Speed Record are not consistent with the Proper Development of High-Speed Aircraft.

ROYAL SANITARY INSTITUTE (at Town Hall, Carlisle), at 7.30.—P. Dalton and others: Discussion on Town Planning of Built-Up Areas.—C. J. H. Stock and others: Discussion on Some Dangers and Difficulties of Small Water Supplies.—R. Simpson and others: Discussion on The Veterinarian in Relation to the Milk Supply.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Special General Meeting.

TEXTILE INSTITUTE (Lancashire Section) (at Rochdale Technical School), at 7.30.—J. Ryan: The Problems of the Cotton Industry with special reference to the Spinners' Difficulties.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8.—R. J. Bartlett: Some Effects of Low-Frequency Vibration.—S. Wyatt: Factors in Unproductive Time.—Dr. A. Macrae: Some Problems of Vocational Guidance.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8.—Dr. J. E. Hughes: A Case of Hydatidiform Mole with Multiple Small Syncytial Infarction of the Lungs.—Dr. Kathleen Vaughan: Maternal Mortality and its Relation to the Shape of the Female Pelvis.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. Jessie E. Sheret: Massive Collapse of the Lungs.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Nottingham Section).—J. A. Reavell: The Scientific Heating of Liquids and Gases.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. F. A. Mason: Peter Griess.

SATURDAY, NOVEMBER 16.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—C. Fox: Mental Energy.

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum, Manchester), at 6.30.—Conference: Is there a Changing Trend in the Textile Industry?

PHYSIOLOGICAL SOCIETY (at Cardiff).

MONDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London) (jointly with Students' Sections of Institution of Civil Engineers and Institution of Electrical Engineers), at 7.—A. G. Brown: Artificial Lighting of Factories and Public Buildings.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Dr. N. W. McLachlan: The Theory and Practice of Modern Loud Speakers.

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—S. Kershaw: Uniform Worsted Yarn Processing.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—A. E. Munby: The Design of Science Buildings.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. G. Richardson: Wind Instruments from Musical and Scientific Aspects (Cantor Lectures) (I.).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—C. Wells: The Colour of Ruwenzori.

ROYAL AERONAUTICAL SOCIETY (Oxford Branch) (at Oxford).—Squadron Leader Orlebar: The Schneider Trophy Race and the Air Speed Record.

TUESDAY, NOVEMBER 19.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Prof. J. H. Jones: The Present Position of the British Coal Trade.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—E. F. Pollock: Exhibition of Lantern-slides of Australian Fauna.—Dr. Ida C. Mann: Demonstration of Iris Pattern in Vertebrates.—H. B. Cott: (*a*) The Zoological Society's Expedition to the Zambesi, 1927. No. 2. Observations on the Natural History of the Land-Crab, *Sesarma meinerti*, from Beira, with Special Reference to the Theory of Warning Colours; (*b*) No. 3. Observations on the Natural History of the Racing Crab, *Ocypoda ceratophthalma*, from Beira.—Dr. Anna B. Hastings: Cheilostomatous Polyzoa from the Vicinity of the Panama Canal, collected by Dr. Cyril Crossland on the Cruise of the S.Y. *St. George*.—H. C. Abraham: The Male of the Spider *Liphistius malayanus* Abraham, with Further Notes on the Female and its Habits.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. E. G. Coker: Some Experimental Methods and Apparatus for Determining the Stresses in Bridges and Framed Structures.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—O. Stott: The Fan Standards Committee's Report.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Capt. C. J. P. Cave: The Telephotography of Architectural Details with the Aid of the Spotlight.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. J. H. Andrew: Some lesser known Facts concerning Alloy Steels.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. W. J. Sollas: The Sagittal Section of the Human Skull.

WEDNESDAY, NOVEMBER 20.

ROYAL METEOROLOGICAL SOCIETY, at 5.10.—M. G. Bennett: The Physical Conditions Controlling Visibility through the Atmosphere.—Dr. L. F. Richardson: The Reflectivity of Woodland, Fields, and Suburbs between London and St. Albans.—*To be taken as read*:—Thora C. Marwick: The Electric Charge on Rain.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. D. Williams: The Geology of the Country between Nant Peris and Nant Ffrancon (Snowdonia).—Beeby Thompson: The Upper Estuarine Series of Northamptonshire and North Oxfordshire.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at British Sea Anglers' Society, 4 Fetter Lane), at 5.30.—Rhys Jenkins: D'Acres, "The Art of Water Drawing", 1659.

OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—R. Borlase Matthews: Standard Intermediate Voltages for Rural Electrification.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30—G. C. Bunn: Address.

LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—H. Mawson: Multiple Refrigerating Systems.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—A. Tustin: Organised Scientific Research and Engineering Progress.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—J. Innes: The Manufacture of Artificial Silk.

ROYAL SOCIETY OF ARTS, at 8.—P. M. Horder: Urban and Rural Amenities.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. P. de Beauchamp: *Dicranophorus hudsoni* (Glascott).—Dr. J. A. Hewitt: Sarcocystis in Human Heart Muscle.—T. E. Wallis: The Projectograph. An Optical Instrument for the Projection of Images of Microscopical Objects.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—Prof. J. P. Hill: The Developmental History of the Primates (Croonian Lecture).

LINNEAN SOCIETY OF LONDON, at 5.

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

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with Institute of Fuel), at 6.—Discussion on Low-Temperature Carbonisation of Fuel, with Special Reference to its Combination with the Production of Electricity. Introductory Papers by E. H. Smythe and E. G. Weeks (English Practice); S. McEwen (American Practice); Prof. P. Rosin (German Practice).

ROYAL PHOTOGRAPHIC SOCIETY (Kinematograph Group—Informal Meeting), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—Dr. J. W. T. Walsh: Illuminating Engineering.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Royal Aeronautical Society) (at Royal Society of Arts), at 7.45.—L. W. Johnson: The Inspection of Metals and their Alloys.

CHEMICAL SOCIETY, at 8.—Prof. T. M. Lowry: The Rotatory Dispersion of Organic Compounds. Part XVIII. The Validity of Drude's Equation.—G. M. Bennett, F. Heathcoat, and A. N. Mosses: The Influence of the Sulphur Atom on the Reactivity of Adjacent Atoms or Groups. Part III. δ- and ε-Chlorosulphides.—G. M. Bennett and W. B. Waddington: Studies in the Penthian Series. Part II. Penthian-4-one. Part III. Stereoisomeric Derivatives of some Penthianols.—F. G. Angell, H. D. K. Drew, and W. Wardlaw: A New Interpretation of the Isomerism amongst Co-ordination Compounds of Platinum.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting at London School of Hygiene and Tropical Medicine), at 8.15.—Demonstrations by A. Balfour, W. B. Alcock, C. A. Hoare, E. Hindle and A. C. Stevenson, Col. S. P. James, H. S. Leeson, M. E. MacGregor, J. F. Marshall and J. Staley, A. Robertson, J. W. Scharff, A. L. Sheather and A. C. Stevenson, H. M. Shelley, Miss E. Sikes, C. M. Wenyon, V. B. Wigglesworth, and Prof. Warrington Yorke.

ROYAL AERONAUTICAL SOCIETY (Bristol Branch) (at Bristol).—Mr. Fraser: Wing Flutter.

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Manchester).—R. Defries: Unburstable Balls.

FRIDAY, NOVEMBER 22.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—D. P. Dalzell: Heaviside's Operational Methods.—E. T. Hanson: The Dynamical Theory of Resonators.—E. C. Atkinson: Escapement Errors of Pendulum Clocks.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—H. W. Rowell: Commercial Synthetic Resin Products.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. S. Atkinson and others: The Utilisation of Low-Grade and Refuse Fuels, including Towns' Refuse.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. D. Bush: The Quick-Running Oil Engine applied to and used in Railway Service.

ROYAL SOCIETY OF MEDICINE (Epidemiology and Tropical Diseases Sections), at 8.—Discussion on Brucella Infections in Man and Animals. Openers: Dr. W. Dalrymple-Champneys (Epidemiology), Dr. J. T. Duncan (Tropical).

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Aero Wheels and Tyres.

PUBLIC LECTURES.

SATURDAY, NOVEMBER 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: The Marvels of India's Canals.

MONDAY, NOVEMBER 18.

UNIVERSITY COLLEGE, at 2.—Dr. O. L. Brady: Alchemy and the Alchemists.

LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers: The Circumnavigation of Africa, Attempts to cross the Atlantic.

KING'S COLLEGE, at 5.30.—Prof. H. Zichendraht: Scientific Radio Research in Switzerland. (Succeeding Lectures on Nov. 20, 22, 25, 27, and 29.)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—R. H. Grubb: The Pruning of Fruit Trees.

TUESDAY, NOVEMBER 19.

BRITISH SCIENCE GUILD (at Goldsmiths' Hall, E.C.2), at 4.30.—Sir Walter Morley Fletcher: Medical Research: The Tree and the Fruit. (Norman Lockyer Lecture.)

UNIVERSITY OF LEEDS, at 8.—Prof. B. A. McSwiney: Health.

WEDNESDAY, NOVEMBER 20.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. M. Donaldson: The Early Diagnosis and Treatment of Malignant Disease.

KING'S COLLEGE, at 5.30.—Prof. W. T. Gordon: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: Geology and Geography; The Estonian Minister in London: Modern Estonian Literature.

ROYAL SCHOOL OF MINES, at 6.—Sir Harold Carpenter: Single Crystals of Metals and Alloys: Their Production and Properties (Armourers and Brasiers' Company Lectures) (I.). (Succeeding Lectures on Nov. 27 and Dec. 4.)

FRIDAY, NOVEMBER 22.

KING'S COLLEGE (at 40 Torrington Square, W.C.1), at 5.30.—Dr. O. Odlozilik: Outlines of Czechoslovak History (I.): The Geography of Czechoslovakia.

SURVEYORS' INSTITUTION, at 5.30.—Dr. A. W. Hill: Kew and its Relation to Botanical Enterprise in the Empire (Institution of Professional Civil Servants' Lecture).

ROYAL SOCIETY OF ARTS, at 8.15.—Prof. A. E. Boycott: The Causes of Cancer (Chadwick Lecture).

SATURDAY, NOVEMBER 23.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Village Life in the Middle Ages.

CONFERENCES.

FRIDAY, NOVEMBER 15.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30.—Conference on the Growth of Winter Food for Livestock. In Chair, Lord Clinton.

J. G. Stewart, of the Ministry of Agriculture.

Harald Faber: The Danish Solution of the Problem.

Dr. H. E. Annett: The New Zealand Solution of the Problem.

W. B. Mercer and W. A. C. Carr: Winter Food for Dairy and Feeding Cattle.

Capt. R. Stallard: Winter Food for Dairy Cows.

T. C. Ward: Winter Food for Cattle.

NOVEMBER 18 TO 23.

PUBLIC WORKS, ROADS AND TRANSPORT CONGRESS AND EXHIBITION (at Royal Agricultural Hall).

NOVEMBER 21.

BRITISH WATERWORKS ASSOCIATION (Public Works Congress at Agricultural Hall).

G. L. Pepler: Water Supply as a Factor in Town and Regional Planning.

Dr. J. B. Firth: The Preservation of Rivers and Streams from the Standpoint of Water Supply: Some Observations on River Pollution.

Dr. W. Rushton: The Purity of Drinking Waters from a Biological Aspect.