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The Charter of the British Association.

THE grant of a Royal Charter to the British Association is, at least indirectly, a testimony to the virility of a national institution nearly a century old. When the question of the application for a charter was brought forward last autumn, it appeared to surprise many people that the Association did not possess one. That in itself was a compliment; but when the subject had been considered on previous occasions the difficulty of meeting the necessary charges stood in the way. That difficulty was removed by the generosity of Mr. A. A. Campbell Swinton, who undertook to bear the costs; and the petition made by the president, Sir Arthur Keith, and the general officers on behalf of the Association, has now been granted by the King in Council. The recognition of the Association as a body corporate should further strengthen its position in the public view. 'Further,' because that position has been materially strengthened, at any rate since the period of the Association's jubilee in 1881, of which the 'Red Lions' of that time sang :

"At York they thought she was sure to die,  
For she didn't seem to enjoy age,  
But at last the doctors bade her try  
The effects of an ocean voyage,"

which evidently was efficacious, for the song went on to celebrate the recovery which 'she,' the 'British Ass,' had accomplished by reason of 'her' first journey to a meeting overseas in 1884. Now, when it is commonly admitted that the public recognition of scientific advancement, restricted though it still be and not always well directed, is at any rate more widespread than it was when the Association was founded to assist in the spreading, it may reasonably be claimed that the recognition of the Association's work also has broadened and is broadening.

Internal signs of this increased public interest—such as the multiplication by four of the number of press cuttings received in the office in a single year—have not been wanting since, in 1919, the annual meetings were resumed after two years' enforced abstinence, not without some sense of apprehension as to the future. On the financial side the generous benefaction of Sir Charles Parsons and others, supplemented later by that of Sir Alfred Yarrow, went far to ensure the maintenance of the Association's activities under the changed conditions of present times; while as regards those activities themselves, the Association benefited by friendly criticism and suggestion in these columns.

There can be no doubt that the Association has in recent years adapted the proceedings of its annual meetings more closely to modern practice and expectation in the furtherance of its aim to obtain "more general attention for the objects of science." In former years the Association used to stage its big effects almost accidentally: there is no better example of this than the famous disputation between Wilberforce and Huxley and Hooker at Oxford in 1860. To some extent it does so yet: under the impenetrable calm of the inaugural meeting, the presidential address may still be received with nothing more than a decorous murmur of applause; yet the words then spoken may, and sometimes do, carry far farther, and arouse more attention and even heart-searching, than they used to do among the public at large—for an illustration we need go no farther back than last year's address. In these days the members and the public have at least some foreknowledge, through preliminary programmes of the meetings, of the leading topics to be brought forward, so that when, for example, the title of one of the evening discourses at the forthcoming meeting in Glasgow is announced as "The Mystery of Life," they will be enabled to indulge in pleasing speculation as to the next 'wonder' which science may have to reveal.

This sort of publicity used to be something to discredit, and certainly the Association would offer no commendation for the type of pseudo-scientific headline of which lurid examples were quoted in these pages not long ago. On the other hand, it is as true now as when Lyell wrote of the Association in 1838, that in Great Britain "no importance is attached to any body of men who do not make occasional demonstration of their strength in public meetings." There was an undercurrent of satire in those words; yet it cannot be accounted a serious national defect if a proportion of the public is willing to listen to the spoken word: many can do that more easily than they can read, and get some good of it. Moreover, the range of the spoken word broadens with the use of broadcasting—the microphone has already made its appearance at Association meetings—as the range of the printed word will likely narrow if books grow much more costly. So that the faculty of 'thinking on their legs' is one which scientific men and women cannot afford to neglect, but rather should cultivate; or, if that ability fail them, at least they should fall back upon practice in reading their own written words intelligibly and with life; for even that is no common art, as many who 'listen-in' can testify.

It is as a public body, and not only as a 'hotch-potch of philosophers,' that the Association will benefit most materially by the possession of the Royal Charter. More particularly so, in its relations with the many public authorities with which it is brought constantly into contact, both in the course of the organisation of its meetings and in advancing science by making recommendations and tendering advice to administrative bodies in the work of which science plays, or should play, a part. Occasions for such action arise out of the proceedings of every annual meeting. The dignity conferred by the grant of a charter is intangible and difficult to define, but the Royal warrant is the highest recognition of the joint efforts of those men of science who voluntarily undertake the maintenance of the Association's work. It constitutes them a body corporate; it recognises them as a legal entity. Finally, this last consideration makes it possible for the Association to undertake without difficulty the grateful charge laid upon it by Mr. George Buckston Browne, of holding as a national memorial the residence of Charles Darwin at Down. That house is at present in the very appropriate tenancy of a school; but whatever its future may be, Mr. Buckston Browne's generosity has given the Association a new duty consonant with the new status conferred by the grant of the Charter, and it is to be hoped that in its new century of existence the Association may find scope for additional and equally worthy extensions of its activities.

### The Physiology of the Higher Functions of the Brain.

*Conditioned Reflexes: an Investigation of the Physiological Activity of the Cerebral Cortex.* By Prof. I. P. Pavlov. Translated and edited by Dr. G. V. Anrep. Pp. xv + 430. (London: Oxford University Press, 1927.) 28s. net.

FOR the first time a full account of the work which Prof. Pavlov and a devoted school of pupils and associates have been doing in Russia has appeared in English. The results of the work, though recognised to be of extreme importance by physiologists, have been known in England in only one or two of its aspects, as all the literature of the subject has been in Russian, except for some short accounts. Furthermore, although the apparatus required is apparently not very expensive, the necessity for well-constructed research rooms and space for keeping animals, together with the difficulty and the time required in getting experience,

have resulted in the confinement of the use of the method to the school of its origin. It is with special interest, therefore, that one surveys this translation of a comprehensive account of the method and its results.

The general principle of the method of 'conditioning' reflexes has been long known from early accounts of the work. Briefly, the method depends upon the temporary association of a stimulus of no particular meaning with an inborn reflex. Reflexes such as the secretion of saliva in response to the presence of food in the mouth are inborn and fixed and are present in animals in which the cortex of the brain has been removed. Such a reflex, therefore, does not require the presence of the cerebral cortex for its function, and like all the reactions of such an animal, it shows no evidence of intelligence except the purpose in its design; an inborn reflex is automatic. Prof. Pavlov and his pupils early showed that any particular signal, such as a flash of light, a sound, or a tactile sensation, can, by repeated association with the presence of food in the mouth, acquire temporarily the subsequent property of itself causing salivation without the accompaniment of food. The signal stimulus thus becomes the 'conditioned,' and the response it evokes is the 'conditioned reflex.' This temporary association was early demonstrated to be a true function of the cerebral cortex, and later work described in this volume continues to confirm that fundamental fact.

That the new response is a true reflex is maintained by Prof. Pavlov, but the reviewer is not at all convinced. A similar response from man would surely be inseparable from consciousness, and there is some evidence that this is indeed the case (Hamel). It is not proved in this book that the response in the dog is other than that of a mechanism in which a conscious factor is an essential part and in which the sole representative of the original reflex is its final common path. Protopopov has been reported to have conditioned the knee jerk, but there is no mention of this in the book under review. If a true knee jerk (latent period of 0.005-0.01 second and a single volley of efferent impulses) could be conditioned, then the conditioned response may be accepted as a true reflex.

Prof. Pavlov makes use of two inborn 'unconditioned' reflexes to serve as the basis of the study of conditioned reflexes. The first is the secretion of saliva caused by the presence of food in the mouth, and the second the secretion of saliva caused by the presence in the mouth of a substance which is automatically rejected. The wisdom in his

choice is seen when it is realised that the whole investigation is quantitative, *i.e.*, under like external conditions the response is measurable and comparable. The animal is provided with a permanent fistula of one salivary duct, so that the whole secretion of saliva by one gland can be accurately measured during experiments without any discomfort to the animal, and experiments can be thus carried out, at intervals of a few days, for months at a time. It is not to be supposed that, because Prof. Pavlov uses these reflexes of salivation, his insight into the cerebral mechanism is confined to the nervous mechanism of alimentation or to the nervous mechanism of defence. The motor reactions of the animal are carefully observed at the same time, and the two basic reflexes are harmonised with the general behaviour.

Much information is given in this book on the varieties of stimulus used, and the methods are continually illustrated by examples. There are long periods of waiting in each day's observations, and the reader has much admiration for the patience of the investigator. As a result of such long experience and concentration, the method has so been perfected that none can cavil with its conduct, and fallacies in interpretation which have been detected are fully explained. It is much to be desired and hoped that the method will be introduced into Great Britain.

The investigation of the process of conditioning reflexes and the use of the conditioned reflexes for other investigations have developed side by side. A stimulus can be conditioned so as to inhibit an already established conditioned excitatory reflex. By means of differentiating closer and closer values from one another, one excitatory and one inhibitory, the power of sense discrimination in the dog was investigated to a degree never before possible. The demonstration of discrimination between tones 12 d.v. apart, the finding that the dog can appreciate tones which are inaudible to the human ear, and that it lacks colour vision, were all surprising, but the recent investigations of skin sensation and its differentiation from muscle sense and joint sensation open further great possibilities. Here is a purely objective method of investigating sensation.

In dealing with the central mechanism, Prof. Pavlov wisely refrained from identifying the loci of analysis of these sensations and of the establishment of the conditioned responses with the conception of 'centres' developed by earlier writers and their methods. He calls the central mechanism for each sensation an 'analyser,' and several lectures

are devoted to the investigation of the process of establishment and disappearance of localised excitation and inhibition. The 'investigatory reflex' which is discussed in several aspects is surely related to the property of 'attention' which is so conspicuous in animal behaviour.

Sleep, the mechanism of which has always seemed such a complete mystery, is identified as a variety of the process which Prof. Pavlov calls 'internal inhibition.' The investigations not only fully support this identity, but he also brings by them a great deal of light on intermediate states such as hypnotism. Prof. Pavlov brings forward evidence to show that the processes of inhibition and excitation as exhibited by conditioned responses are essentially the same nature as those processes as they are known in spinal reflexes. Inhibition is clearly not synonymous with exhaustion. The identity with spinal processes is only to be expected, but as inhibition in the spinal reflexes shows so much evidence of being an *active* process, the reviewer finds it difficult to reconcile sleep with a process implying cortical activity. But now that the process has been so brilliantly demonstrated, sleep and the intermediate states will surely become increasingly investigated by this method; we look forward to much further information of the mechanism of internal inhibition, especially as to the means of its localisation.

Subsequent lectures lead the reader to the investigation of pathological states. Here the work becomes of extraordinary interest to the neurologist and psycho-pathologist. With its facilities for comparable quantitative measurement, the method has a unique scientific value in investigating the temperament of an animal; the degree of 'stability' of behaviour becomes something definite and the physiological bugbear of 'nerve energy' appears in a new light. The interpretation is rightly most guarded, and few will deny the soundness of all the deductions. The results of experiments on functional interference with the cortex, indeed, bode serious rivalry to current psychological methods of attack on the problems of neuroses and psychoses. In analysis of the results of surgical interference with the cortex, the method also entirely replaces the old crude methods of appreciating defects in intelligence in animal conduct. One is surprised that some of the smaller operations should produce such large degrees of change attributable to scar tissue, and would like more detailed histological investigation of all the operated cases. Prof. Pavlov, however, realises this lack, and it is hoped that future work will fully remedy it.

The refutation of the doctrine of specific association centres is timely and well founded. The widespread representation of the visual and acoustic analysers will be a revelation to most of those interested in visuo-psychic disturbances, aphasia, and the psychic aspects of other special sense disturbances. The establishment of visual responses to luminosity and shape after extirpations of the occipital areas is not only a great advance in knowledge but also reflects the extraordinary sensitivity of the method. Prof. Pavlov points out the richness of speech in factors of intensity, time intervals, sound discrimination and discrimination of order in serial succession, each provocative of conditioned reflexes. A method for the physiological approach to the problems of aphasia at last seems indicated. Another striking result of the flexibility of the method is the proof that both hemispheres are necessary for the appreciation of direction of origin of sound, and the description of the extraordinary case of the dog showing symptoms of visual illusion following the appearance of strange objects in one field of vision and not when they appeared in the other.

The storing of past associations which forms the essential part of the process of conditioning would seem to form the greater part of the gulf between reflex action and conditioned response. The reviewer would like to have seen this discussed. The appreciation of relative time impresses the reviewer as being one of the fundamental properties of the cerebral cortex, and he considers it as another manifestation of the storage capacity of the nervous tissue of the cerebral cortex. The development of this storage factor is the fundamental process in the evolution of consciousness and memory.

The degree of precision in stimulus evaluation and measurement of effect, and the recognised high degree of intelligence of the dog in the study of conditioned reflexes, make maze learning and problem-box experiments with rats, as an approach to the problems of mind, crude and undifferentiated in comparison.

It is of vital interest to all who study the mind and the brain to become intimate with the developments described in this book. The wisdom of the Royal Society in enabling a translation to be made, and in the choice of translator, is manifest, and Dr. Anrep, a former pupil and collaborator of Prof. Pavlov, is to be congratulated on his excellent rendering into English, especially of the large new terminology.

D. DENNY-BROWN.

### Hypothetical Ethnology.

*Peoples and Problems of the Pacific.* By J. Macmillan Brown. In 2 vols. Vol. 1. Pp. xiv + 327 + 65 plates. Vol. 2. Pp. x + 297 + 32 plates. (London: T. Fisher Unwin, Ltd., 1927.) 50s. net.

IN these two closely packed, well-illustrated volumes, Dr. J. Macmillan Brown has collected a number of articles written during the last fifteen years for various magazines, newspapers, etc., and it must be admitted that the book rather suffers from its journalistic origins. It is the record of many wanderings throughout the Pacific, and contains a great number of original observations and suggestions on the past, present, and future of the Polynesians. In this, as in his previous books, Dr. Macmillan Brown lays great stress on movements of upheaval and depression in the area, and refers to accounts of islands which later have become submerged. He heard in the Cook Islands that the island of Tuanaki had disappeared about the middle of last century. If this be so, W. T. Brigham had not been informed, as he describes it as being an uninhabited atoll ("Index to the Islands of the Pacific Ocean," 1900). An interesting reference is made (vol. 1, p. 188) to Malden Island; it is reported to contain ruined pyramid-temples and paved roads, and thus deserves careful investigation. Malden is quite incapable of supporting human life, and "the people who built the temples could not have lived on the island as it is. Probably they lived on fertile archipelagoes within canoe-distance of its shores," as uncharted shoals exist in its neighbourhood.

Dr. Macmillan Brown also is of opinion that the great ruins of Ponape in the Carolines "cannot be explained without assuming a submerged empire with millions of inhabitants." He argues that the culture of Ponape was due to a Polynesian migration bringing with it kava, father-right, and megalithism. It is true that kava drinking, which also occurs in Micronesia only in Kusaie and Ponape, is a characteristic Polynesian custom. Christian and Rivers have suggested that probably it was not an independent invention, but merely a retention of one element of betel chewing, which was developed in Oceania into a ceremonial rite. Kava drinking was unknown in Torres Straits (vol. 1, p. 104). Dr. Macmillan Brown adds, "Hereditary chieftainship could have come from Polynesia alone, the realm of father-right; but Williamson states that in most of the Polynesian islands women were qualified to succeed, and that the line of succession could pass through women"

("Social and Political Systems of Central Polynesia," 1924, vol. 3, p. 395), though, as a matter of fact, succession was practically invariably in the male line. Rivers says, "If the succession of women to the dignity of chief be put on one side as capable of special explanation, it becomes probable that such indications of matrilineal institutions as are found in Polynesia are to be connected with the earlier stratum of the population" ("History of Melanesian Society," 1914, vol. 2, p. 322). It therefore appears that the predominance of patriliney (father-right) in Polynesia is relatively recent. Hereditary chieftainship could as readily have come from the west, and W. J. Perry as easily disposes of hereditary chieftainship, megalithic remains, and many other matters as being brought into the Pacific from the west by the 'Children of the Sun'; but he has nothing to say about kava. The third argument is based on megalithic structures; such certainly occur in Polynesia, but they are also to be found in Melanesia, Indonesia, and Asia. However, our author goes on to say, "there are features in the architecture of this wonderful city [Metalanim] that never came from Polynesia"; these he traces to a later movement from Japan.

The author is a strong supporter of the thesis that there were great land masses in the central Pacific which have only recently disappeared. On these very hypothetical lands the Polynesians developed their civilisation, untouched by foreign cultures, and it was due to their submergence that the Polynesians migrated westwards. By a linguistic argument he comes to the conclusion that the Polynesian language was brought into the Pacific lands by the first migration in the "Old Stone Age . . . at least twelve thousand years ago" (vol. 2, pp. 175, 176), and with it came the race that contributed traces of blond hair that still persist in Polynesia; but apart from this "there is sufficient in the physique of the Polynesians to point to western Europe as their origin and home," and he suggests that "Polynesian physical characters point through Japan and Central Asia to Western Europe" (vol. 2, p. 153)! The facts upon which he bases many of his theories admit of other solutions, and in not a few instances the data themselves are open to question. The reader should be warned that specialists in the various subjects dealt with in this book do not regard Dr. Macmillan Brown as a safe guide to follow.

Many interesting and suggestive remarks are made by Dr. Macmillan Brown about the present and future economic and political problems of the Pacific. A historical sketch of ancient empires.

paves the way to a consideration of Japan and what may happen there. He regards British Columbia and New Zealand as "the sure naval shields of the English-speaking peoples in the Pacific"; indeed, he prophesies a great future for New Zealand, but is pessimistic about the United States of America. The strictures on the condominium in the New Hebrides are outspoken and timely—if they are not too late; the present writer has recently had information from Malekula which shows the unsatisfactory nature of this compromise—but indeed it is generally admitted.

The decay of the native population in Oceania is discussed in several places, and our author comes to the following conclusion, for which there is much to be said: "If our paternal governments and our missionaries mean to save our primitive peoples from themselves and death, they must recognise the law of struggle and work as the only panacea. They must study their manners and customs and see how far they can modify these so as to make them methods and stimuli to work."

A. C. HADDON.

### Crystal Surfaces.

*The Nature, Origin, and Interpretation of the Etch Figures on Crystals.* By Prof. Arthur P. Honess. Pp. xiii + 171. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 17s. 6d. net.

IT is probably evident to many others besides specialists how greatly the science of crystals has lately progressed by the introduction of the X-ray method. Brilliantly created some fifteen years ago by Laue, and simplified and developed by Sir William and W. L. Bragg, the method early led to convincing deductions of the atomic arrangements within certain crystals; and almost immediately was also applied by Moseley to the elucidation of the atom itself. After a marked pause due to the War, the method has been systematically developed in many directions, not least actively in its original rôle as a crystal probe. The purely crystal development has in fact been so rapid that a general halt is now recognisable, not in the number of workers or of their results, but in the kind of results. It is probably true to say that there has been no advance in principle for the last three years.

It therefore seems possible to make an estimate of the present position without incurring much danger of its being upset by immediate developments. Divested of all qualifications, it may be

said that the X-ray method illuminates the interior of a crystal and casts shadows on its surface. Dürer's picture of "Melancholia beholding a Crystal" possibly acquires prophetic qualities!

The second half of the above conclusion doubtless needs support. From time immemorial have crystallographers been concerned with the problem of structure, although possibly only with limited curiosity: they would pry into the inside mainly in order to understand the outside. A partial understanding was first allowed to Haüy, according to whom the plane boundary faces correspond to the simpler planes, drawn through a close-packed stack of the presumed structural units. But subsequent accumulations of material gradually led to a knowledge of scores, if not hundreds, of substances the external planes of which bear no thoroughgoing, simple relation to any conceivable structure. Bravais in the middle of the last century and Fedorov at its close had to leave much unsimplified. In this they have been strongly supported by the X-ray method, which adds considerably to the sum total of perplexities. A single example will serve as an illustration.

Early in his career, Haüy felt quite sure about the shape of the barytes unit—an orthorhombic prism, walled-in by cleavage planes and of a modest altitude. Later workers equally confidently doubled the height, as giving a slightly simpler correlation between boundary planes and structure. Fedorov was not so certain. In his "Krystallreich" (a catalogue critically arranged according to classical conceptions of structure) he places barytes here; its isomorph potassium perchlorate there; and potassium beryllio-fluoride elsewhere (others would have placed all three together). The X-ray results show that Fedorov was right for barytes and wrong for the perchlorate (for the beryllio-fluoride there is still no evidence). It must here be interpolated that Fedorov's treatment of barytes seems to have been guided by instinct rather than a close adhesion to his own expressed principles. In any case, the X-ray results prove that the crystal distances along the front-to-back direction of barytes are twice those advocated by any crystallographer, simpler-minded than Fedorov. Inferentially, structurally simple planes are not always observed on a crystal, giving place to complex planes. Conversely, omnipresent cleavage planes may be structurally complex.

The present-day position is now perhaps realisable. The relation between form and structure, after being deemed simple and then less simple, must be recognised as being complex now that

exact information concerning structure is available. It is of course not impossible that another Haüy may bring about a tolerable synthesis of cause and effect, but it seems more probable that another Laue must first appear—one who shall conceive of a method of examining surfaces as powerful as that which now penetrates into the interior.

In the meantime, crystallographers have obviously to carry on in their several spheres of work. Some, no doubt, will acquire the new X-ray technique in time to win results from simple compounds, while others, whose field of work lies in the investigation of complex molecules, may hesitate to ponder whether the results justify an expensive equipment. Perhaps the majority will remain on the surface; either investigating new substances in the classical way; or seeking to classify morphologically the existing crystal kingdom for purely utilitarian ends (the identification of substances by crystal measurement); or in the pursuit of truth by a more intensive examination of individual crystals—which brings us to the book under review.

It is now many years since students of crystal symmetry first recognised how important it is to supplement older observations on forms of growth by the more experimental method of a partial dissolution. The etch figures (plane or curved) thereby obtained frequently take up highly significant forms and orientations. The results are, however, only to be found in German monographs, so that any attempt to render them more generally available to English-speaking students is welcome, especially when it comes from one who has adopted this subject as his own province of work.

The work falls informally into two parts, general and special. In the former, divided into five chapters, the author presents a historical and well-documented discussion under the following main heads: introduction; methods; the process of growth of the etch figure and its interpretation; anomalous etchings; the etch figure and isomorphism. In the special section, occupying one long chapter of some eighty pages of text and illustrations (mainly photographs), are brought together the results of his own investigations on some ten mineral species, representing six classes of symmetry. A concise statement of conclusions brings the monograph to a close (except for a good index).

In offering any general criticism of the book, the reviewer is so conscious of its many good qualities that he would expressly ask a reader not to conclude from any indications of defects, that it is lacking in aim or achievement. Here and there

one meets with doubtful expressions. The statement "theoretically, of course, a crystal cannot possess a curved face" leaves one guessing at the identity of the theory, which is sufficiently powerful to override a wealth of facts—if the author had extended his survey beyond the limits of the mineral kingdom, he would have been able to cite many cases of crystals making good their claim to develop curved surfaces under uniformly continuous conditions of growth. But quite apart from an occasional lapse, there seems to be more general grounds of dissatisfaction.

We are told in the preface that the book is a thesis offered by a candidate for the D.Sc. degree. Unfortunately, it has preserved not only the virtues but also the defects of its origin. It was no doubt originally advisable to bring together the author's own work and stress its importance by a wonderful series of photographs and diagrams, but now that the work is addressed to a wider audience, a less complete polarisation seems desirable. Many of the excellent photographs and diagrams of the special part seem badly needed in the first part, as well as others not included in the book. Anyone new to the subject might do worse than read the particular before the general.

Another element of weakness is possibly referable to the same antecedent. The author has elected to specialise in the older methods of investigation by microscope and camera, and there is no doubt still much to be done in this way. But much has also been done by the aid of the two-circle goniometer, the introduction of which first placed a three-dimensional measuring instrument in the hands of the crystallographer. A chapter on the results obtained by Goldschmidt, Wright, and others, would seem to be almost indispensable in any general account.

It is high time to turn, however, to the author's merits. Within his self-imposed limits he has covered much ground in an engaging way, the whole work being illumined by a simplicity of style which many will covet. He is ever cautious in drawing a conclusion, even if it be his own; and there is certainly no other such work in English (and probably not in German). The book can be confidently recommended to the attention of senior students, both on account of the importance of the subject and as a corrective to the text-book attitude that Nature is simple; and also to the researcher, as showing how one may hope to attain further information concerning surfaces by present-day methods. In any selection of material for such future work, a plea may perhaps be here

offered for the six thousand or so non-minerals catalogued by crystallographers. Although the kings and queens of the crystallographic pack may be minerals, there are surely not a few useful cards among the laboratory products the constitutions of which are known—not to speak of the embarrassing number of aces in the four hundred orthorhombic, monoclinic, and anorthic crystals, the symmetry classes of which are *a priori* fixed by the Pasteur principle. The extensive application of the etch method to such first-rate material would seem to be bound up with any serious attempt to define its standards.

T. V. B.

### Our Bookshelf.

*Kostychev's Plant Respiration.* Authorised edition in English with editorial notes. By Dr. S. Kostychev. Translated and edited by Prof. Charles J. Lyon. Pp. xi + 163. (Philadelphia: P. Blakiston's Son and Co.; London: Arthur F. Bird; American Book Supply Co., 1927.) 2.50 dollars.

THIS book seeks to do what has not previously been attempted, namely, to outline the main features of plant respiration. There is no student of this subject better qualified to write on it than Prof. Kostychev. Trained by Palladin, among others, and long an active worker on the chemical problems associated with fermentation and respiration, he is in a position to present a balanced and authoritative discussion of a subject in which Russian workers have long been leaders.

As might be expected from the author's researches, attention is focused principally upon the biochemistry of respiration, and particularly upon the establishment of the theory of the connexion between the intermediate products of alcoholic fermentation and 'normal' respiration in the presence of oxygen. While the author expressly states that this is only a working hypothesis, he marshals his facts ably and presents a most attractive case in its support. Kostychev undoubtedly lays very great stress upon his discoveries that partly fermented sugar solutions not only greatly increase the rate of respiration in oxygen, but will also liberate carbon dioxide in quantity when acted upon by an oxidase system. He clearly regards the former fact as good evidence for the view that oxygen respiration starts with the intermediate products of alcoholic fermentation, and the second fact accounts for his preference for the Bach-Engler theory of oxidation. He states very clearly alternative explanations and theories.

It is in this broad statement of Kostychev's point of view that the great interest of the book will be found. It should not be assumed, however, that other aspects of respiration are ignored. Adequate space is given to the relation between external conditions and respiration, including fermentation, and there are valuable outlines of methods used in measuring the products of these processes. The

translator and editor has judiciously amplified these, and has added many references which serve to bring the extensive bibliography up-to-date. The author has also added an account of Warburg's theory of respiration which was absent from the original German edition. There is, finally, an interesting attempt to co-ordinate the various processes in the respiration of different types of plants, on the basis of the ratios of oxidising to fermenting enzymes which are present.

W. H. P.

*Air Ministry: Meteorological Office. The Observatories' Year Book, 1924: comprising the Meteorological and Geophysical Results obtained from Autographic Records and Eye Observations at the Observatories at Lerwick, Aberdeen, Eskdalemuir, Cahirciveen (Valencia Observatory), and Richmond (Kew Observatory), and the Results of Soundings of the Upper Atmosphere by Means of Registering Balloons.* (M.O. 289.) Pp. 366. 5s. 6d. net. *Year Book, 1925.* (M.O. 229.) Pp. 372. 6s. net. Published by the Authority of the Meteorological Committee. (London: H.M. Stationery Office, 1927.)

THE appearance during 1927 of two issues, for 1924 and 1925, of the "Observatories' Year Book" of the Meteorological Office indicates notable progress in overtaking arrears of printing due to post-War causes; it may be hoped and expected that a continuance of this acceleration of printing will soon lead to the attainment of the ideal practice of publishing each year's observations before the close of the following year. The volumes include an immense amount of standard observational data for meteorology, terrestrial magnetism, and seismology, made efficiently by good observers and published in concise, economical form. The period in question was marked by the retirement from Kew Observatory of Dr. C. Chree, who had been superintendent for thirty-two years; he was succeeded by Mr. F. J. W. Whipple. At the same time, 1925, the Kew magnetographs were discontinued, and their place was taken by Galitzin seismographs brought from Eskdalemuir; Kew thus succeeds Eskdalemuir as the official seismological station in the British Isles. The last-established observatory under the Meteorological Office is that at Lerwick, in the Shetlands; its work is almost wholly confined to atmospheric electricity, terrestrial magnetism, and auroræ; many experimental difficulties, not wholly overcome by the end of 1925, have been experienced with the instruments installed there.

*Meteorology.* By David Brunt. (The World's Manuals.) Pp. 112 + 8 plates. (London: Oxford University Press, 1928.) 2s. 6d. net.

THE aim of this book is, in the author's words, to give "a brief sketch of the physical principles underlying the phenomena which constitute 'weather,' in so far as this is possible without mathematical analysis."

The absence of mathematical formulæ and the small size of the book, together with a certain



simplicity of style, may combine to give the impression to a meteorologist who may casually glance at it, that he has before him one of those entertaining little handbooks in which the presence of numerous inaccuracies is regarded by the author, if he should happen to be aware of them, as a matter of small importance, seeing that few readers will be likely to detect them. A more careful perusal of the book will dispel this impression: not only will he find a high standard of accuracy, but he will see also that a serious effort has been made, and with a considerable degree of success, to give a picture of the development of meteorology as a branch of physics and some suggestion of the lines along which it may advance in the future.

There is no account of practical weather forecasting—a wise omission in view of the size of the book and the predominant part played by un-systematised experience in the 'science' of weather forecasting; on the other hand, a whole chapter is set apart for the important subject of the reception of solar radiation by the atmosphere. The general and local circulations of the atmosphere are admirably dealt with, having regard to limitations of space.

Some knowledge of physics is essential to anyone who wishes to appreciate fully the later chapters, but these chapters should nevertheless be very instructive to those whose only knowledge of physics is 'picked up' in the earlier chapters.

The printing and the illustrations of cloud forms and lightning are both exceptionally good, and the work can confidently be recommended for educational purposes.

*A Handbook of the Birds of Iceland.* By Masa U. Hachisuka. Pp. v+128+7 plates. (London: Taylor and Francis, 1927.) 12s. 6d. net.

THE Honourable Masa U. Hachisuka is a very young ornithologist, but his work—his first, we understand, of any magnitude—shows that he is keen, industrious and methodical, and, though it is an ambitious attempt for a first work, there is little doubt it will prove most useful. We congratulate the author, not only on his pluck in undertaking it, but also on the result itself.

The author admits a total of 141 birds actually found, either as straggler, regular visitor, or resident in Iceland. A few of the birds mentioned he admits as 'non-proven,' and one new species, *Calidris maculata*, the American Pectoral Sandpiper, he adds as new to the Iceland list. The author's remarks on the various geese sum up our knowledge of these birds to date and are interesting. He considers it reasonable to believe that the pink-footed goose breeds in Iceland, and, though he admits the Bean goose on very slender evidence, probably indeed quite insufficient, he agrees that it never breeds there.

The photographs with which this little book is fully illustrated are quite good, though we fear that the plate giving the comparative size in diagram form of the eggs of ducks and geese will not be of very much use, as the overlapping of dimensions in big series of these eggs is very great. We shall

look forward to further works on birds by Mr. Hachisuka, and recommend this, his first, to all those who intend to visit Iceland to study ornithology. It summarises in a compact form much scattered information and will save Icelandic visitors an immense amount of research and trouble.

*The Crustaceans of South Australia.* By Herbert M. Hale. (*Handbooks of the Flora and Fauna of South Australia*, issued by the British Science Guild (South Australian Branch), and published by favour of the Honourable the Premier.) Part 1. Pp. 201. (Adelaide: Harrison Weir, 1927.) 5s.

FULL descriptions and good illustrations of all the South Australian Malacostraca are given in this useful book. It is intentionally written in a popular way, and quite untrained naturalists should be able to identify any species, whilst the specialist is greatly helped in having this book for reference. The malacostracan fauna of South Australia is large and of great interest, and obviously many problems are only waiting for the worker to elucidate them. This seems specially the case with the life histories, so little being known about the larval forms and the few notes given suggesting so much. Some of the Reptantia hatch in a very late stage of development. It is well known that members of the family Potamonidæ hatch as forms very like the parent, the truly larval stages taking place within the egg. In South Australia we find other crabs with the same peculiarities. Thus some of the Dromiidæ are known to hatch as tiny crabs, having no free-swimming stage and sheltering under the body of the parent; other species with very large eggs are probably similar.

Notes on habits and biology make the book readable as well as valuable, and the low price places it within reach of anyone interested in the group.

*Proceedings of the London Mathematical Society.* Second Series. Vol. 26. Pp. ii+558. (London: Francis Hodgson, 1927.) n.p.

This volume of *Proceedings* maintains the usual high standard of the London Mathematical Society's publications. Of the thirty-two papers it contains, twenty deal with various aspects of the modern theory of functions, four with geometry, and three with applied mathematics. This preponderance of function theory should be regarded more as an indication of the tendency of present-day mathematical research in Great Britain than as a sign of the relative importance of the subject. When Cayley and Sylvester, Clifford and Smith, dominated mathematical development, papers on geometry and invariants were paramount, while recent volumes of the *Transactions of the American Mathematical Society* contain a large proportion of papers on non-commutative algebra, a subject which has scarcely been touched by British mathematicians. Meanwhile, the higher function theory is enjoying a protracted run which is likely to continue until there arises an outstanding leader inspired to direct research activities into some other branch of pure mathematics. W. E. H. B.

### 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.]

#### The Relations of Nile and Faiyum in Pliocene and Pleistocene Times.

DURING the past winter we have had an opportunity of investigating, under the auspices of the Oriental Institute of the University of Chicago, the Pliocene and Pleistocene geology of that part of the Nile Valley adjacent to the Faiyum depression, and it has occurred to us that some of the results may interest readers of NATURE who followed some time ago a discussion of certain archaeological problems of the Faiyum and its lakes.

It has long been known that the northern part of the Nile Valley was occupied by an arm of the sea in early Pliocene times and that a marine fauna was succeeded by an estuarine one, which lasted until the close of the Pliocene epoch. This indicates a Lower Nile Valley cut to much its present form in pre-Pliocene times.

Fossiliferous marine strata have now been found to a height of 100 metres above sea-level, resting on the old valley side, with a gulf stretching into the southern part of the Faiyum basin. They had been eroded before the deposition of the estuarine beds, which are found upon them and filling hollows in them. The deposits have now been connected with a remarkable system of lateral valleys, which drained a part of the Libyan plateau and in Upper Pliocene times became choked with boulders and gravel. The fossil valleys are in all stages of dissection, some standing out as the most prominent ranges of hills in a soft Eocene country, eroded below their base, others still retaining substantially their original form. Some of the valleys flowed across the region which is now the Faiyum, some draining directly into the Nile Valley and one or more into the southern Faiyum gulf already partially filled with marine and estuarine strata. Part of the northern side of the basin is now bounded by one of these dissected Pliocene valleys, cut along the boundary of the Eocene and Oligocene beds. While the Eocene marls on the southern side of this old valley have been entirely removed by erosion, the harder Oligocene rocks on the north still stand as a high escarpment above the Pliocene filling. The Faiyum basin, as such, did not exist in Pliocene times, and the southern gulf was probably but a flooded pre-Pliocene tributary of the Nile.

The Nile Valley returned to normal fluvial conditions in Plio-Pleistocene times, when a magnificent series of terraces was cut along its western side, the river at times meandering over the eastern part of the region now the Faiyum. The terraces with Nile gravel first appear at 470 feet above Nile, and below this three successive river channels may be identified to 150 feet, which stage seems immediately to have preceded Pleistocene times (assuming for convenience that the incoming of Lower Palaeolithic man marks the beginning of that epoch in Egypt).

There follows the most extensive remaining channel, with a marginal level of about 60 feet. This contains Lower Palaeolithic implements, while at a similar level a fragment of terrace or beach containing implements has been found inside the eastern boundary of the basin.

Prior to the Middle Palaeolithic, the Faiyum seems to have been dissected by normal processes of stream and river erosion, in harmony with the rest of the Libyan plateau. But, owing to the extremely soft strata locally exposed, a broad plain had been formed at a low level, and the drainage of this could only escape into the Nile by cutting a narrow passage (the Hawara Channel) between two of the Pliocene valleys choked with virtually indestructible materials. In Middle Palaeolithic times this plain first appears definitely as a lake, and for the first time we find a reversal of drainage. In the Nile Valley a Middle Palaeolithic drainage has been found at about 25 feet, sweeping through the Hawara Channel and falling as it does so. On the inside it passes into shoals, a beach, and a storm-beach, which have been followed and mapped along the eastern side of the Faiyum. Implements and fossil Mollusca have been found *in situ* throughout this series.

At a slightly lower level, with an increased tilt towards the Faiyum, another similar series has been found, of Sebilian, probably Lower Sebilian, age. (Sebilian is the term applied by M. E. Vignard to a post-Mousterian industry of Capsian affinity in Upper Egypt, and we now find it *in situ* at this level in Lower Egypt.)

Succeeding stages in the Nile Valley and in the Hawara Channel are hidden below the level of recent alluvium, but it will be remembered that the extremely valuable work of Miss E. W. Gardner proved the existence of two lower lakes in the Faiyum. Miss Caton-Thompson showed the more recent to be Neolithic, but the age of the older remained in doubt. On the east side of the Faiyum, where its magnificent storm-beach first appears, such evidence as we have collected is suggestive of a probable Upper Sebilian age. Accurate levelling was carried to the point of meeting with Miss Gardner's lakes on the north and south sides of the basin.

There is no sign of desert conditions in Palaeolithic times in the region with which we have dealt; on the contrary, the rainfall was heavy. Levels set certain bounds to the size of any lake, and in view of the climate and the essentially fresh-water fauna of the Palaeolithic lakes, it would appear that the water flowing in from the Nile returned to it at times, with the local drainage water, by the Hawara Channel. No evidence has been found that there was ever any other inlet from the Nile. The presence of the fresh-water fauna at a sufficiently low level on the divide between the Faiyum and Wadi Rayan to the southwest leads us to suppose that the latter was flooded in Mousterian times.

The excavation of that part of the Faiyum basin below sea-level must, in view of the above, be relegated to late- or post-Sebilian times, when the Nile cut a deep channel, now choked with alluvium of unknown thickness. The rise in the bed of the Nile, with the deposition of this alluvium, seems to have synchronised with the inception of desert conditions. The cutting off of rainfall prevented local detrital material from silting up the Faiyum basin and it became a 'sump' of the rising Nile, with a bottom below the new sea-level. The evidence recently published by Miss Gardner that the old lake bed was drained and eroded before the advent of the Neolithic lake here acquires new significance.

We find it difficult to believe that the Faiyum was excavated by any other means than fluvial erosion, although the modifications to which it has been subjected since the incoming of desert conditions are obvious. In view of this, the conclusion seems to be inevitable that a gorge of about the same depth as the Nile Valley was cut beneath the

Hawara Channel and has since been filled with alluvium.

The work will be published in full by the Oriental Institute of the University of Chicago.

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**The Origin of the Spectrum of the Solar Corona.**

THE arguments which have been brought forward to explain the origin of the spectra of nebulae may be used with certain modifications to explain the spectrum of the solar corona; for it must be composed of such atoms thrown out by radiation pressure or other agencies from the general atmosphere of the sun. On account of the lower temperature of the sun, the atoms concerned should be non-ionised, or such as can be easily ionised. They should also be light. All these considerations narrow down the choice to a very few elements like Li<sup>+</sup>, Be<sup>+</sup>, B<sup>+</sup>, C, N, O . . . Si, P, S, P<sup>+</sup>, and S<sup>+</sup>, etc. It is the object of this note to discuss how these elements can give rise to the coronal spectrum.

It is now generally recognised that matter above the solar photosphere is largely supported by radiation pressure acting in a selective way. Prof. Milne has shown from transition probabilities of the Ca<sup>+</sup>-atom (or the average life), that Ca<sup>+</sup> emitting the H-K lines is subjected to such a large radiation pressure that it almost overcomes the force of gravity. If this argument be true, the logical consequence would be to extend it to other elements. We can leave out H and He because their resonance lines are in the extreme ultra-violet and their normal atoms would be subjected only to slight radiation pressure. But such is not the case with Li. The resonance line of Li is at 6708 Å., the corresponding  $E_\lambda = 0.8 E_m$ , the maximum emission  $E_m$  of the sun regarded as a black body at 6500° K; hence the force of radiation would more than balance the force of gravity; it would be expelled entirely from the solar atmosphere. It can be retained only in the ionised form. The entire absence of Li-lines from the Fraunhofer spectrum seems to support this view. If Li<sup>+</sup> be present, it may or may not be detectable, as the fundamental lines are in the Schumann region, and the excitation required to bring out the next important lines will be too large. The only favourable line is  $\lambda 5484.69$ , or  $\lambda 5484.90$  (Rowland's Scale—a very weak line is given at 5484.846 in Rowland's Table, but the identification is doubtful), which belongs to the singlet system of Li<sup>+</sup> (2S-3P). Similar considerations would apply to Be<sup>+</sup> and B<sup>+</sup>.

In carbon we come across a new feature. This new feature is best explained by taking the case of Si, for which the full details of the spectrum are known. Si has five fundamental levels,  $^3P_{0,1,2}$ ,  $^1D_2$ ,  $^1S_0$ , all arising out of the combination  $pp$  (or  $M_2M_2$ ). The next combination is  $ps$  ( $M_2N_1$ ), and it gives rise to  $^3P_{0,1,2}$ ,  $^1P_1$ . The lines are shown in the accompanying table, the figures being taken from Fowler, *Phil. Trans.*, vol. 225, p. 45. The table shows that the ( $^3P$ - $^3P$ ) lines are the most fundamental, but their wave-length is at  $\lambda 2514 - 2528$ , while the less fundamental  $^1S_0 - ^1P_1$ ,  $^1S_0 - ^3P_1$  lines are at  $\lambda 4103$ ,  $\lambda 3905$ . Si is in fact detected in the sun by those two lines, some other subordinate lines, and some lines of Si<sup>+</sup>. The problem now arises that if we

heat Si to incandescence, to say 4000° C., so that the corresponding wave-length of the maximum emission is towards the red, will the group at  $\lambda 2514-2528$  be more intense or the lines  $\lambda 4102$ ,  $\lambda 3905$ ? Laws of temperature radiation demand that  $\lambda 4102$ ,  $\lambda 3905$  will be more intense, while the theories of spectra require that  $\lambda 2514-2528$  will be more intense at all temperatures, as the  $^3P_{0,1,2}$  states will be much more numerous than the  $^1S_0$ -states ( $n_{1s}/n_{3p} = e^{-\frac{22000}{T}}$ ), and there is always a greater tendency on the part of the higher excited  $^3P_{0,1,2}$ ,  $^1P_1$  states to revert to the more fundamental state.

An experiment was performed at this laboratory by Messrs. Majumdar and Kichlu to decide this question. They did not work with silicon, but with the more easily manageable thallium. This has two fundamental states,  $2p_1$ ,  $2p_2$ , separated by a large interval  $\Delta\nu = 7793$ , so that  $n_{2p_2}/n_{2p_1} = \frac{1}{2}e^{-\frac{25011}{T}}$ . They heated thallium in a vacuum graphite furnace to about 2500° A. and photographed the spectrum of thallium vapour. The  $2p_1 - 3s$  line has the wave-length  $\lambda 3775.72$ , the  $2p_2 - 3s$  line has the wave-length  $\lambda 5350.46$ . As the  $2p_1$  state is about a hundred times more in abundance, we expected that the line  $\lambda 3775.72$  would be more intense; at any rate it would not have less

$\frac{L_2L_2}{L_2M_1}$	$^3P_0$	$^3P_1$	$^3P_2$	$^1D_2$	$^1S_0$
$^3P_0$		2524.118 39605.89(8)			
$\bar{P}_1$	2514.331 39760.04(7)	2519.210 39683.03(7)	2528.516 39537.01(9)	2987.65 33461.39	4102.945 24365.89(5)
$\bar{P}_2$		2506.904 39877.83(9)	2516.123 39731.73(10)	2970.35 33656.27(1)	
$^1\bar{P}_1$	2438.782 40991.64(3)	2443.378 40914.54(3)	2452.136 40768.42(3)	2881.585 34692.97(10)	3905.515 25597.61(9)

than half the intensity of  $\lambda 5350.46$  (because the weights of  $2p_1$  and  $2p_2$  states are as 1:2). But  $\lambda 5350.46$  was at least ten times more intense than  $\lambda 3775.72$ . This fact is therefore more in accordance with the view that thallium vapour is partly in equilibrium with temperature radiation from the walls. But still we have to find out why the larger proportion of the  $2p_1$ -atoms is maintained. This is met by assuming that the prohibited transition  $2p_1 - 2p_2$  occurs in large proportion—in other words, under the influence of the existing field of radiation, most of the thallium atoms in the  $3s$ -state return first to the  $2p_2$ -state, and then from the  $2p_2$ -state they return by the prohibited transition to the  $2p_1$ -state, so that the equilibrium between the proportion of atoms between the  $2p_1$ - and  $2p_2$ -states is maintained by the prohibited transition, which marks the emission of the line  $\nu = 2p_1 - 2p_2$ .

Turning now to the case of silicon in the sun, we find that the same argument can be applied. The emissivity of the sun is almost a maximum at  $\lambda 4102$  and  $\lambda 3905$ ; at  $\lambda 2500$ , the emissivity is about 0.57 of the maximum. When silicon atoms are traversed by a radiation field of this type, we shall find that transitions corresponding to the emission of  $^1S_0 - ^1P_1$ ,  $^1S_0 - ^3P_1$  of silicon will be very frequent, while the transitions  $^3P_{0,1,2} - ^3\bar{P}_{0,1,2}$  will be too small. The proportion between the fundamental  $^3P$  and metastable  $^1D_2$ ,  $^1S_0$  levels will be maintained by the prohibited transitions  $^3P_1 - ^1S_0$ ,  $^3P_{1,2} - ^1D_2$ . Also it follows that if the transitions from the excited  $^1\bar{P}_1$ ,  $^3P_1$ -state to the  $^1S_0$ -state are as numerous as in the case of calcium, then silicon, being much lighter

than calcium, would be thrown out into the corona in the metastable state  $^1S_0$ . Hence the coronal spectrum would show the prohibited transition.

If these hypotheses regarding the presence of silicon be correct, we should expect the following deductions to be verified:

(1) The Fraunhofer spectrum of the sun should show the line corresponding to  $^3P_1 - ^1S_0$ ,  $\lambda = 6527.05$  (Rowland Scale). Rowland's table shows a line at  $\lambda 6526.89$ , intensity zero. The agreement is not satisfactory.

(2) The coronal spectrum should also show this line. There is a line of approximately this wave-length in Father Cortie's table of coronal lines; the wave-length is given as  $\lambda 6528.9$ .

(3) The silicon lines  $\lambda 4103$  and  $\lambda 3905.67$  should be high chromospheric lines. This is not quite confirmed; in Mitchell's tables they are stated to reach only heights of 500 km. and 800 km. This may be due to paucity of transitions from the  $^1P_1$ -state to the  $^1S_0$ -state.

Excited silicon atoms may or may not (in the  $^1S_0$ -state) form a constituent of the corona. But the above arguments will apply to other suitable elements. I have chosen silicon for illustration because we know all about its spectrum. The same cannot be said of carbon, nitrogen, and oxygen, to which similar arguments can be applied, because in these cases the differences in value between the metastable states are only roughly known. To take carbon; this has an ionisation potential of about 11.3 volts; the spectrum is in all respects similar to silicon. The fundamental  $^3P - ^3P$  lines are at  $\lambda 1656-1658$ , but the metastable  $^1S_0 - ^1P_1$ -line is probably the line  $\lambda 2478$ . Hence it can be stated that metastable carbon atoms, being very light, would be thrown into the corona, and there give rise to prohibited transitions  $^3P_1 - ^1S_0$ ,  $^3P_{1,2} - ^1D_2$ . The electrical field in the corona would increase the number of transitions. The frequencies of such lines are of the same order as the frequencies of the more intense coronal lines, but whether they agree absolutely will depend upon the exact determination of the value of these terms.

Similarly, prohibited transitions between the fundamental levels of N and O, P and S,  $P^+$  and  $S^+$ , may account for some of the coronal lines. The present spectroscopic knowledge of the metastable states of these elements is so meagre, and the wave-lengths of the coronium lines are so roughly known, that I have not yet tried to institute any search for their origin amongst these states. MEGHNAD SAHA.

### Mammoths and Man in the Transvaal.

PROF. DART's paper in the Supplement to NATURE of Dec. 10, 1927, on "Mammoths and Man in the Transvaal," followed by Dr. R. Broom's letter in the issue of Mar. 3, 1928, under the same title, renders desirable the immediate description of two elephant teeth kindly sent to me by Curator Wilman, of the McGregor Museum at Kimberley, South Africa, in 1926 and 1927.

The first type (represented in Fig. 1) I name *Archidiskodon subplanifrons*; it is a low-crowned, broad-plated, heavily cemented tooth, apparently a third inferior molar of the right side (McGregor Mus., 3920). The specific name *subplanifrons* refers to the fact that the crown height—from 2 to  $2\frac{1}{2}$  inches—is about equal to that of the low-crowned types of *Elephas planifrons* Falconer of the Siwalik Hills, India; in some of Falconer's Upper Siwalik specimens the crown rises from  $3\frac{1}{2}$  to  $4\frac{1}{2}$  inches. The present specimen accordingly is believed to be of Upper Pliocene age.

In the second type (Fig. 2) the anterior half of a third superior molar, probably of Pleistocene age, we

observe a far more progressive stage, with lofty ridge-plates, the sixth attaining a height of 5 inches, equal to that of certain specimens of *Archidiskodon meridion-*

McGregor Mus. 3920 Kimberley S. Africa.

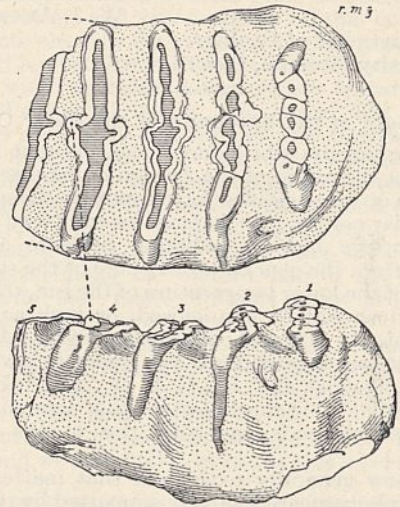


FIG. 1.—Type third inferior molar of *Archidiskodon subplanifrons* sp. nov., from the Upper (?) Pliocene, Sydney-on-Vaal, Vaal River diggings, South Africa, one-sixth natural size. McGregor Mus. 3920, Kimberley, South Africa; cast Amer. Mus. 21924.

alis in which the ridge-plates equal or exceed 5 inches. This relatively high-crowned type (McGregor Mus., 3682) I name *Archidiskodon broomi*, in honour of

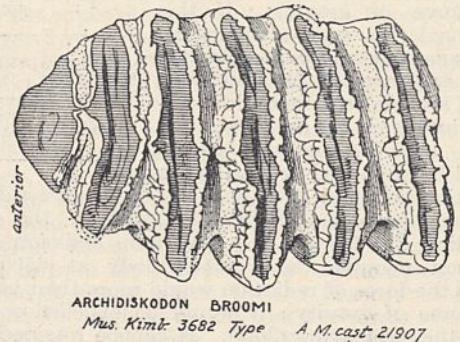


FIG. 2.—Type third superior molar of *Archidiskodon broomi* sp. nov. Original in the McGregor Museum, Kimberley, South Africa (No. 3682), cast Amer. Mus. 21907, one-sixth natural size. Seven ridge-plates partly preserved, broadest portion of the crown at fifth ridge-plate, indicating that three or four posterior ridge-plates are missing and that this may represent a ten- or twelve-plated molar.

Dr. Robert Broom, who, after the specimen was named in MS. and figured by myself, requested that one of these molars should be named after Mr. W. Millett, who discovered the type of *A. subplanifrons* at a depth

of from 50 to 60 feet in the Vaal River diggings near Sydney-on-Vaal.

Neither of these new types is as progressive or as elevated in crown structure as the types of *Archidiskodon transvaalensis* Dart, 1927, or *A. sheppardi* Dart, 1927, in which the posterior portion of the crown of the third superior molar in *A. transvaalensis* attains a height of 247 mm., or 9¾ inches, far exceeding the height recorded even for the corresponding molar of *A. meridionalis*; it also exceeds the height of the American species *A. columbi* (7 inches), but is far below the height of the very tall ridge-plates of *A. imperator* (10¼ inches). Consequently we attribute a relatively recent Upper Pleistocene age to *A. transvaalensis*.

THE AFRICAN CENTRE.

Apart from this evidence of at least three progressive stages in the evolution of *Archidiskodon*, a genus hitherto known only in the northern hemisphere, is the increasing proof of the existence in southern and central Africa of many different kinds of proboscideans,<sup>1</sup> which will shortly be reviewed by Mr. Arthur T. Hopwood, of the British Museum (Natural History). Pending this thorough examination of past and original materials, I am inclined to summarise the previous discoveries, including the present descriptions, as follows :

ORIGINAL DESCRIPTION.

- Loxodonta griqua* Haughton, 1922, type, Griqualand West, Transvaal
- Elephas (Loxodon) zulu* Scott, 1907, type, Zululand
- Elephas zulu*, referred by Hopwood, 1926, Kaiso bone beds, near Lake Albert
- Elephas antiquus Recki* Dietrich, 1916, type, Oldoway, British East Africa
- Elephas aff. meridionalis* Nesti, 1825, referred by Hopwood, 1926, from Kaiso bone beds, near Lake Albert
- Archidiskodon transvaalensis* Dart, 1927, type, lower Vaal River gravel terrace
- Archidiskodon sheppardi* Dart, 1927, type, lower Vaal River gravel terrace
- Archidiskodon subplanifrons* sp. nov., upper (?) Vaal River gravel terrace
- Archidiskodon broomi* sp. nov., lower (?) Vaal River gravel terrace
- Mastodon (Bunolophodon)* sp. Felix, referred by Beck, 1906, Waldeck's Plant

PRESENT REFERENCE.

- = *Archidiskodon griqua*.
- = *Loxodonta (Pilgrimia) antiqua zulu*.
- = *Loxodonta (Pilgrimia) antiqua zulu*.
- = *Loxodonta (Pilgrimia) antiqua recki*.
- = *Archidiskodon meridionalis*.
- = *Archidiskodon transvaalensis*.
- = *Archidiskodon sheppardi*.
- = *Archidiskodon subplanifrons*.
- = *Archidiskodon broomi*.
- = *Mastodon (Bunolophodon)* sp.

The absence up to the present time of the distinctive lozenge-shaped grinding tooth which distinguishes the existing African elephant as the genus *Loxodonta*, is a striking circumstance. All the above new types belong either to the broad-plated and broad-crowned *Archidiskodon* or to the narrow-crowned type of tooth with much more numerous ridge-plates for which I proposed (1924) the generic name *Pilgrimia*, typified by *Elephas falconeri* Busk from Malta, also by *E. antiquus Recki* Dietrich, from Oldoway, northern British East Africa; numerous species of small elephants with grinders of this type have been described, extending northwards throughout Africa into the islands of the Mediterranean, none of which presents the true *Loxodonta* molar.

HENRY FAIRFIELD OSBORN.

The American Museum of Natural History,  
New York, Mar. 21.

Natural Reactivity and the Origin of Species.

DARWIN'S theory of the origin of species presupposes the occurrence of occasional variants from the parent stock, of which some are preserved and fostered by natural selection. The cause of this natural variation has been sought in various quarters; and indeed it is to be presumed that it is due not to one cause, but to many. It is our purpose in this note to direct

<sup>1</sup> A. T. Hopwood, "On some Mammalian Remains from Lake Nyasa," *Quart. Jour. Geol. Soc.*, London, vol. 83, pt. 3, pp. 442-444; 1927.

attention to an agency which must play an important, and may prove to play the predominant, part in producing variations among plants and animals.

It has been demonstrated for two forms of animal and plant life the antecedents of which have been known for many generations, namely, the fruit fly (Muller, *Science*, 66, 84; 1927) and the tobacco plant (Goodspeed and Olson, *Proc. Nat. Acad. Sci.*, 14, 66; 1928), that treatment with X-rays produces new and permanent varieties which far exceed those which occur normally, both in number and in degree of departure from the parent. Thus, when a bud of the tobacco plant was X-rayed, eighty per cent. of the resulting seeds which germinated were decided variants, and the extent of variation in this one planting was greater than had been observed in a study of the normal plant lasting over a quarter of a century. Some of these variants were not fertile, but many were, and in particular one giant form seems more fertile and more vigorous than the normal plant. Equally striking results were obtained with the fruit fly.

In Nature, all living things are exposed throughout the whole of their existence to gamma rays of low intensity which are due to widely distributed radioactive substances. It therefore occurred to us at the time the experiments with the tobacco plant were begun, to inquire what part this feeble gamma radiation

might play in causing naturally occurring variations. This question has also been asked by Muller, but his data did not suffice for an answer. The tobacco experiments, however, were so planned as to permit a direct comparison with natural radiation.

It is true that the relative effect of rays of different frequency upon the production of variants has not been experimentally ascertained. However, since the rays can only be effective when they are absorbed, and thus produce ionisation, it seems safe to assume that the various rays will produce biological effects in proportion to the ionisation which they cause.

In one cubic centimetre of air, natural radiation produces per second about six ionisations, while the X-rays used in the tobacco experiments produced  $2.8 \times 10^8$ . This ratio of about  $5 \times 10^7$  will not be materially changed when we consider the ionisation in living tissue. The exposure to X-rays lasted about ten minutes and resulted in eighty per cent. of variants. We may substitute these figures in an equation based simply upon the law of probabilities, namely,  $\log(N/N_0) = kIt$ . Here  $N_0$  is the original number of germ cells exposed,  $N$  is the number remaining unaffected at the end of the time  $t$ , and  $I$  is the intensity of the radiation in terms of ionising power. We thus obtain  $k$ , the constant of the process. From this equation we calculate that the same plants exposed to natural radioactivity for one year would produce two variants per thousand.

In this calculation we have considered only the surviving plants, no account being taken of the

occasional lethal effect of the rays. If the cells which have been killed are to be regarded merely as one type of variant, the calculation is unaffected. However, in the experiments with the intense X-rays a large fraction of the cells experienced several ionisations. This would be likely to increase relatively the number of cells destroyed, a view for which there seems to be some experimental evidence (for example, the work of Wood, quoted by Crowther, *NATURE*, **118**, 86; 1926). Any allowance made for this effect would increase the calculated number of variants produced by natural radiation.

We may, therefore, conclude that the number of variants caused per year in the tobacco plant by natural radiation is greater than two per thousand. The number of variants in the normal plants actually found per year in a prolonged study of this plant is estimated as lying between two and four per thousand. It seems, therefore, not altogether extravagant to assume that such variations as actually occur in Nature are due largely to the radioactivity of the environment. It becomes an extremely interesting task to ascertain whether, in those places where an exceptional accumulation of radioactive material occurs, any unusual variability of fauna and flora is to be observed.

AXEL R. OLSON.

GILBERT N. LEWIS.

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#### What becomes of Stellar Radiation?

ON the occasion of Dr. Jeans's magnificent lecture (*NATURE*, Mar. 24, pp. 463-470) Sir Oliver Lodge (*ibid.*, p. 462) asked: "What becomes of the radiation which the stars are continually pouring into space? . . . No one has yet been able to hazard even a plausible guess as to where it goes or is destined to go in a possible finite space." Formerly we should have been obliged to assume that it vanished into infinite space. Einstein's theory of relativity has, however, entirely changed this point of view, and to-day space must be regarded as finite. If a straight line starts from a star it does not go straight to infinity, but returns to the original source. I beg to conjecture or suggest that the radiation from a star may behave like the straight line and be brought back to its origin again, after having travelled around the universe.

According to Dr. Jeans, light would require for this return 100,000 million ( $10^{11}$ ) years. As the stars are much older, some  $10^{13}$  years (Jeans), a great part of their radiation might have been brought back to them, or to other stars in its way, which will again provide other stars with their energy, so that the energy which they have lost would be partly renewed in this way. The stars might be regarded as a kind of *perpetuum mobile*—to some degree, like a mill on the river. Thus the lives of the stars would be prolonged.

BOHUSLAV BRAUNER.

Bohemian Academy, Prague,  
Mar. 27.

It is, I think, generally recognised that light can travel round and round an Einstein universe in the way described by Prof. Brauner. Alternative universes have of course been imagined in which this cannot happen; that of de Sitter, for example, expands so rapidly that light can never get back to its starting point.

If light goes round and round, a certain fraction must inevitably re-enter the stars, but the faintness of the night sky seems to show that the fraction must be very small; if it were nearly unity we should see

a star in every direction in space, and the sky would be a uniform blaze of light. The sun occupies about a hundred-thousandth part of the half-sky, so that if even one part in 100,000 of their light fell back into the stars, the night would be half as bright as the day. Or, if the radiation were transformed into heat on its journey, the heat received from the night sky would be equal to that received from the sun. The actual fraction, then, must be very minute.

Personally, I do not feel the difficulties of Sir Oliver Lodge and Prof. Brauner as to the ultimate fate of stellar radiation. Hubble estimates the average density of matter in space to be  $1.5 \times 10^{-31}$ , so that the total annihilation of all the matter in the universe would produce an energy-density of  $1.35 \times 10^{10}$  ergs per c.c., which would only raise the temperature of space from  $0^\circ$  abs. to  $11.5^\circ$  abs. The total annihilation of all matter outside the solar system would only raise the temperature of the earth's surface by 0.00018 of a degree centigrade, so that the radiation of ten thousand dead universes may be eternally wandering round space without our suspecting it. Space is so vast by comparison with the matter it contains, that discussing the ultimate fate of radiation seems rather like discussing the ultimate fate of a few lumps of sugar dropped into the Atlantic.

It is particularly hard to see how stray stellar radiation could create new matter. The creation of a single electron and proton, or of a hydrogen atom, requires a quantum of energy 0.0015 erg. Quanta of this energy do not begin to appear until a temperature of the order of 7,500,000,000,000 degrees is approached. Then, and not until then, there begins a free (reversible) transformation of energy between its two forms of matter and radiation. The statistics of such a process have been discussed by Stern (*Zeits. f. Elektrochem.*, **31**, 448; 1925; and *Zeits. f. Phys. Chem.*, **120**, 60; 1926) and Jordan (*Zeits. f. Phys.*, **41**, 711; 1927), but in view of the foregoing figures the interest would seem to be academic rather than astronomical. A simple calculation shows that if the present universe were left to itself long enough for its total energy to distribute itself in thermodynamical equilibrium between atoms and radiation, the expectation of the total number of non-permanent atoms in the final steady state would be of the order of  $e^{-mc^2/RT}$ , or  $10^{-420,000,000,000}$ . The reciprocal of this, raised to a power equal to the total number of non-permanent atoms in the present universe, may be interpreted as the odds (relative to our present knowledge) in favour of the universe being a special creation and not a mere fortuitous concurrence of atoms and radiation.

Apart from all calculation, the widely desired cyclic universe in which just as much matter is created as destroyed, would seem to be a universe already dead. Its entropy must be a maximum, otherwise the system could and would increase its entropy by irreversibly disturbing the balance between creation and destruction of matter. With universes, as with humanity, the only possible life is progress to the grave.

J. H. JEANS.

#### The Branchial Gland of the Cephalopoda: a Possible Endocrine Organ.

UP to the present day, no definite endocrine organs have been discovered in any invertebrates, though some evidence of adrenalin production in annelids has been obtained by Gaskell,<sup>1 2</sup> and of an internal secretion of the testis in turbellarians by Vandel,<sup>3 4</sup>

<sup>1</sup> *Phil. Trans. Roy. Soc.*, B, **205**; 1914.

<sup>2</sup> *J. Gen. Physiol.*, **2**; 1919.

<sup>3</sup> *C. R. Acad. Sci.*, **170**; 1920.

<sup>4</sup> *Bull. Biol. Fr. Belg.*, **55**; 1922.

and in oligochaets by Harms.<sup>5</sup> The purpose of this letter is to direct attention to the probable endocrine significance of the branchial gland of the cephalopod molluscs.

The branchial gland is found in all the dibranchiate Cephalopoda, lying beneath the gill on each side and clearly visible from the mantle cavity. It is stated by Huxley and Pelseneer<sup>6</sup> to be absent in Spirula, but in a specimen of that rare mollusc which I examined through the kindness of Mr. G. C. Robson at the British Museum, it appeared well developed. The 'gland' has a rich blood supply which has been studied in detail by Joubin.<sup>7</sup> A capillary network can be demonstrated by injection. No lumen or duct exists, the organ consisting of cells in a connective tissue meshwork and of syncytial tissue perhaps derived from the degeneration of such cells. The histology was chiefly investigated in Sepia, but is essentially similar in Octopus. Sections of material fixed in Bouin and stained by the methylene blue and eosin method advocated by Lim<sup>8</sup> show irregular polygonal cells with large vesicular nuclei. Most of the peripheral cytoplasm is filled with a fine basophil suffusion or granulation. In some cells, frequently found in groups, one or more vacuoles containing highly eosinophil bodies are found; such bodies may also be found in the intercellular spaces, and it is hard to avoid the conclusion that they have been extruded from the cells.

The gland can be extirpated in *Octopus vulgaris* unilaterally, through a slit in the mantle. In one such individual which survived 62 days, very marked hypertrophy of the remaining gland was noticed. The hæmocyanein content of the blood of this specimen, determined by the refractometric method of Quagliariello,<sup>9</sup> was identical with that of its control.

The Cephalopoda are in many respects of the same grade of organisation as the lower vertebrates, and it is among them that we should most probably find endocrine organs if they exist in invertebrates. Such histological evidence as is presented above suggests that some substance is produced by the branchial gland and liberated into intercellular spaces where it might be taken up by the blood stream. The branchial heart appendix, another organ of unknown function in the Cephalopoda, may also be worthy of investigation along similar lines.

My investigations of the branchial gland were made at Naples, October 1925–May 1926, while holding an International Research Fellowship of the Rockefeller Foundation and occupying the Cambridge table at the Stazione Zoologica. My very best thanks are due to Prof. R. Dohrn and his staff for every help and encouragement during my stay in Italy; also to Prof. Quagliariello for demonstrating to me the use of the refractometer in the physiological laboratory of the University of Naples. If opportunity occurs of continuing the work, a detailed account will be published.

G. EVELYN HUTCHINSON.

Department of Zoology,  
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Johannesburg, Mar. 8.

#### Investigation of a Mercury-Thallium Molecule.

EVIDENCE has been obtained which seems to prove the existence of mercury-thallium molecules when the vapours of the two substances are mixed. The evidence is the result of two quite different methods of attack.

<sup>5</sup> "Experimentelle Untersuchungen über die innere Secretion der Keimdrüsen" (Jena, 1914).

<sup>6</sup> *Rep. Sci. Res. H.M.S. Challenger, Zool.*, **83**; 1895.

<sup>7</sup> *Arch. Zool. Exp. Gen.* (2), **3**; 1885.

<sup>8</sup> *Q.J.M.S.*, **63**; 1919.

<sup>9</sup> *Arch. Sci. Biol.*, **1**; 1920.

In the first method, two evacuated pyrex U-tubes were prepared, one of which contained a small amount of thallium in one branch, and a small amount of mercury in the other. The second U-tube contained only a small amount of thallium in one branch, the other branch being empty. The tubes were placed together in a vertical furnace with their ends down, and were heated to 600° C. The amount of mercury was so small that it was entirely volatilised at this temperature, while only a small part of the thallium was vaporised. The ends which had not contained the thallium were then cooled simultaneously for thirty seconds by means of an air blast, and the tubes were removed from the furnace. The ends which had been cooled by the air blast were analysed for thallium. More thallium was found in the end which had contained mercury than in the end which had been empty. The experiment was repeated once, giving the same result. While it might be possible to explain this result on the grounds of lack of temperature equilibrium or of a mechanical entrainment of the thallium molecules in the mercury vapour, neither seems at all likely under the conditions of the experiment. The more probable explanation is that mercury-thallium molecules were formed, and that these molecules were more volatile than thallium.

A more convincing proof of the existence of such molecules resulted from the study of the absorption spectra of mixtures of thallium vapour and mercury vapour. The region investigated extended from about 2200 Å. to about 7000 Å. The vapours were studied at temperatures ranging from 300° C. to 1100° C. A number of bands have been photographed in the ultra-violet and one in the green. In no case has the resolving power been sufficient to show the fine structure. These bands have not been observed in the spectra of pure mercury or of pure thallium, hence it seems that their origin must be a mercury-thallium molecule. Most of the bands are sharp on the side of shorter wave-length and shaded toward the longer wave-lengths. With rising temperature most of the bands broaden more on the long wave-length side than on the short. The results confirm an early experiment on the ultra-violet absorption spectra of mixtures of mercury vapour and thallium vapour (Wood and Guthrie, *Astrophysical Journal*, **29**, 211; 1909).

The problem was undertaken at the suggestion of Prof. R. W. Wood, and the work carried out under his direction and with his assistance.

R. K. WARING.

The Johns Hopkins University,  
Mar. 12.

#### Prof. A. Abetti and the 1874 Transit of Venus.

As a supplementary note to the obituary notice in NATURE of April 14 of my old friend, Prof. Antonio Abetti, of the Arcetri Observatory, Florence, may I direct attention to a remarkable observation of his made in India at the transit of Venus in 1874? This consisted in viewing the planet projected against the solar chromosphere on the C-line through the open slit of his spectroscope. The observation, which is figured in the *Mem. Soc. Spett. Ital.*, and which he described to me on one of my visits to Arcetri, was considered most remarkable at the time and, by some, was scarcely credited. Venus, however, remained visible through the slit for four minutes, while the chromosphere appeared with its usual brightness interrupted only by the dark body of the planet. A similar observation in the case of a transit of Mercury was suggested a few years ago by the late Mr. Thorp.

W. ALFRED PARR.

St. Albans, April 18.

## An Inexpensive Solar Telescope and Spectroheliometer.

By Prof. GEORGE E. HALE, For. Mem. R.S., Mount Wilson Observatory, Pasadena, California.

IN previous numbers of NATURE I have described some of the new possibilities in solar research afforded by the spectroheliometer.<sup>1</sup> Since their publication I have developed a cœlostat telescope and spectroheliometer which can be built at such small cost that I trust it may come into general use. At least eight spectroheliometers will soon be systematically employed at solar observatories distributed around the world, thus permitting the sun's atmosphere to be observed frequently throughout the astronomical day. It is hoped that under this scrutiny few important eruptions will be missed, and that their connexion with auroræ, magnetic storms, and other terrestrial phenomena such as radio transmission can thus be more certainly determined.

In the well-known method of Lockyer and Janssen, the form as well as the spectrum of a prominence can be seen at the sun's limb. Suppose the narrow slit of a spectrograph to be tangent to an image of the sun, across the base of a prominence. The bright lines of hydrogen and helium will then be seen against the spectrum of the sky, which is due to scattered sunlight, weakened by the dispersion. Consider only the red hydrogen line  $H\alpha$ , which is nearly monochromatic if the prominence is free from irregular motions in the line of sight. The form of this line then corresponds to that of the straight narrow slit. When the slit is widened the brightness of the prominence remains unchanged, while that of the sky spectrum increases. If the prominence is of average brightness, and not too high, the slit can be opened sufficiently to show its entire form against the background of the sky spectrum. If, however, the sky were as bright as the sun's disc, the prominence, except in rare cases, would be rendered invisible by its overpowering brilliancy.

Prof. Charles A. Young, one of the ablest and most experienced of solar observers, stated the case as follows in his well-known book, "The Sun": "In a few instances the gaseous eruptions in the neighbourhood of a spot are so powerful and brilliant that with the spectrograph their forms can be made out on the background of the solar surface in the same way that the prominences are seen at the edge of the sun. In fact, there is probably no difference at all in the phenomena, except that only prominences of most unusual brightness can thus be detected on the solar surface." Secchi also remarked in "Le Soleil," after describing the use of the spectrograph for the observation of the spectra of objects on the sun's disc: "Ce qui serait à désirer maintenant pour faciliter encore davantage ces recherches, c'est la découverte d'un milieu parfaitement monochromatique pour les raies de l'hydrogène. On verrait alors l'image de ces flammes rouges comme

on voit celles des taches." The spectroheliometer has some important advantages over such a medium, even if it were attainable, because of the ease of changing the wave-length of the transmitted light, thus rendering visible rapidly moving flocculi, and at the same time indicating their velocity in the line of sight.

Prominences observed in projection against the sun's disc (flocculi) usually appear dark, because their comparatively cool gas absorbs the light of the hotter photosphere. Bright flocculi also occur, due to hotter hydrogen, usually found at lower levels. When these flocculi are intensely bright their forms can be made out roughly against the disc with a spectrograph by widening the slit, as noted by Lockyer, Secchi, and Young in 1869-70. Extremely dark flocculi may also be seen imperfectly in the same way; but these are exceptional cases. Most of the flocculi, bright or dark, disappear when the slit is widened sufficiently to include their forms. The weakening and disappearance of most of the lines of the solar spectrum, observed when the purity is decreased by widening the slit of a spectrograph, illustrates this effect. The spectroheliometer retains the strong contrast given by a narrow slit, and thus renders visible the flocculi, both faint and intense, against the brilliant disc. It also shows the prominences at the limb with greater contrast than is obtainable with a wide slit. Moreover, as a narrow slit prevents the overlapping of images observed in white light with a wide slit, the spectroheliometer renders visible the structure of sunspots, which can be sharply seen with light from any part of the solar spectrum away from the dark lines.

The spectroheliometer consists of a spectrograph of considerable dispersion, provided with a slit in the focal plane of the spectrum, which permits only the light of the line in use to reach the observer's eye. If the first slit, on which the solar image is focused, is moved in the plane of dispersion, the spectrum will move a corresponding distance. To remain on the line, the second slit must be displaced accordingly. The first and second slits are therefore carried at the opposite ends of a very light metallic bar, mounted on a bearing half-way between them. This bar is oscillated rapidly by a small electric motor, through an amplitude (usually about a quarter of an inch) which is limited by the brightness of the spectrum. The observer, looking through the oscillating second slit, which remains exactly on the  $H\alpha$  line, sees by persistence of vision a hydrogen image of a portion of the sun. This may include a part of the limb, where a prominence appears bright against the sky, and at the same time a part of the disc, upon which a portion of the same prominence may extend as a dark flocculus.

High velocities in the line of sight produce distortions of the  $H\alpha$  line, towards the violet when

<sup>1</sup> "Some New Possibilities in Solar Research," NATURE, July 3, 1926; "The Fields of Force in the Atmosphere of the Sun," NATURE, May 14, 1927.



the gas is approaching, toward the red when it is receding. To see a mass of hydrogen receding at a velocity of say sixty kilometres a second the second slit must be set, not on the normal position of the  $H\alpha$  line, but at a position completely outside of it toward the red. A simple 'line-shifter' is employed for this purpose. A graduated arc indicates the displacement of the line from the zero position, and thus gives the radial velocity of the portion of the flocculus under observation.

As in the case of the spectroheliograph, a monochromatic image can be produced either by motion of narrow slits with respect to the solar image, or by motion of the solar image with respect to the slits. The chief difference between the two instruments lies in the fact that the spectroheliograph builds up its image gradually, slit-width by slit-width, by a slow motion of the slits or of the solar image with respect to the photographic plate, while the spectrohelioscope must reveal a considerable area of the image at once to the eye, which obviously could not see the forms of the flocculi through slowly moving slits a few thousandths of an inch wide. Hence the rapid motion of the slits or of the solar image required for the spectrohelioscope.

I have tried successfully three systems of moving slits, as follows:

- (1) An oscillating bar carrying single slits at each end.
- (2) An oscillating bar carrying three or more slits at each end. By increasing the number of slits the rate of oscillation necessary to avoid flicker may be reduced, with corresponding reduction in any effects of vibration.

- (3) A rotating disc carrying fifty radial slits.

Three means of producing rapid motion of the solar image with respect to fixed slits have also been devised:

- (1) An oscillating plane mirror, so mounted in conjunction with a second plane mirror that the second slit can be viewed in another part of the same mirror system. This was suggested by Dr. Sinclair Smith.
- (2) A square prism of glass, mounted before each of the slits, rotating uniformly about an axis parallel to them. The portion of the solar image under observation reaches the first slit through one prism, while the resulting fixed monochromatic image is seen in an eye-piece focused through the other prism on the second slit. This device is due to Dr. J. A. Anderson.
- (3) An oscillating right-angle prism, mounted with its edge parallel to the slits and its hypothe-

nuse surface normal to their plane. In this arrangement, previously used in somewhat different form on the spectroheliographs of our 60-foot and 100-foot tower telescopes, the solar image moves at twice the speed of the prism.

All three of these devices are here supposed to be used with a spectroscope in which the apparent motion of the solar image, as observed through the second slit, is opposite in direction to the actual motion of the solar image across the first slit. In this case, when looking at the second slit through an extension of the oscillating or rotating optical system which causes the motion of the solar image, the effect of this motion is exactly com-

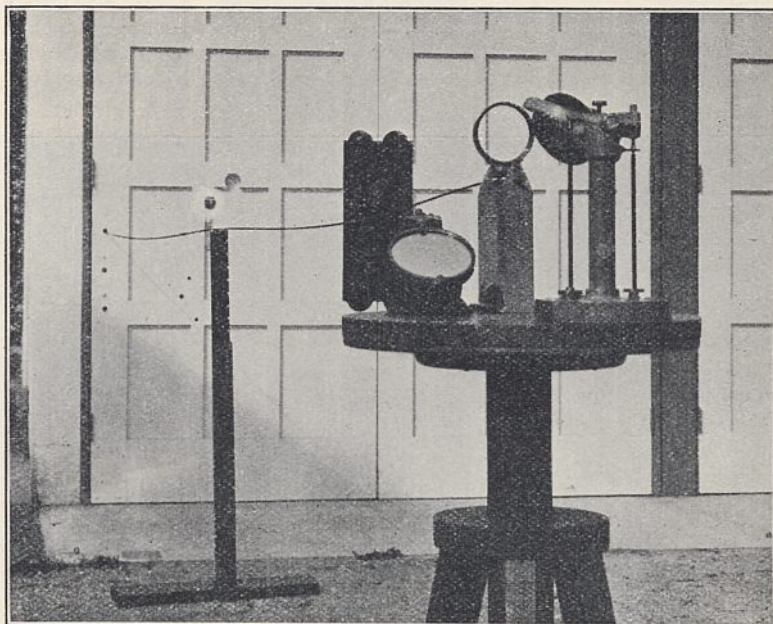


FIG. 1.—Solar telescope. The cœlostast mirror at the left, driven by clockwork, reflects the sunlight to the second mirror, which is provided with slow-motion screws for directing the solar image. This is formed by the simple lens (centre), adjustable by a screw for focusing the image on the slit of the spectrohelioscope 18 feet away, within the building.

pensated and the monochromatic image appears at rest. The same devices can be adapted for use with spectroscopes of other types.

#### THE SOLAR TELESCOPE.

The small solar telescope, temporarily mounted in conjunction with a horizontal spectrohelioscope, is shown in Fig. 1. A wooden tripod serves for support, but in a permanent arrangement the cœlostast, second mirror, and lens should be mounted on a solid pier of brick or concrete.

The cœlostast, with plane mirror  $5\frac{1}{2}$  inches in diameter, is driven by an ordinary two-dollar clock movement. With the low powers employed the intermittent motion is not perceptible. The second mirror,  $4\frac{1}{2}$  inches in diameter, receives the parallel beam of sunlight from the cœlostast and reflects it due north to a 4-inch single lens, of 18 feet focal length. This forms a solar image 2 inches in diameter on the first slit of the spectroheli-

scope. A crossed lens is here employed, but a plano-convex lens (or, with a modified arrangement, a concave mirror) would serve well. On account of the small angular aperture and the use of monochromatic light, an achromatic lens is unnecessary. By means of cords or rods leading to the position of the observer (not shown here in the case of the second mirror), any portion of the solar image can be brought upon the slit by tipping the second mirror, and focused by sliding the lens.

The 4-inch lens is sufficient for a 13-foot spectrohelioscope with a 4-inch grating (ruled surface about  $2\frac{1}{2}$  inches  $\times$  3 inches). When a smaller grating or prisms are employed, a lens of 3 inches aperture and the same focal length (18 feet) will serve equally well.

#### THE SPECTROHELIOSCOPE.

Last August I completed and tested a simple spectrohelioscope of 3 inches aperture and 13 feet

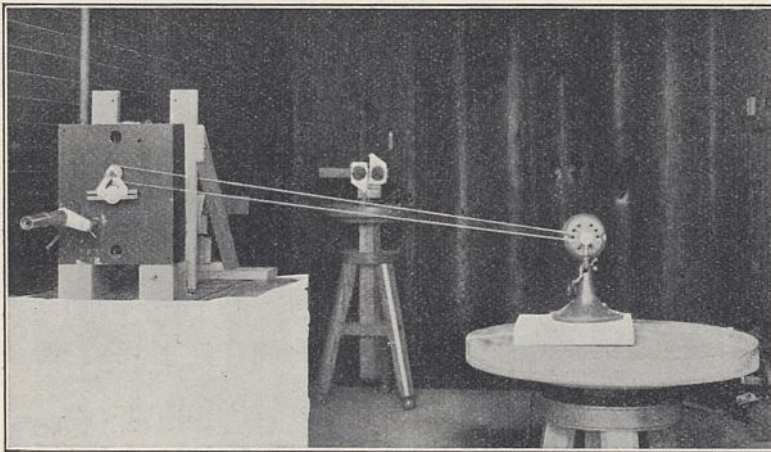


FIG. 2.—Spectrohelioscope of 13-foot focal length. Sunlight passing through the first slit (right) falls on the collimating mirror, which returns a parallel beam to the grating, mounted above the slits behind the casting. An image of the  $H\alpha$  line of hydrogen in the first order spectrum is formed by the left concave mirror on the second slit. When the slits are rapidly oscillated by the motor, a portion of the solar atmosphere is seen in hydrogen light through the eyepiece on the left (here turned aside to show the second slit).

focal length, designed for use with this solar telescope. A 4-inch grating was an essential part of its optical equipment, but unfortunately such gratings are not easily obtained, and all our efforts to secure satisfactory reflecting grating replicas have proved futile. Moreover, the length and mass of the oscillating slit-bar (7 inches between centres in the chosen design) rendered it difficult to push the vibration rate to a point sufficiently high to eliminate flicker without jarring the instrument. Excellent images of the flocculi were obtained with this spectrohelioscope, but the above considerations, and my desire to decrease the cost of construction, made further study of the problem advisable. A few weeks later Dr. Anderson and Dr. Sinclair Smith suggested the ingenious devices already mentioned, and I determined to make a comparative test of a variety of designs, in the hope of reaching a simple and inexpensive solution.

Several of these designs have proved satisfactory, including one in which the monochromatic image

is produced with the aid of a revolving glass disc, cut in the milling machine, on a surface of silver or of "Duco" paint, with fifty radial slits; as well as one employing the revolving prism device of Anderson, which can be adapted to any suitable spectroscope of sufficient dispersion provided with fixed first and second slits. These instruments will be described in detail elsewhere; my object here is merely to mention briefly the simplest and least expensive spectrohelioscope that I have found to give excellent results.

The oscillating slits are shown in Fig. 2, a general view of the spectrohelioscope temporarily set up in a garage. As their centres are only  $3\frac{1}{2}$  inches apart they are mounted horizontally, so as to permit direct observation through the second slit by the right eye without obstruction of the solar image on the first slit by the observer's head. The bar that carries them, like the slits themselves, is extremely light and stiff. An upward extension of this bar is pierced by a fibre-lined vertical groove, in which a steel pin, fixed eccentrically in the head of a horizontal shaft, serves as the driving device. A small electric motor, belted to a pulley on this shaft, causes the slits to make thirty or forty single oscillations per second. The amplitude is about a quarter of an inch or less, and the motion is smooth and quiet.

Light from any part of the 2-inch solar image given by the cœlostate telescope passes through the first (right hand) slit and diverges until it meets a 2-inch concave spherical collimating mirror of 13 feet focal length, which returns a parallel beam to the dispersing system (not visible), consisting either of a plane grating, ruled with about 15,000 lines to the inch, or a pair of  $60^\circ$  prisms of flint glass, through which the light passes twice. The plane of dispersion is vertical, and the grating (or the mirror behind the prisms) is set at such an angle that the  $H\alpha$  region (of the brightest first order spectrum, if the grating is used) is returned to the centre of a second concave mirror. This is exactly like the collimating mirror, and is mounted with it on an adjustable support with screw for focusing. The centres of the mirrors are opposite the centres of the slits, and the second mirror is adjusted so as to cause the  $H\alpha$  line to coincide with the second slit. This is viewed through a positive eyepiece magnifying from two to four diameters. The line-shifter, a strip of plane parallel glass, is mounted behind the second slit on a short shaft, provided with a large milled head for easy rotation by the observer and a divided arc showing the displacement in angstroms or the equivalent radial velocity. An important adjunct is a screen to prevent the diffuse light of the collimating mirror from reaching the eye of the observer.

I have found by experiment that with slits 0.004 inch wide, oscillating with an amplitude of  $\frac{3}{15}$  inch, the bright and dark hydrogen flocculi can be well seen on the sun's disc when the grating aperture is reduced to  $1\frac{3}{15} \times 2$  inches.<sup>2</sup> A larger grating naturally gives a brighter image, in which more detail can be seen, but the above will serve for most classes of work.

Suitable gratings, even of the smaller size just mentioned as a minimum, may not be obtainable. I have therefore tried a less expensive arrangement, which may be adopted by amateurs who wish to build their own instrument and are content (until a good grating or replica can be obtained) to see only the more conspicuous phenomena. This is a pair of 60° prisms,<sup>3</sup> which should be of very dense flint, and may be only just large enough to transmit a beam 1 inch in diameter, though a somewhat larger aperture is preferable. The dispersion of two ordinary flint prisms (here equivalent to four) is less than that of the first order of a (15,000) grating, and their performance is much inferior to that of a good grating; but with suitable slit-widths they will show the stronger bright and dark flocculi, as well as the prominences at the limb. If, as I greatly hope, a satisfactory method of producing cheap reflecting grating replicas of excellent definition can be found, these may ultimately become available in place of original gratings or prisms.<sup>4</sup>

The ingenious rotating prism device of Dr. Anderson, which is used with fixed slits, is shown in Fig. 3. This is more expensive than the oscillating slits, and seems to show no details of the flocculi not visible with them. However, the elegance of this method, and the complete freedom from vibration and flicker which it affords, make it an attractive alternative for oscillating slits. It can be readily attached to any Littrow spectroscope of suitable dispersion, but I have found this type of spectroscope much less satisfactory for the purposes of the spectrohelioscope than the two-mirror form illustrated, because of the impossibility of excluding from the eye the light due to the illumination of the collimating lens and grating by sunlight from the first slit. The reflected light can be excluded, by using a suitable lens for the collimator, but the remaining diffuse light, superposed upon the H $\alpha$  line, materially reduces the contrast of the flocculi, even when a red glass is placed over the eyepiece.

The spectrohelioscope shown in the illustrations was built from various parts that happened to be available, and does not represent the final design. Thus the casting that carries the slits, line-shifter, and eyepiece will be considerably reduced in size in the finished instrument. The working drawings now in preparation will also show a more compact

support for the two concave mirrors, and various other improvements. These will soon be published in a series of articles, intended for those who wish to build and use their own instruments.

#### USE OF THE SPECTROHELIOSCOPE.

I have indicated in previous papers some of the many possible applications of the spectrohelioscope. Mr. Buss (NATURE, May 28, 1927) and M. Deslandres (NATURE, Oct. 8, 1927) apparently think that a solar spectroscope would serve equally well for such work, but as all the

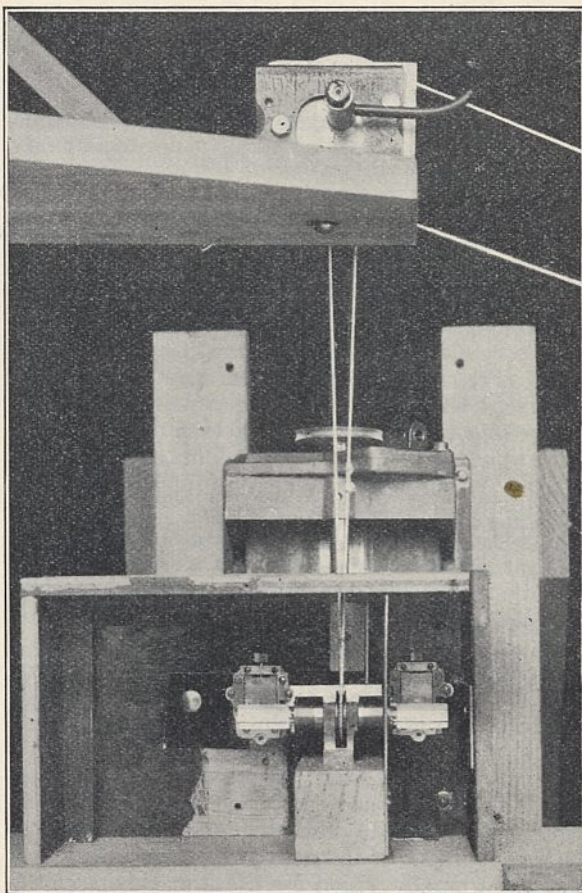


FIG. 3.—Anderson's rotating prism device for use with fixed slits. A square prism of glass, rotating uniformly, causes a succession of images of a part of the sun to move across the first slit at the rate of four per revolution. When the second slit (set on H $\alpha$ ) is viewed through a similar prism, rotating at the same rate, a stationary image is seen in hydrogen light.

astronomers and physicists who have observed the sun with my instrument seem to agree with me as to its usefulness, I am quite willing to leave this question to the future. If one wishes to see the characteristic structure of most of the dark hydrogen flocculi, the slit-widths must be kept below one-hundredth of an inch, even when very high dispersion is employed. As already remarked, the prominences at the limb are also shown in greater contrast by the spectrohelioscope than by the spectroscope with wide slit. As for the line distortions caused by the radial velocities of the hydrogen flocculi, which have been known since

<sup>2</sup> This is nearly the size of Hilger's plane grating K14, ruled with about 14,400 lines per inch at the National Physical Laboratory on a surface 3.5 cm.  $\times$  5 cm.

<sup>3</sup> Loaned me by the Massachusetts Institute of Technology, through the kindness of Dean Goodwin.

<sup>4</sup> The most promising means of reproducing reflecting gratings appear to be either an electrolytic process or the method described by Merfield (*Proc. Roy. Soc. Victoria*, vol. 38, 1926). The latter can perhaps be used for copying speculum metal as well as glass gratings by adopting means of preventing firm adhesion of the cathode deposit.

the earliest days of solar spectroscopy, the advantages of the spectrohelioscope in quickly interpreting them must be seen to be appreciated. The line-shifter serves in somewhat the same way as the 'blink' device of a Zeiss stereocomparator, but instead of merely indicating, in a very striking way, any differences between two photographs, it shows at a glance the connexion of a series of related phenomena by linking them into a sequence. This is what I referred to in my last article when describing "a new effect of inflow," by which I meant the motion of the maximum of intensity along a focculus due to progressive differences in radial velocity, at once interpreted by the line-shifter.

In M. Deslandres's remarkable theory of the sun, "tout se passe comme si le rayonnement corpusculaire de nos orages émane d'une couche

solaire profonde qui tourne comme un corps solide ; et cette couche offre au moins 24 volcans permanents, répartis uniformément autour de l'axe de rotation, et d'activité variable, qui rejettent au dehors la matière ionisée ou radioactive des masses intérieures. Cette division régulière est celle des corps à symétrie circulaire qui se refroidissent." This theory involves so many considerations that it cannot be discussed in the space at my disposal. In any event, such a discussion would be premature, as the theory rests upon M. Deslandres's belief in a regular sequence of terrestrial magnetic disturbances which Messrs. Chree and Stagg, after an exhaustive study of the international magnetic data for twenty years, have been unable to confirm.<sup>5</sup>

<sup>5</sup> "Recurrence Phenomena in Terrestrial Magnetism," *Phil. Trans.*, Series A, vol. 227, pp. 21-62.

### The New Vision.<sup>1</sup>

By Prof. G. ELLIOT SMITH, F.R.S.

THE recent researches of Minkowski, Brouwer, and Woollard have brought to light the remarkable fact that in man and his nearest allies such revolutionary changes have been effected in every part of the visual system as to justify the statement that a new visual instrument has been evolved. Considering these facts from the point of view of function, we may speak of the emergence of a new vision, which differs profoundly from that enjoyed by all other living creatures. It may be of interest to discuss the nature and meaning of these changes, which are intimately related to the evolution of intelligence and the attainment of what in colloquial language we know as insight, foresight, and the wider vision.

A quarter of a century ago the term neopallium was introduced to express a new conception of the nature of the essential evolutionary changes that transformed the brain of a primitive reptile into that of a mammal, and conferred upon the latter enormously enhanced powers of learning from experience and modifying behaviour. Incidentally, the development of the new cortical area provided a means whereby vision for the first time secured representation in the cerebral cortex, which created fuller opportunities for the confluence of visual with other kinds of perception. On the anatomical side it inaugurated a series of interesting structural arrangements which marked the transference to the neopallium of functions which in all other vertebrate animals are carried on in the mid-brain and other lower centres. The new light recently thrown on this interesting process of transformation reveals the fact that the transference of functions did not occur at one time, but in progressive stages. Magnus showed experimentally that the optic-righting reflexes in mammals were not acquired until binocular vision developed. Still later the development of the macula lutea in the retina (in monkeys and man) brought about the

further changes in the brain which I am attempting to define.

In all vertebrates the nerve fibres proceeding from the retina cross (wholly or only in part in most mammals) to the other side of the brain, where they end in two masses of grey matter, the lateral geniculate body, which is part of the thalamus, and the superior quadrigeminal body, which is part of the mid-brain. The former connexion is concerned with the awareness to vision, the phenomena of consciousness, and the latter (mid-brain), with such unconscious functions as the reflex actions of the eye muscles and the general musculature of the whole body. Brouwer has shown that in a lowly mammal such as a rabbit the four quadrants of the retina have a topographical representation in the quadrigeminal body. Wilson (of Cairo) has recently demonstrated that the corresponding quadrants in a lizard's brain control definite movements or postures of the body—a kind of autonomous mechanism for the analysis and functional expression of optic influences analogous to the analytic functions of the semicircular canals in connexion with equilibration.

In mammals the lateral geniculate body, for the first time in the vertebrate series, emits a large strand of fibres (optic radiation) to provide a path for visual impulses to the cerebral cortex. But the neopallium also begins to assume some of the motor control, which hitherto has been a function of the quadrigeminal bodies. It is interesting to note that, according to Allen, this process is not completed in the rabbit. Its cerebral cortex, according to him, controls the movements of the head, forelimbs, and body, but the control of the hind-limbs is still retained by the mid-brain. In most mammals, however, the transference of motor control to the cerebral cortex is complete.

With the acquisition of binocular vision (in mammals such as the cat or, better, monkeys) the fibres of the optic tracts become rearranged. The fibres from the lateral part of each retina no longer

<sup>1</sup> From the Bowman Lecture delivered on April 20 to the Ophthalmological Society of the United Kingdom.

cross to the other side of the brain, but become connected with the same side, so as to bring into connexion the terminations of the fibres coming from the medial side of one retina and the lateral side of the other, which in binocular vision necessarily act together so as to merge in consciousness the two images of one object.

But this rearrangement of the optic tracts necessarily affects the endings of these tracts in the geniculate and quadrigeminal bodies. Instead of a modification of the retinal localisation in the quadrigeminal body to adapt it to the new conditions, the cerebral cortex seems more fully to usurp its motor-controlling functions. With the loss of such functions the quadrigeminal body also loses most of the direct connexions with the optic tracts, and the cerebral cortex acquires a correspondingly enhanced control of the quadrigeminal body.

In monkeys and man further profound changes occur in the whole of the visual system. A definite macula lutea develops in the retina, and each of the percipient cells in the area of acute vision transmits its impulse (indirectly) to a separate fibre of the optic nerve. In the rest of the retina and in the retinas of other mammals groups of sensory cells (rods) transmit their impulses into one granule and ganglion cell, so that there are far more percipient elements than nerve fibres in the optic nerve. Hence, when the macula develops in monkeys and man, this small area adds a contribution to the optic nerve and tract that is out of all proportion to its size. The macular fibres form more than a third of the optic nerve, and there is added to the geniculate body a new formation as a macular receptive mechanism.

With the atrophy of the quadrigeminal fibres of the optic tract and the sudden increase of the geniculate connexion in monkeys and man, practically the whole (more than ninety per cent.) of the optic fibres go to the lateral geniculate body. But with the enormous increase of the latter the body loses much of its autonomy. Its ventral nucleus, which in other vertebrates controlled the quadri-

geminal body, atrophies in the Primates. In its place the cerebral connexion is still further strengthened. The geniculate body becomes more and more an intermediary between the retina and the neopallium, and almost the whole function of visual perception becomes concentrated in the cerebral cortex.

The development of macular vision confers upon man the ability to see the world and appreciate its meaning in a way that no other living creature is able to do. His new vision depends upon powers of visual perception as distinctive as the use of articulate speech to give expression to what he sees and thinks. The late Dr. Henry Watt, of the University of Glasgow, expressed the opinion that

“Of the conditions which enrich the sensory basis of the human mind and so provide the greater wealth of material by which it attains levels beyond those of the animal mind, probably the most important are the functions of the fovea (macula lutea), of accommodation, and of static stereoscopy, and the development of a delicate skin and prehensile hands. All these make in some way for a differentiation that is the first form of abstraction. The fovea refines and distinguishes positions and forms, while accommodation sharpens the objects of attention and dissipates the rest; stereoscopy adds a new character to a group of forms that may persist for indefinite periods of observation; delicate skin gives greater sensitivity to variations of pressure, and the prehensile hand implies a very great refinement in the positions and forms of the derived articular sense. In the hand this becomes a fine mobile tridimensional sense that, like the stereoscopic eye, can go round and through things, so almost isolating them from their surroundings. At the same time the articular sense is the conscious correlate of action and of the individual's share in his experiences.”

All these conditions that confer upon man the fuller vision to see and understand the world and interpret what is happening around him, can be shown to be the results directly or indirectly of those profound structural revolutions which have given man what is virtually a new instrument of sight and with it a new vision.

### News and Views.

MR. G. H. WILKINS, accompanied by Mr. C. B. Eielson, left Point Barrow, Alaska, on April 15, and flew across the Arctic Ocean to Spitsbergen, a distance of 2200 miles, in a little over twenty hours. The machine used was a Lockheed monoplane with a 220 h.p. Wright Whirlwind engine. The start was difficult and a long snow runway on the frozen surface of a lagoon had to be made. For the first five hundred miles the weather was clear; then a hundred miles of cloud were passed through before the visibility again became good. In lat. 84° N. long. 75° W., dark clouds were seen to the north, described as possibly land clouds, but as this was near one of Peary's tracks, on which he reported no land, Mr. Wilkins did not turn aside. Landing-places on the pack-ice which might have served in an emergency were seen, but no attempt was made to descend, since the ascent would have been a very difficult matter. A view of Grant

Land (Ellesmere Island) was obtained, and then the course was set for Spitsbergen. This course, it will be noted, did not pass over the North Pole itself. Strong winds were experienced and there was much cloud to the south over Greenland, but one high peak of the land was seen. The temperature was then about -48° F.

WITHIN 200 miles of Spitsbergen, flying conditions became more trying. The open water and high temperature to the south were associated with great cloud masses, and even at 8000 ft. they could not be avoided. The difficulty was to locate King's Bay, Spitsbergen, where it was hoped to land. The weather became worse and flying was difficult. Petrol was running short when a landing was made on fast ice near the shore at the northern entrance to Ice Fjord. The reports mention an island, but there is

no island off the plains of Dödmandsören. The arrival was followed by four days of bad weather, during which the airmen lived in the cabin of their machine. At length, on April 21, the fifth day after landing, the conditions improved sufficiently for the flight to be resumed. There were only 20 gallons of petrol left and the start proved difficult. At a height of 3000 ft. the mast of the wireless station at Green Harbour was seen and the station was reached shortly afterwards. Mr. Wilkins will leave for Europe as soon as a vessel is available. The shipping season in Spitsbergen opens shortly. The flight scores a new track over the unexplored Beaufort Sea to the east of Amundsen's track of 1926. No new land was seen, but it must be remembered that low islands, the only possible land in that sea, would be snow-covered and not easily distinguishable at this season, even if the weather were clear. Meteorological observations were taken throughout the flight. The pilot is to be congratulated on the accuracy of his navigation, especially in view of the bad weather between Greenland and Spitsbergen.

THE following official records of earthquakes have been received from Kew Observatory: A violent earthquake was recorded at 19 hr. 27 min. 22 sec. G.M.T. on April 18. The epicentre is estimated to be 1360 miles away at a bearing of  $115^\circ$  from true north from Kew, which locates the disturbance in the Balkan States. The size of the disturbance recorded is quite as big as that of the destructive earthquake which occurred in the same region on Saturday, April 14. A further disturbance of very much milder character, and estimated to be at the same place, was recorded later at 23 hr. 19 min. 21 sec. G.M.T. Another earthquake was recorded on April 22 at 20 hr. 18 min. 41 sec. G.M.T. The epicentre is estimated to have been 1470 miles away and probably in Bulgaria. The intensity of the disturbance was about one quarter of that produced by the two destructive earthquakes which recently occurred in that region.

THE earthquakes felt in southern Bulgaria during the latter half of April have been remarkable for their number as well as their intensity. The first occurred on April 14. Its epicentre was evidently close to Chirpan, which was almost entirely destroyed. The area of damage was of wide extent, for it includes Plovdiv (Philippopolis), nearly 30 miles to the west. Another violent earthquake occurred on the evening of April 18, the centre having shifted to the neighbourhood of Plovdiv, where more than five thousand houses were damaged and many persons lost their lives. Even at Sofia, more than 80 miles from Plovdiv, houses were injured. So far, the most interesting features of the earthquakes are the westerly migration of the focus along a line parallel to the Balkan ranges, and the great size of the areas over which damage occurred in the principal earthquakes, the latter feature pointing to a great depth of focus. The Athens correspondent of the *Times* reports that the earthquake of April 22 wrecked Corinth, and that Kalamaki and Loutraki, near Corinth, have also been much damaged. It is estimated that 15,000 people are homeless.

ALTHOUGH the Society of Chemical Industry is this year holding its annual general meeting in New York, and is combining that function with interesting visits in Canada and the United States, distance is not yet so completely annihilated as to render it possible for all to take part who have a mind to do so. Numbers of members will therefore welcome arrangements enabling them to meet in Great Britain and discuss matters of common concern. The Society, in co-operation with its London section, the Chemical Engineering Group, and the Institution of Chemical Engineers, has organised a conference to be held in London on May 11-15. On the first day the Chemical Engineering Group will hold a business meeting, followed by the annual dinner; Mr. F. H. Carr, president of the Society, will afterwards deliver an address entitled "Some Chemical Engineering Aspects of the Fine Chemical Industry." Rothamsted Experimental Station, Harpenden, is to be visited on the second day. On Monday morning Sir Arthur Duckham, the first president of the Institution of Chemical Engineers, will discuss "The Fuel Industries and the Work of the Chemical Engineer," and Prof. G. T. Morgan will deal with "The Chemical Study of Low-Temperature Tar," the chairman being Sir Hugo Hirst; in the afternoon Lord Desborough will preside, and Sir Alexander Houston will speak on "Water Purification," and Mr. J. H. Coste will give an account of "The Pollution of Tidal and Non-Tidal Streams." On the same evening there will be a dinner, preceded by a reception by Mr. and Mrs. F. H. Carr, and followed by dancing. The British Science Guild has been invited to participate in the final sessions of the Conference on May 15, when Sir Alfred Mond, the president of the Guild, will deliver an address entitled "Scientific Research as applied to Industry," and Sir John Russell will describe "The Part Played by British Workers in the Application of Fixed Nitrogen to the Soil." The afternoon session, over which Lord Bledisloe will preside, will be devoted to a consideration of "Developments in the Heavy Chemical Industry," by Lieut.-Colonel G. P. Pollitt.

PROF. J. H. BREASTED has issued an account of the work accomplished by the Oriental Institute of the University of Chicago, of which he is director, during the eight years of its existence. A summary of the report appears in the issue of the *Times*, April 12. It records an activity in the archaeological field, especially in the later years, which reflects great credit on the organisation of the Institute. During the past two years an expedition to Asia Minor has discovered fifty-five new and unmapped Hittite sites. By its excavations at Alishar Huyuk it has established clearly a pottery sequence and the criteria for dating levels on Hittite sites. Further evidence of Hittite influence in Palestine has been found at Megiddo. Human occupation there has been traced back to the Stone Age, and a monument has been found recording the victory of Sheshonk (Shishak) over the son of Solomon and the capture of Jerusalem. It is expected that the excavations of the present season will reach the Egyptian Imperial levels. Reference is made to

the researches of Dr. Sandford and Mr. Arkell on the pliocene and pleistocene history of the Nile, and the finding for the first time of stratigraphically dated palaeolithic implements on the borders of the Red Sea. Reference is also made to the alabaster vessel workshop discovered in the Fayum, originally overhastily attributed to the palaeolithic, which more careful examination has shown to be dynastic. The Institute is devoting itself to two valuable and extremely important pieces of work in recording the wall paintings and carvings of the Egyptian temples, beginning with Medinet Habu, and in the compilation at headquarters in America of a dictionary of cuneiform.

DURING the past winter, Miss G. Caton-Thompson has continued her work on the archaeology of the Northern Fayum Desert under the auspices of the Royal Anthropological Institute, to which body a concession to excavate was granted by the Antiquities Department of the Egyptian Government. Miss Caton-Thompson was accompanied by Miss E. Gardner, who continued her researches in the geology of the area with special reference to the question of lake levels at different periods. The main object of the expedition was to search for cemeteries which might afford material for dating the 'Fayum industry.' Reports of the season's work received to date, of which a partial summary appears in a letter from Miss Caton-Thompson in the *Times* of April 17, indicate that, while the main objective has not yet been attained, results of no small importance have been achieved. Of these the most interesting is, perhaps, the discovery of an unsuspected irrigation system in the Fayum of Ptolemaic date, which has aroused considerable interest in Egypt, and has secured the practical co-operation of the Irrigation Department in the provision of workmen and monetary contributions through H. E. Osman Pasha Moharram, late Minister of Public Works, and Ahmed Bey Ragheb, of the Irrigation Department. The examination of neolithic mounds and granaries has carried the investigation of the Fayum flint industry a step further, and it is now divided on stratigraphical and typological grounds into two well-defined stages. A big gypsum quarry and alabaster vase factory of the early Old Kingdom have been discovered and explored, the site including a village of hut circles belonging to the workers. Investigation of the lake levels has fixed the Fourth Dynasty shore-line at about O.D. zero, or 145 feet above the present lake. The remaining weeks of the season are to be devoted to work on new ground. In order that these plans may be carried out, a further amount of £250 is required towards the cost of the expedition. The Royal Anthropological Institute has issued an appeal for subscriptions, which may be sent to the Honorary Treasurer, 52 Upper Bedford Place, W.C.1.

THE number of passengers arriving and departing from the Croydon Aerodrome, which is London's terminal port for the Anglo-Continental transport service, was last year more than 20,000, and the value of the goods exported and imported amounted

to ten million pounds. As a modern air liner accommodates eighteen passengers besides a crew of three, it is necessary that all precautions be taken for their safety. A new radio telegraph and telephone equipment has just been installed at Croydon by the Marconi Co., Ltd. The control tower is 80 feet above the ground and gives a clear view of the aerodrome on all sides. The radio officer is in control of the receiver and direction finder. He also operates three of the four transmitters at the sending station at Mitcham, which is  $2\frac{1}{2}$  miles from the aerodrome. One of the transmitters is for telegraphy, another for telephony, and the third is a spare one in case of need. Some distance from the control tower is the receiving station, which has a 200-foot long horizontal aerial. The receiving and transmitting officers work quite independently of each other. A radio goniometer is used to determine the bearings of aircraft. When the pilot of an aeroplane sends a request to Croydon for his position, Pulham and Lympne, at which stations constant watch is kept, simultaneously take his bearings and transmit them by radio to Croydon. At Croydon these bearings, together with the local bearings, are plotted on a large map, the point of intersection of the three bearings giving the position of the aeroplane. This reading is at once communicated to its pilot, the whole process taking less than one minute. The transmitters at Mitcham are brought into action from the control tower. An ingenious device makes it impossible to damage the transmitting valves by switching them on in the wrong order. The valves are kept constantly alight, as it is found that continual switching on and off shortens their lives more than when they are left to burn continuously.

THE first elaborate attempt to light a theatre by electricity was carried out at the Opera House, Vienna, in 1886 by Col. Crompton and other Englishmen. A few months afterwards the electric light was installed in the Theatre Royal, Drury Lane, and the Savoy Theatre. During the last few years theatre lighting has been revolutionised. We learn from a paper on the subject by H. D. Wilkinson, read to the Royal Society of Arts on April 6, that high candle-power gas-filled lamps (1000 c.p. and above) are now almost invariably used instead of arc lamps. The factor of safety has been very greatly increased. The long-standing problem of controlling the auditorium lighting from the stage has been solved. The fuses are grouped in readily accessible and fire-proof positions. In the early days they used to be scattered over the house in order to economise on the expense of wiring. The L.C.C. Regulations prescribe that the lighting of the auditorium and all parts of the house open to the public shall be from two independent sources of power supply. Half the total number of lights is supplied from each source, and so far as possible alternate lamps are supplied from a different supply. The stage lighting, both the overhead lights (battens) and the footlights (the float), must be from a third and independent source. Pleasing lighting effects are sometimes produced by ultra-violet rays falling

on objects covered with fluorescent paint. It seems probable that a still higher degree of illumination on the stage will be used in the future. An ingenious mechanism for the production of moving clouds from photographs has recently been developed. It is called the cyclorama, and has been much used abroad. Apparatus of British manufacture for producing sky and horizon effects quite equal to the cyclorama is, however, now available.

In the April number of the *Electrical Age for Women*, Mrs. Lawson writes an interesting article on electricity at the London Zoo. In the new buildings great difficulty was experienced in regulating the heat so as to suit the individual requirements of each inmate. The average temperature maintained is 80° F. The temperature of each cage and department is separately controlled, electrically. Should the temperature rise or fall 5°, this is at once detected by a coloured lamp lighting on a board, the number beside the lamp indicating the cage. A red light indicates that the temperature is too high, and a green light that it is too low. The tropical humid heat is confined to the cages, the corridors being independently ventilated. In the new reptile house 20 miles of electric cable were required. The monkey house is roofed with vita-glass which is transparent to the ultra-violet rays from the sun. The monkeys sit on swinging perches underneath ultra-violet ray lamps. The swamp and the rocks and sand for the crocodiles are all electrically heated. About two hundred connexions are necessary to heat and control the temperature of this cage. In some cases bowl electric fires are fixed in the roof to warm the air. The new aquarium is electrically heated and the water is pumped, filtered, and aerated electrically. Hygienically, the new arrangement is greatly superior to the method of heating by steam pipes formerly used.

An interesting gathering of the members of the Research Association of British Paint, Varnish, and Colour Manufacturers took place at the laboratories of the Association at Waldegrave Road, Teddington, Middlesex, on Wednesday, April 18. It will be remembered that these laboratories were officially opened on Sept. 21 of last year by Dr. Weidlein, the head of the Mellon Research Institute of Philadelphia. At the meeting on April 18 a lecture was given by Mr. R. A. Coolahan upon "Cellulose Lacquers," which was illustrated by a short cinema film. After the lecture a tour of the laboratories was made, when it was soon apparent that considerable development has taken place since last September; a useful extension has been made by adding rooms for colorimetry, constant temperature and humidity, and for the testing of paint and varnish films by accelerated methods. In addition, a small open laboratory has been built to accommodate varnish and oil-treating plants. This should prove of great value in the examination of these and like products. Demonstrations were given of the investigations in hand. It is clear that this laboratory is rapidly becoming of first-class importance to the industry and will in time be the chief centre of all new developments.

THE Italian Arctic expedition in the airship *Italia*, under General U. Nobile, left Rome for the north on April 15. The *Times* reports that the route to be followed was by Fiume, Zagreb, Vienna, Stolp, and Vadsö to King's Bay, Spitsbergen. The *Italia* reached Seddin near Stolp on the following day, after sustaining some injuries in bad weather. A vessel of the Italian Navy will await the airship in King's Bay. General Nobile has with him several Italian scientific men, and the Swedish meteorologist, Prof. Malmgren. From the base in Spitsbergen several flights will be made during the two months of summer. These will include observations at Nicholas Land, Crocker Land, if that land exists, and at the Pole itself. The inability of the airship to descend at these little-known parts of polar regions will, however, militate against the scope and value of the scientific observations.

COL. THE HON. FL. VERNON WILLEY, of Messrs. Francis Willey and Co., Ltd., Bradford, has been elected chairman of the British Research Association for the Woollen and Worsted Industries. Col. Willey is a past president of the Federation of British Industries and president of the Wool Textile Delegation. He succeeds Sir James P. Hinchliffe, who has presided over the Association since its establishment in September 1918 and has been responsible for the administration of an expenditure of more than £100,000 on research work for the wool textile industry during the past nine years.

At the meeting of the London Mathematical Society on May 10, at 5.0 P.M., at the rooms of the Royal Astronomical Society, Burlington House, Prof. W. E. H. Berwick will give a lecture on "Some Recent Advances in the Theory of Equations." Members of other scientific societies are invited to attend the meeting.

THE eighteenth annual May Lecture to the Institute of Metals will be delivered by Prof. Cecil H. Desch, on "The Chemical Properties of Crystals," at the Institution of Mechanical Engineers, Westminster, S.W.1., on Tuesday, May 8. Cards of invitation to the lecture can be obtained on application to Mr. G. Shaw Scott, 14 Members Mansions, Victoria Street, London, S.W.1.

At the annual general meeting of the Physical Society, held on Mar. 23, the following officers for 1928-29 were elected: *President*, Dr. W. H. Eccles; *Hon. Secretaries*, Prof. A. O. Rankine and Mr. J. Guild; *Hon. Foreign Secretary*, Prof. O. W. Richardson; *Hon. Treasurer*, Mr. R. S. Whipple; *Hon. Librarian*, Mr. J. H. Brinkworth. Prof. Albert Einstein was unanimously elected an honorary fellow of the Society.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Nautical College department of the Liverpool Central Technical School—The Director of Education, 14 Sir Thomas Street, Liverpool (April 30). A temporary research assistant to the advisory mycologist of the University of Reading—The Dean of the



Faculty of Agriculture and Horticulture, The University, Reading (May 1). A lecturer and demonstrator in organic chemistry in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (May 7). An assistant keeper of the City Museum and Art Gallery (Natural History Department), Birmingham—The Keeper, City Museum and Art Gallery, Birmingham (May 11). Lecturers in philosophy (psychology), physics, and mathematics in University College, Rangoon—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (May 12). An assistant entomologist and an assistant mycologist at the Imperial Forestry Institute, Oxford—The Secretary, Imperial Forestry Institute, Oxford (May 12). An experimental officer in the acoustical section of the Air Defence Experimental Establishment, Biggin Hill, Kent—The Secretary, Royal Engineer Board, 14 Grosvenor Gardens, S.W.1 (May 18). A lecturer in botany at the University College of Wales—The

Secretary, University College of Wales, Aberystwyth (May 31). An assistant lecturer in mathematics at the University College of North Wales—The Secretary, University College of North Wales, Bangor (June 2). A Research Officer at the Punjab Veterinary College, Lahore—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (July 31). A head of a new department of the British Cotton Industry Research Association to deal with fundamental scientific problems arising out of the use of artificial silk in conjunction with cotton—Dr. R. H. Pickard, Director of Research, Shirley Institute, Didsbury, Manchester. A physicist for work in connexion with explosives—The Manager, Research Department, Nobel's Explosives Co., Ltd., Ardeer, Stevenston, Ayrshire. A head of the explosives research branch, two assistants, and some junior assistants, in the Research Department, Woolwich (Directorate of Explosives Research)—The Chief Superintendent, Research Department, Woolwich, S.E.18.

### Our Astronomical Column.

NOVA PICTORIS.—Further telegrams from Johannesburg and the Cape announce that this star has further subdivided and is now in four nebulous portions; these are too small to be photographed separately, and the observations of them are wholly visual. On the other hand, the large rings round them are only observable by photography. They are three in number, the outer one having a diameter of 3'. It was at first thought that these were due to the outward travelling of the light waves rendering visible nebulosity that was already there, as in the case of Nova Persei in the autumn of 1901.

It is now suggested (according to the *Times* of April 21) that the star is much nearer than was supposed, and that the rings are the matter blown off the star by the outburst. On this supposition its distance from us is estimated as 40 light-years or 12 parsecs. This supposition would quite negative the suggestion of a collision of two stars; in that case the proper motion at such a small distance would be much larger than it is. In fact, the sun's motion foreshortened would give a shift of 5" in 24 years, which is four times the observed shift, so that if the star is at that distance it must be travelling at a speed about the same as the sun's, in the same direction. Also its absolute magnitude before the outburst was about 12, so that it was an extreme dwarf (perhaps a white dwarf). The star has been put down for parallax measures, which apparently have not yet been made. Measures during the next few months may throw further light on the question.

ε AURIGÆ.—*Harvard Announcement Cards 59 and 63* deal with the expected minimum of this star. At the Washburn Observatory it was observed to decline 0.12 mag. between Jan. 22 and Mar. 4. Measures at Detroit Observatory give a decline of 0.18 mag. between Jan. 17 and Mar. 16. On the other hand, Margarete Güssow at Neubabelsberg gives the decline as only 0.04 mag. between Jan. 25 and Mar. 20 (*Astr. Nach.*, 5555). She concludes that the real approach to minimum has not yet commenced, and that the present oscillation is one of shorter period. *Harvard Announcement Card 63* also directs attention to the fact that there is an oscillation of 150-day period superimposed on the principal one, of much longer period. The star should be carefully watched.

Mr. McLaughlin at Detroit notes that on Mar. 16 the H<sub>γ</sub> line had a well-marked satellite on the side towards the red, not seen on earlier plates.

THE EBRO OBSERVATORY.—Father Puig has written an interesting volume on the work of this observatory, which has been in existence for more than twenty years ("El Observatorio del Ebro. Idea General sobre el mismo." By the Sub-Director, P. Ignacio Puig, S.J. Tortosa, 1927). Its work embraces seismography, terrestrial magnetism, and earth-currents, solar radiation, meteorology in all branches; solar physics, both visual and spectroscopic; time determination. The observatory was in the totality track in the eclipse of 1905; the results have been already published, but are briefly summarised.

An interesting investigation carried out at the Observatory is the apparent influence of the earth on the birth and development of sunspots; it was first suggested by Mr. E. W. Maunder in 1907 that such an influence exists; the present investigation tends to confirm it. The records show that the majority of spots registered had their birth on the hemisphere away from the earth; the actual ratio should be still higher than the observed one, since it would include short-lived spots that formed and disappeared on the invisible hemisphere. Further, the number of spots born on the eastern half of the visible hemisphere exceeds by 20 per cent. the number born on the western half. There seems to be a slight excess of spots when the earth is in aphelion; also, the northern hemisphere has an excess when the earth is south of the sun's equator, and vice versa. It is noted that it is very difficult to understand how the earth can have such an effect on the spots (which extends to the faculæ and prominences, as Evershed and others have confirmed). A magnetic or electrical interaction between sun and earth is suggested as the most probable explanation.

The curve of sunspot activity from the Ebro Observatory records shows a very flat minimum in 1913 (the preceding and following years being nearly as low), a sharp maximum in 1917, a slight hump on the downward curve in 1919, a sharp minimum in 1923, and a rapid, steady rise in the three following years. The volume is well illustrated with photographs of the buildings and instruments, solar prominences, etc.

## Research Items.

**THE DALLEBURRA TRIBE, NORTH QUEENSLAND.**—Mr. M. Bennett has published in the *Journal of the Royal Anthropological Institute*, vol. 57, pt. 2, an account of the Dalleburra, a tribe virtually extinct, from notes made by Robert Christison, who settled among them in 1863, and whose collection of Dalleburra weapons, with a series of fine photographs of members of the tribe, is now in the British Museum. It is probable that the Dalleburra had never seen a white man before. Christison got into touch with them only with extreme difficulty, but secured great influence through healing the broken leg of a small boy whom the tribe expected to die. The incident revealed the existence of a custom by which on occasions of both extreme sorrow and great joy the women gashed themselves with stone knives. He could not discover that they believed in one supreme being, though they did believe in supernatural beings. Tribal government was in the hands of headmen, and the chief offences were marrying within the prohibited degrees, abduction, and encroaching on others' hunting grounds. Message-sticks and smoke signals were the chief means of communication. The headmen pretended to be able to call down rain and to cure disease. They determined the distribution of food, getting the best for themselves, and indeed some of the tribe had never tasted emu. There was a regular marriage system, for which purpose the tribe was divided into four divisions, classified in pairs. The children belonged to different sections from their parents. Members of the same section of the same generation were brothers and sisters. All members of the Ko-bro section had the first joint of one forefinger cut off. Incest was punished by the death of the guilty parties, but the child was abandoned. Indicative of their intense feeling on the point is the fact that one case was still regarded with the greatest shame by a member of the tribe thirty years after the event. The youths of the tribe had to go through various trials and courses of instruction before they were regarded as grown-up men and qualified to marry; but no account of the initiation ceremony could be obtained.

**THE COFFEE MEALY-BUG IN KENYA.**—The common coffee mealy-bug (*Pseudococcus lilacinus* CK11) is prevalent in the most important coffee-producing area in Kenya Colony. It is very easily confused with the closely allied species *Pseudococcus citri* Risso, and it is probable that some of the records relative to the latter insect may really refer to *P. lilacinus*. In *Bulletin 18* of the Colony and Protectorate of Kenya, Nairobi (1927), Mr. T. W. Kirkpatrick provides an interesting and very practical study of this insect. In addition to coffee, it affects a wide range of other host-plants and is largely spread by the whirlwinds or 'dust devils,' especially prevalent in the warmer seasons. A whole complex of other insects live in association with the mealy-bug, including ants which attend that insect for the honey-dew it yields, together with various parasites and predators. The damage entailed to coffee by mealy-bug was estimated to amount to £100,000 during the first six months of 1927: the flower buds and young berries form an ideal food and in severe attacks all the leaves may be shed, the crop being ruined. One of the most important factors concerned in the life of the mealy-bug is the ant *Pheidole punctulata*, which attends and protects it in various ways, besides destroying large numbers of other insects which normally prey upon it. Since the presence of this ant involves grave risk of rapid spread and severe injury by the mealy-bug, and in its absence it is unlikely much damage will occur, control measures

aim at excluding the ant from the coffee plants. It was found that if the *Pheidole* is kept off the trees, the mealy-bug is always almost completely destroyed by its natural enemies. Various methods of exclusion are discussed, and the most feasible is the use of paper cones soaked with a high boiling-point tar oil. The cones are fastened round the stems, where they should require no attention for two or three months, and they act as effective barriers to the progress of ants up the trees.

**LIVER FLUKE DISEASE OF SHEEP.**—The Ministry of Agriculture and Fisheries has issued a revised edition (January 1928) of *Leaflet No. 89* on this subject. A brief account in simple language is given of the life history of the fluke and of the symptoms of the disease. The destruction of the snail (*Limnæa truncatula*), which is the intermediate host of the fluke, is the obvious preventive, and this may be accomplished by drainage or by dressing the land and treating the water of ditches, ponds, etc., with copper sulphate. Dykes should be cleaned out and their sides made vertical, so as to do away with dead water under the banks in which the snail is commonly found. The details of treatment with copper sulphate are clearly set forth in the leaflet. The sheep should be kept on good, well-drained land during the autumn and winter months, the period when infection is likely to be acquired. Curative treatment with extract of male fern and with carbon tetrachloride is advocated and described. The last serious outbreak of liver fluke disease occurred during the winter of 1920–21, when in four counties in North Wales alone 60,000 sheep died or were killed. In a pamphlet on liver fluke disease recently issued by the Council for Scientific and Industrial Research of the Commonwealth of Australia, the loss directly attributable to this disease in Australia is estimated at £100,000 per annum. Treatment by carbon tetrachloride is strongly advocated, and various methods of administration are briefly described.

**HAWAIIAN BARNACLES.**—Mr. Henry A. Pilsbry ("Littoral Barnacles of the Hawaiian Islands and Japan," *Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. 79; 1927) describes some collections of littoral barnacles from the small islets and reefs strewn over the Pacific for two thousand miles between the Hawaiian group proper and Japan, and also some species from the larger Hawaiian Islands. As these regions, particularly the smaller islands, are practically unexplored for cirripedes, there is here a fertile field for naturalists. Among the many interesting species recorded is a new form, probably belonging to Darwin's *Pœcilasma fissa*, which is named *Trilasmis fissum hawaiiense*, the genus *Trilasmus* having priority over *Pœcilasma*. Darwin's species, based on a single individual attached to a spinose crab from Bohul, Philippines, is much larger than the Hawaiian form which was found frequently on the mouth parts of the crab *Dromia dromia*, and differs in other respects also. It is a question, however, whether these small specimens may be the young of a larger barnacle not yet found.

**BURMESE MYXOPHYCEÆ.**—In the *Journal of the Burma Research Society*, vol. 15, pt. 3, vol. 16, pt. 3, and vol. 17, pt. 3, Dr. S. L. Ghose makes considerable contributions to our knowledge of the Indo-Malayan Myxophyceæ. At the present time, identification of the various genera and species of the group can only be carried on with the expenditure of a large amount of labour on account of the rather rare and much

scattered condition of the literature. Dr. Ghose has taken upon himself the laborious task of making as complete a descriptive record as possible of the blue-green algæ of his region, so that the work of future systematic and ecological investigators will be considerably lightened. The species are listed according to locality, those treated so far being, Myxophyceæ from Rangoon 1, 2, and 3, Myxophyceæ from Maymyo, and Myxophyceæ from Mergui and some neighbouring islands. Genera and species are described critically, and illustrated by means of good plates with line drawings. A few new species and several new varieties are included in the lists.

AGRICULTURAL RESEARCH IN CONNECTICUT.—The fiftieth Report of the Connecticut Agricultural Experiment Station (for the year 1926) is a volume of more than 600 pages dealing with the various activities of that Institution. A large part of this publication is occupied by the report of the State Entomologist. The Asiatic beetle which appeared in 1925 in New Haven has received a good deal of attention as it is a new pest in the United States. Up to the present, its injury to plants is confined to grass lawns, where the larvæ live. Many experiments have been conducted with the view of finding a method of control of the oriental peach moth, while the birch leaf skeletoniser is the subject of a long and detailed paper on its biology. On the botanical side one of the most interesting facts brought to light is the discovery that tobacco leaves dried and preserved for twenty-four years still retain the active principle of mosaic disease and can be used to infect living plants. With regard to soil research, the subject of the phosphorus requirements of tobacco with particular reference to old soils is given special prominence. The Report mentions that the library of the Station now contains 16,400 volumes, and that 48,000 copies of bulletins were mailed during the year.

THE UPPER WATERS OF THE BLUE NILE.—An important addition to our knowledge of the Nile drainage system was made by Major R. E. Cheeseman in 1926–27 in his survey of the Abbai River, one of the Abyssinian headstreams of the Blue Nile. Major Cheeseman's account of his explorations and his map of the river from Lake Tana to the Wanbera country is contained in the *Geographical Journal* for April. Previous knowledge of the river and earlier maps were fragmentary, and based mainly on the routes of travellers who had crossed it at various fords. The explorations included an examination of the Tisisat falls, some twenty miles below Lake Tana.

REGIONAL SURVEY.—An addition to the growing number of regional studies of Great Britain is made by Miss C. Pugh and Mr. G. E. Hutchings in "Stockbury: a Regional Study in North-East Kent," published by The Hill Farm, Stockbury. The study is divided into five sections: Geology and physical features, vegetation, animal life, historical geography, and the Stockbury district. The plants and animal life occupy more than half the book, and while a great deal of valuable matter occurs in these pages, much of it has little real bearing on the regional study of the area in the geographical sense which such work is generally taken to imply. The human part of the study, on the other hand, is disappointingly brief, but the work with its good maps is a careful introduction to the subject.

A FOSSIL MEDUSA.—Very few traces of the existence of Medusæ have been found in rocks of earlier date than the Upper Jurassic, so that interest attaches to the discovery of a specimen in the Carboniferous Limestone at Denée in Belgium, and described by

V. Van Straelen (*Acad. R. Belg. Bull. Classe des Sci.*, p. 952; 1927). It is a cast of the upper convex surface, nothing being known of the oral surface. The specimen is provisionally referred to the Rhizostomidæ.

PROTONS IN METALS.—In a letter in *Die Naturwissenschaften* of Mar. 16, Prof. A. Coehn announces that he has succeeded in effecting an electrolytic transport of hydrogen through palladium. A wire of the metal was charged with gas at the cathode of a cell containing decinormal sulphuric acid, and the subsequent diffusion of the hydrogen was followed by measurement of the electrode potential at various points on the wire. When an electromotive force was applied to the ends of the latter, the hydrogen passed preferentially towards the negative terminal, and could be moved to and fro by reversal of the field. The conclusion that Prof. Coehn draws from these results is that the hydrogen atoms, like those of the metal itself, are partly ionised, but that the resulting protons, not being bound in a space lattice, are free to be affected by an electric field.

SIMPLE MICROSCOPE PROJECTION APPARATUS.—A simple and useful accessory to the microscope has recently been designed by Mr. J. F. Marshall, director of the British Mosquito Control Institute, Hayling Island, by means of which the enlarged image of any object inserted under the microscope can be projected directly upon a screen either for the purpose of demonstration, drawing, or photography. The apparatus, which is known as the 'Moscon Macrograph,' consists of a projection screen attached to a vertically adjustable rod carried in a light but rigid framework which may be clamped to any table, shelf, or other convenient support. The microscope and the illuminant are placed on the floor and the image of the object is focused on the screen. As the screen is horizontal and can be fixed at a convenient height, the apparatus is extremely well suited for drawing, the tracing paper being easily fastened on the clear glass screen by means of the frame clips. For photographic purposes a light-tight bag of black cloth is attached to the frame of the screen and to the tube of the microscope, and a plate carrier is substituted for the glass screen after the image is focused. In this carrier the plate is covered by a hinged lid which opens downwards and works more smoothly than the usual sliding shutter. The macrograph, which costs £5, complete with carrying case and two projection screens, but without the photographic accessories, is marketed by Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1.

THERMAL AND ELECTRICAL CONDUCTIVITY.—The paper on the thermal and electrical conductivity of some aluminium alloys and bronzes read by Ezer Griffiths and F. H. Schofield at the annual meeting of the Institute of Metals on Mar. 7 is of considerable practical importance. It is frequently stated that the Lorenz law, namely, that the thermal conductivity varies as the product of the electrical conductivity and the absolute temperature, fails when applied to data obtained with alloys. The results obtained by the authors prove, at least, that as a generalisation, this statement is erroneous. The error has probably arisen from the fact that the values usually given for the thermal conductivities of alloys are untrustworthy. The primary object of the research was to obtain the thermal conductivities of the alloys employed in the construction of aero-engines. Two different sets of alloys were investigated. The first group consisted of alloys rich in aluminium, and the second group

those rich in copper. For the second group, it was found that the Lorenz coefficient had practically the same value within  $\pm 2.5$  per cent. from  $75^\circ$  to  $250^\circ$  C. This is probably within the limits of experimental error. It appears, therefore, that the thermal conductivity can be deduced from a measurement of the electrical conductivity. As the determination of the latter quantity presents far less difficulty than that of the former, this result will be of great practical use. For the twenty-one aluminium alloys experimented on, very consistent results were obtained, except with a 13 per cent. silicon alloy. A determination of the Lorenz coefficient for a single crystal of aluminium (99.6 per cent. aluminium) gave the value  $5.46 \times 10^{-9}$ . This is in good agreement with that obtained for the alloys. The value of the Lorenz coefficient for very pure copper was  $5.89 \times 10^{-9}$ , which is in close agreement with the values obtained for the bronze alloys, but is decidedly higher than that obtained for the aluminium alloys.

**AN ULTRA-VIOLET LAMP WITH NEW ELECTRODES.**—The 'Uvir' lamp, made by Messrs. Bellingham and Stanley, Ltd., is interesting and of unusual design. The arc is formed between two parallel metallic electrodes mounted vertically in front of a radiator which constitutes the series resistance. The heating elements of this radiator are solid rods of a special composition which reach a higher temperature when running than is possible with wire spirals, and hence yield a greater percentage of radiant heat. The electrodes are rigidly mounted in a simple clamp, so that the arc has to be lit by placing a carbon rod across the points. A rod mounted in an insulating handle is supplied with each lamp. The electrodes are made of a special alloy which has been selected as giving an intense radiation over the range of wave-lengths 2900 Å.—3100 Å. For use on an A.C. supply, the metallic electrodes are replaced by carbon cored with the same alloy, but even so the starting of the lamp is found to be more difficult than on D.C. Both arcs burn steadily with less fume and oxide than tungsten, and can be blown out like a candle, but the electrodes require adjustment and turning round in the holder from time to time to keep them at the same height. The cost of the alloy electrodes is about half that of tungsten. The radiation generated by this lamp is of an unusual character, as a great percentage is concentrated round the wave-length 3000 Å., a range which is generally regarded as being of great therapeutic activity. Further, the shorter wave-lengths, of more dubious value, are not present to any marked degree. The 'Uvir' lamp may therefore be described as an efficient source of ultra-violet radiation of therapeutic value. It is for that reason to be regretted that more attention has not been given in the electrical design to safety devices. The radiator heating elements are protected by a wire grid, but the arc, which reaches a higher temperature and may be equally 'alive,' is outside the grid and entirely exposed. It is claimed that the somewhat crude method of striking the arc described above has the advantage of eliminating moving parts which are likely to corrode or oxidise, and in one way or another get out of adjustment. It may be found that the public is shy of taking such liberties with the ordinary type of mains and will require some form of switch on their ultra-violet lamps. The current consumed is approximately 3 amp. and the price is £5 5s.

**THE INFLAMMABILITY OF HYDROGEN.**—The January number of the *Journal of the Society of Chemical Industry of Japan* contains a further account of the work of Y. Tanaka and Y. Nagai upon the inflamma-

bility of hydrogen-air mixtures. They have found that, as would be expected, the tetra-methyl compounds of tin and lead act as anti-knocking agents in internal combustion engines, but these substances do not produce so great an effect upon the limits of inflammability of hydrogen mixtures as do the corresponding ethyl compounds. This is attributed to the smaller cross-sectional areas, and hence the smaller probability of collision with activated hydrogen molecules, of the molecules of the methyl derivatives. The theory of active collisions in combustion, and a derivation of the effects of pressure on the limits of inflammability, have already been given by Y. Nagai in the *Journal of the Faculty of Engineering of the Tokyo Imperial University*, vol. 17, No. 3, 1927.

**DEVELOPER STAINS.**—It is well known that in developing a photograph the oxidation products of the developer are deposited with the silver of the image and form a secondary 'stain image,' unless sufficient sulphite is present to prevent it. Messrs. Lumière and Seyewetz (*Brit. Jour. of Photography*, Mar. 11, p. 172) find that the colour of this image varies with the nature of the developer and sometimes with the alkali used, being orange yellow with pyrogallol and various shades of brown with other developers. The amount of anhydrous sodium sulphite necessary to prevent the formation of this stain image is generally 2 gm. to the litre, but pyrogallol requires 11 gm., pyrocatechin 6 gm., and glycin needs none, as it does not give this image at all. The formation of the stain image renders the gelatin insoluble in proportion to its intensity. This image is a mordant for basic dyes, and may be intensified by such dyes to a density even exceeding the density of the original image as developed. To isolate the stain image, the silver is dissolved away by means of ferricyanide and hypo.

**ELECTRICAL HARDENING AND ANNEALING PROCESSES.**—Electric salt bath furnaces have been found to be very useful for heating metals up to the exact temperature required for hardening in the shortest possible time. They are largely employed for hardening cutting tools. The tool to be hardened is placed in the salt which is to carry the electric current. When the salt melts it makes good thermal contact with the metal, the required temperature being attained very quickly. The salt bath also serves as a heat accumulator. Air is not in contact with the heated metal, and so it is not oxidised on quenching. Owing to the excellent way they retain their heat, salt bath furnaces are particularly suitable for hardening metals on a large scale. In *A.E.G. Progress* for December, a description is given of electrical welding and hardening processes. The furnaces for  $800^\circ$  C. are used for hardening carbon steels, and those for  $1300^\circ$  C. for high alloy steels. The salt used for temperatures from  $750^\circ$  C. to  $1000^\circ$  C. is composed of a mixture of barium and potassium chlorides, and that from  $1000^\circ$  C. to  $1300^\circ$  C. of barium chloride only. Electric annealing furnaces are also described. For these furnaces chrome nickel has been found most useful for the conductor which converts the electrical energy into heat. These furnaces are generally designed for temperatures up to  $950^\circ$  C. and are specially useful for heating processes which have to extend over long periods. They are sometimes equipped with automatic temperature regulators and can be used for annealing metals in hydrogen and other gases. The tempering of hardened tools can also be effected in electric salt bath furnaces even when the temperature required is so low as  $220^\circ$  C. In this case the conducting salt is a mixture of sodium and potassium nitrates.

## Pharmacological Research in Great Britain.

THE second Annual Report of the Pharmacological Laboratories of the Pharmaceutical Society of Great Britain (1927) gives a brief summary of the research work carried out during the year, and indicates the part the laboratory is beginning to play in the physiological standardisation of different drugs for commercial manufacturers. In February of last year the Vitamin-testing Department, under Dr. Katharine H. Coward, was ready to carry out its first tests, and these now occupy an important place in the laboratory's work.

The director, Dr. J. H. Burn, has continued his researches on the metabolism of rats on a fat diet: he has found that in summer the excretion of acetone bodies in the urine of a 100-150 gm. rat reaches a maximum of 50 mgm. in a day, whilst in winter the maximum may not be greater than 5 mgm. The summer acetonuria can be inhibited by injection of pituitary extract or adrenalin, indicating that these hormones control the metabolism of fat as well as that of carbohydrate. On the other hand, daily injections of insulin, after a day or two, increase the winter acetonuria, and this increase is not simply related to the fall in the blood-sugar, since the latter occurs to about the same extent on all days on which the injections are given.

Some work has been carried out on the assay and preparation of extracts of ergot, and also, in conjunction with Mr. A. Bourne, on the clinical value of pituitary and ergot extracts. It was found that during labour a dose of 2 units of pituitary extract was quite sufficient to hasten its conclusion, and also that of the possibly active substances present in extracts of ergot, the specific alkaloid ergotamine or ergotamine produces, after a short latent period, a

prolonged contraction of the uterus *postpartum*, whilst histamine causes an immediate powerful but short-lived contraction, and tyramine is inert.

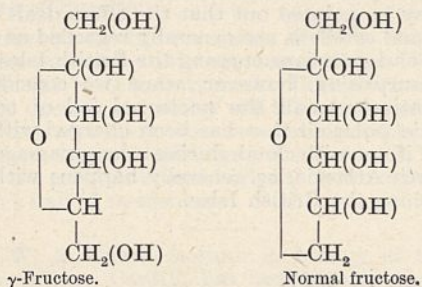
A paper on the oestrus-producing hormone has been published by Drs. Burn and Coward: it was found that the individual variation between different rats or different mice is as much as 1000 per cent. The authors therefore define the unit as the dose necessary to produce oestrus in 50 per cent. of ovariectomised animals. They have constructed a standard curve relating the percentage of rats in which oestrus occurs to the dose injected from observations on a group of 90 animals. A curious point that emerged from this work was that the mouse unit has exactly the same value as the rat unit, in spite of the difference in body weight between the two species.

In the vitamin department, a stock colony of Wistar rats is in process of being built up, by inbreeding the animals and maintaining them on a constant diet: the most suitable diet, however, has not yet been determined. A sample of irradiated ergosterol is being used as a standard for vitamin D assay: a unit has been defined as the amount of antirachitic activity contained in 0.0001 mgm. of this sample. This definition has been rendered necessary by the fact that certain workers are defining the unit of vitamin D as the least amount which will cure rats of rickets, when they are maintained on a rachitogenic diet: such a unit may vary by 400 to 500 per cent. in different experiments. It is hoped to use a sample of the unsaponifiable matter of cod-liver oil as a standard for vitamin A in the near future. The report also gives the number of samples of the different preparations which have been assayed during the year: approximately 170 were tested.

The Synthesis of Cane Sugar.<sup>1</sup>

By Prof. AMÉ PICTET and H. VOGEL.

THE fine researches of Haworth and of Irvine have shown that fructose (levulose) does not possess the same chemical composition when it is in one of its natural combinations (cane sugar, inulin) as when it has been extracted. Hence it must be admitted that it can exist in two isomeric forms, one of which, to which the name of  $\gamma$ -fructose has been given, is unstable and changes spontaneously into the other, called normal fructose, as soon as it is set free. Haworth and his collaborators have made it very probable that the formulæ which should be attributed to these two forms are the following:



It follows from these facts that if it is attempted to realise a synthesis of saccharose by the union of its two constituents, glucose and fructose, it cannot be effected by utilising the second of these sugars in its normal form, the only one available. It would

be necessary to start with one of the artificial derivatives in which it occurs in the  $\gamma$  form. Some of these are known (methyl, ethyl), but none of these would be available for the operation in question, since the substituted groups that they contain are too firmly fixed to the rest of the molecule to permit of their being detached, once the condensation with the glucose had been carried out.

Hence the synthesis of saccharose necessitates the preliminary preparation of a derivative of  $\gamma$ -fructose containing only substituent groups relatively easy to remove. The following observation has furnished us with a substance which fulfils this condition.

We have found that when the tetracetate of normal fructose is prepared by the method of Hudson and Brauns (*Jour. Amer. Chem. Soc.*, **37**, p. 2739; 1915), that is, by treating fructose at a low temperature with acetic anhydride and zinc chloride, on crystallising the product from alcohol, a second compound is formed in small quantity which remains in the mother liquors. On evaporating these in a vacuum a thick syrup is obtained which, on contact with cold water, is slowly converted into a solid vitreous mass. Up to the present, this substance has not been obtained in the crystalline condition, but its analysis, and the fact that it easily reduces alkaline copper solutions, proves that it consists of a second tetracetate. Moreover, its rotatory power, much lower than that of the normal tetracetate, would suggest that it belongs to the  $\gamma$  series.

The formation of a derivative of this nature would be explained by admitting (as already suspected by

<sup>1</sup> Translated from *Comptes rendus* for Mar. 19 of the Paris Academy of Sciences.

Ohle) that when fructose goes into solution, an equilibrium is established between its normal form and the  $\gamma$  form. This would take place in acetic anhydride as in any other solvent and each of these forms would then be acetylated on its own account. Under the conditions of our experiment, the equilibrium would appear to be approximately 97 parts of normal fructose and 3 parts of  $\gamma$ -fructose.

It would have been easy to prove the  $\gamma$  nature of the new acetate by methylating it, and then saponifying the product; the methyl- $\gamma$ -fructoside prepared by Irvine should thus have been obtained. But there was another method, more simple still, and that was to combine it with glucose tetracetate: it should then, if really derived from  $\gamma$ -fructose, give rise to the octacetate of saccharose.

Glucose tetracetate +  $\gamma$ -fructose tetracetate = saccharose octacetate + water.

This experiment was carried out by dissolving in chloroform equal weights of our tetracetate and that of glucose (prepared according to the method of E. Fischer and Delbrück), and this solution was shaken for 15 hours with phosphorus pentoxide. On evaporation in a vacuum, it left a syrupy residue, which, taken up in warm alcohol, deposited fine crystals on cooling. These presented the principal characters of saccharose octacetate

Melting-point of our crystals . . . . .	70° C.
"    "    of saccharose octacetate . . . . .	70° C.
"    "    of their mixture . . . . .	70° C.
Rotatory power in chloroform solution . . . . .	+ 59°·4
"    "    of saccharose octacetate . . . . .	+ 60°·0

It may be noted that the same substance was obtained in two series of experiments, in one of which a fructose prepared by inversion of saccharose was the starting-point, and in the other a fructose extracted from inulin.

The saponification of the synthetical octacetate, carried out by Zemplen's method, finally gave an anhydrous, non-reducing disaccharide, of crystalline structure and very sweet taste. The comparison of its principle properties with those of cane sugar gave the following figures:

Analysis (per cent.) . . . . .	C 42·3, H 6·6 (calculated for $C_{12}H_{22}O_{11}$ : 42·1 and 6·5).
Cryoscopy in water . . . . .	Molecular weight found: 344 (calculated 342).
Melting-point of our sugar . . . . .	183° C.
"    "    of saccharose . . . . .	184° C.
"    "    of their mixture . . . . .	184° C.
Rotatory power in aqueous solution	
of our sugar (C = 5·07) . . . . .	+ 66°·3
of saccharose at the same concentration . . . . .	+ 66°·5
of our sugar after inversion . . . . .	- 20°·6
of saccharose after inversion . . . . .	- 20°·7

From the concordance of these figures the identity of these two substances must be regarded as proved.

We still have to clear up certain points concerning the intermediate products of this synthesis, and to give an account in greater detail of the whole of our operations. These results will be published in due course.

### The Development of Cyclonic Depressions.

IN the *Monthly Weather Review* for November 1927, two articles by W. J. Humphreys appear, both of which deal with the growth of cyclonic depressions in the United States and Canada.

The first article gives an explanation of the great increase in size and intensity of a depression that so often takes place when it moves north-east across the eastern parts of the United States or of Canada. Since such an increase of intensity with increasing latitude is not a world-wide phenomenon, the idea that it may be due to change with latitude of the deflective force of the earth's rotation is rejected. If, on the other hand, contrast of temperature is regarded as essential for cyclonic development, an obvious explanation is afforded by the fact that the farther north the depression goes, the shorter is the distance through which the incoming supply of polar air has to pass, and the colder that air will be on arrival, while the high temperature of the equatorial air is largely maintained by latent heat set free by condensation of its water vapour, even when the distance travelled from equatorial regions is very great, the result being an increase of temperature contrast between the parts of the depression fed, respectively, by these two supplies of air. Such opportunities for increasing temperature contrast as exist over eastern North America and the western part of the North

Atlantic are available in few if any other parts of the world.

The second article seeks to explain why depressions moving north-eastwards across the United States in winter increase in size and intensity more rapidly by night than by day. Thermal considerations are again made use of: it is pointed out that the cold portions of the depression have as a rule clearer skies than the relatively warm portions, and consequently are far more strongly cooled by radiation at night, an increase of temperature contrast due to this effect being added to the general effect of latitude mentioned above. During the daytime, on the other hand, not only is the polar air with its clearer skies warmed more than the equatorial air, so as to reduce the contrast of temperature, but also, being so warmed, thermal convection will normally set in and obstruct to some extent the simple cyclonic wind-system.

It may be pointed out that the effect dealt with in this second article is not generally regarded as characteristic of depressions crossing the British Isles. This is not surprising, however, when we consider how comparatively small the nocturnal fall of temperature is in polar air that has been charged with water vapour, if not with cloud, during a long passage across the North Atlantic, as generally happens with polar air reaching the British Isles.

### Earthquakes in the Crimea in 1927.

PROF. A. V. VOZNESENSKY in *Priroda* (No. 12, 1927) gives the preliminary results of observations on the Crimean earthquakes of last summer. The data on which the account is based are admitted to be somewhat fragmentary and inexact, since the Crimea was considered not to be subject to earthquakes and there was no seismological station there before, though

one is established now in Feodosia. Apart from that, observations on the spot during the earthquakes were not organised properly and have been made without system or knowledge.

The first tremor occurred on June 26, when many buildings were partially destroyed, and afterwards slight tremors were experienced for five months, until

November; during this period the second great earthquake occurred, on Sept. 12, which was still more destructive than that in June. The strength of the earthquake was estimated by local observers as 8, but the author is inclined to regard this figure as exaggerated and not exceeding 6, since not more than 20 per cent. of buildings were damaged, and those only partially and owing to their unsatisfactory state. The area of the June earthquake covered by the isoseist 6 occupied the south-western extremity of the Crimean peninsula; the area covered by the isoseist 2 is more or less triangular in shape and stretches from Kiev to Batum (1280 km.). The axis of the September earthquake was almost perpendicular to that of the June one, and the area of the isoseist 2 was about half as long again, but the epicentre could be determined as practically in the same spot, while the strength increased more than twice.

A comparative study of records from seventeen Russian and foreign observatories permitted the author to determine the epicentres in a preliminary way, for the June earthquake at  $44^{\circ} 30' N.$  and  $35^{\circ} 50' E.$ , for the September one  $44^{\circ} 30' N.$  and  $35^{\circ} 10' E.$  Both these points are in the Black Sea; the first 53 km. from the shore south of Cape Tchauda; the second 43 km. south of the mouth of the River Otusa; both at the depth of 1.5 km. The depth of the epicentres is suggested by the author as about 25 km. Preliminary data of a hydrographical survey of these areas showed considerable alterations in the state of the sea bottom, since instead of soft mud found on previous occasions the survey discovered stony bottom. The probable cause of the earthquakes was purely tectonic, since there was absolutely no indication of volcanic action, though some vague rumours to that effect circulated amongst the panic-stricken population. Losses of life were negligible, which was explained by the fact that strong tremors were preceded by slighter ones and nearly everybody left buildings. On the other hand, the moral sufferings of the population were great, owing to the enormous number of successive tremors keeping the people in permanent suspense. During the first month as many as 265 tremors were registered, or 8.2 tremors daily, while on the first day their number was 41, and it is easy to understand the assertions of inhabitants that there was an incessant trembling for many days.

### University and Educational Intelligence.

GLASGOW.—At the Ceremony of Graduation held on April 21, the degree of doctor of science (D.Sc.) was conferred on Dr. R. C. Smith, for a thesis on "The Stability of Emulsions, with Additional Studies in Rates of Reaction."

NOTTINGHAM.—In our issue of Feb. 4, p. 190, reference was made to the opening of the new buildings by H.M. the King in July next. It is now announced that the opening ceremony will take place on July 10.

Sir Jesse and Lady Boot are making further contributions to the new buildings. Sir Jesse will bear the cost of the great hall, and Lady Boot the expense of a women's hall of residence.

DR. W. B. CROW, lecturer in botany at the University College, Cardiff, has been appointed head of the Department of Biology at the Technical College, Huddersfield, in succession to Dr. T. W. Woodhead, president of the British Ecological Society, who, at the end of the present session, will be retiring from the headship after thirty-two years' service.

FOLLOWING upon the Hackett bequest of about £550,000 to the University of Western Australia, the

Government has resolved to celebrate the centenary of the State in 1929 by erecting such buildings as will enable the entire University to be moved to its 165-acre site at Crawley. The Departments of Engineering, Biology, and Geology are now in their permanent buildings, and a building for physics, to be erected at a cost of about £32,000, should be completed by August 1929. The Anglican Church has commenced the erection of St. George's College—a residential college for students—the foundation stone of which was laid on Mar. 8. The central Winthrop Hall, with its adjoining administrative buildings and Students' Union, is being erected in accordance with a design by Messrs. Alsop and Sayce of Melbourne, whose plans were awarded the first prize last August in an Empire-wide competition. The late Mr. R. J. Gledden, who died towards the close of 1927, left his entire estate to the University for the promotion of the study of applied science, and this bequest will, when the property is realised, amount to nearly £100,000.

THE eighteenth annual report of the University of Leeds on adult education work gives particulars of thirteen university extension lecture courses and forty-five tutorial classes, which cost £373 and £4931 respectively. Among the tutorial class subjects the natural sciences were represented by biology only. In this subject there were five classes with ninety-five members. As an indication of the interest aroused, mention is made of two public exhibitions of their work arranged by the students. The tutor in biology, Mr. Norman Walker, has demonstrated by the continuance of his classes for more than three years the effectiveness of his methods, an account of which is given in the recently published Report on Natural Science in Adult Education by the Board of Education's Adult Education Committee. He insists, above all, on the teaching being practical and never losing contact with life. "This aspect possesses great inspiration and is effective in mind training, while the intellectual satisfaction obtained secures the adult student's devotion and attention over several years, if not for a lifetime."

THE Carnegie Trust for the universities of Scotland has published its twenty-sixth annual report, which gives particulars of grants made during 1926-27 as follows: grants to universities, £39,700; grants to other institutions, chiefly colleges, £8345; grants in aid of post-graduate study and research, £16,829; assistance to students by way of payment of class fees, £58,664. Among the new buildings for which some of the largest grants to universities were made are students' hostels and a students' union. Apart from a research lectureship in Scottish history, the assistance rendered to research by the Trust is in three forms: research fellowships, scholarships, and grants; the laboratory of the Royal College of Physicians; and teaching fellowships. A pleasing feature of the report regarding assistance to students is the unprecedentedly large amount (£2575) of voluntary repayments of their class fees by former beneficiaries. Of the total amount thus repaid since the trust began its operations, nearly half has been contributed by former students of the faculties of medicine. The policy of the trustees in dealing with applications for admission as Carnegie students has recently been modified. Instead of accepting without question declarations by applicants and their parents or guardians purporting that without the assistance of the Trust university education would be impossible, the Trust now inquires into the financial circumstances of the family. It finds that the circumstances of the great majority of applicants clearly justify any assistance which can be rendered to them.

## Calendar of Customs and Festivals.

April 30.

**ROOD MASS. WALPURGIS NACHT.**—Believed to be one of the greater, if not the greatest, of the occasions on which a witches' Sabbat took place. According to one version, witches from all parts had to fly to the Sabbat on the Brocken, those arriving late being sacrificed to provide the ceremonial meal.

May 1.

**MAY DAY.**—Among European peoples the first day of summer is, or was until quite recently, marked by customs, practically everywhere identical, which can be traced back over a considerable period of time. Ceremonies which can be paralleled in every particular among recent observances, including the ceremonial contest between representatives of summer and winter, are recorded by Saxo Grammaticus.

On the eve of May Day, or in the early hours of May morning before sunrise, parties went out to collect green or flowering branches, and brought them back to place before the doors or hang them on either their own houses or those of others. The fetching of the May was an occasion for merrymaking, not always too decorous, and was accompanied by music and the blowing of horns welcoming the summer. The custom in olden days was common to all classes. In Malory, Queen Guinevere goes a-maying with all her knights, and so did Henry VIII. with his Queen Katherine.

At times a sapling or tree took the place of green boughs and was erected in the middle of the village with more or less ceremony, in some places being brought in by teams of gaily decked oxen. From this grew the custom of erecting a more or less permanent maypole, gaily coloured in stripes and decorated on the day with flags and streamers and sometimes a doll. Several such maypoles existed in London, the most frequently mentioned long standing in the Strand. The origin of the maypole, however, as the annual revival of vegetation, continued to be indicated by a bunch of fresh leaves or a garland fastened to the top. The garland, conventional in form, was similar to those carried by children, one or two small hoops or wreaths of flowers and leaves, if two in number fastened at right angles to one another. These the children carried at the end of a stick or wand from door to door, singing a May song, with the object of collecting pence.

The maypole was the centre of the day's rejoicing, which embraced various forms of sport and Morris dancing. The Morris dances invariably included a principal man, a female character, a fool, and often a hobbyhorse. The best-known example of the last named was the Padstow hobbyhorse with its special song. In England the characters of the May Day dances are usually Robin Hood, Maid Marian, and their traditional followers, Little John, Friar Tuck, and Scarlett. Maid Marian became a travesty as the character was taken by a male dancer. At the same time she originally represented the female principal of Nature, which found more graceful expression in the election of a May Queen. The May Queen sometimes held authority not for the day only, but in all assemblies of young people throughout the year. The male principle was represented not only by the chief male character, but was also expressed in the pole itself, which undoubtedly had a phallic significance similar to that of the *lingam* in the religious observances of India.

A figure in the May observances to which reference is frequently made is 'Jack in the Green'—a man disguised and completely hidden in a framework of greenery. A pyramidal garland, six feet high, carried

in the procession of the May Queen in Huntingdonshire, has clearly taken his place. The career of Jack in the Green sometimes ended by his being thrown into a pond or stream. Obviously he is a materialisation of the vegetation spirit and his end a rain charm.

The special virtue of the dew of May morning was recognised in the custom of dabbling the feet in the dew, and bathing the face and hands, the latter a beauty charm, but the whole observance originally a rite to secure fertility. A similar custom, to name an example, is the May Day evening practice of the women of the island of Syra in the Ægean, who go in parties to the seashore to bathe their feet, possibly as a tribute to ensure the blessing of fertility from the sea goddess Aphrodite.

**BEALLTAINN OR BELTANE.**—In both Scotland and Ireland, May Day was celebrated by observances similar to those of England and other European countries. It was also the first day of summer—Beltane, in the Celtic calendar, being, however, not the first, but the middle day of the month Céitein, which included fourteen days of April and fourteen days of May.

Beltane was pre-eminently a fire festival among the Celtic peoples, and akin to the Easter fires previously mentioned and the midsummer fires. Indeed it has been explained as meaning the Fires of Bel or Baal. The meaning is obscure, and an alternative, the separation or parting of the seasons, has been suggested. It is a time of purification by fire from the evil influences of the past winter in preparation for the summer of fertility and growth. On May 1, whatever the weather, the cattle had to be driven out to the summer grazing grounds. Before this could be done they were purified by fumigation or by being driven through the flames of burning straw, as in the south of Ireland. Pennant records that the herdsmen of the Highlands of Scotland, while standing round a fire built on turf in a surrounding trench, first poured a libation of eggs, butter, oatmeal, and milk on the ground, and then threw offerings of oatmeal cake over their shoulders with a request for the protection of their flocks, herds, and horses from eagles, crows, and noxious animals. In a similar observance by boys in Perthshire, one of the number had to leap through the flames of the fire.

May 2.

**ST. HELEN'S DAY, ROWAN TREE DAY.**—In Yorkshire rowan tree branches were collected in a certain prescribed manner and planted over each door and window of the homestead as a protection against witches. Small pieces were carried in the pocket or purse with the same object. In Aberdeenshire the twigs were made into crosses and suspended at windows and doors. Witches and fairies were especially feared at this time, and in Scotland on May Day eve the cattle were protected by tar smeared behind the ear and on the root of the tail. A churning and a cheese made before sunrise protected the dairy produce against fairies in the coming year. If fire or rennet were given away on May Day, it gave the receiver power to take away the substance of the donor's milk.

May 3.

**THE DAY OF AVOIDANCE.**—In Scotland during the May Day week it was considered unlucky to undertake field operations, but the third day of summer was considered particularly unlucky for any undertaking. This may be connected with the fact that it was sometimes believed that the great witches' Sabbat took place on this day instead of on April 30.



## Societies and Academies.

## LONDON.

**Geological Society, April 4.**—G. W. Tyrrell: The analcite-syenites and associated rocks of Ayrshire. These rocks occur in differentiated intrusions along with analcite-olivine-dolerites or crinanites, as stratiform bands, schlieren, and veins. The principal occurrence is at Howford Bridge, Mauchline, where analcite-syenite forms a considerable part of the sill. In the remaining three described occurrences (Dippol Burn, Trabboch Burn, and Prestwick) the analcite-syenite is restricted to schlieren and veins. They all belong to the widespread suite of analcite-bearing igneous rocks of late-Carboniferous and Permian age in the west of Scotland. The most noteworthy mineralogical feature is the abundant occurrence of analcite, thomsonite, natrolite, and prehnite, which must be regarded as late primary crystallisations from the magma. A hypothesis for the development of schlieren and veins in the sills by the effects of the varying incidence of the pressure due to the superincumbent column of rock, upon a crystal mesh filled with interstitial liquid, is framed. The liquid is believed to be progressively driven towards the centre of the sill, and also laterally towards those places where the pressure is compensated in various ways, so that free contraction of the crystallising mass can take place.—J. Parkinson: A note on the Pleistocene history of western Buchivacoa (Venezuela). The area consists of alternating estuarine or freshwater false-bedded sandstones, and sandy clays, folded along east-north-easterly axes in many places. Burdigalian and Aquitanian fossils occur in the eroded centres of the folds. There is an unconformity between the Miocene and the overlying strata, which appear to be of Lower or Middle Pliocene age. The Tertiary deposits are covered by Pleistocene pebblebeds. The latter are probably an old sea-beach. Subsequent elevation during a pluvial period allowed of a 'creep' of the pebbles northwards. Redeposition in successive stages was effected by eastward-flowing rivers of the Indus type. Since Pliocene times, an elevation of about 1000 feet has taken place along the southern edge of the district.—A. Tindell Hopwood: *Gyrinodon quassus*, a new genus and species of toxodont from western Buchivacoa (Venezuela): with a note on the reptilian remains by W. E. Swinton. *Gyrinodon* differs from *Toxodon* in its more primitive dentition, and in the characters of the skull-cap. It differs from *Alitoxodon* in the characters of the mandibular symphysis. This is the northernmost locality for toxodonts hitherto recorded in South America. Apparently the toxodonts followed a northward dispersal.

**Royal Statistical Society, April 17.**—Major P. Granville Edge: Vital registration in Europe. Modern public health work is largely directed and controlled by the conclusions reached after the study and analysis of data resulting from the careful collection of the vital facts of human life. Such records constitute a national system of book-keeping. Accurate and complete vital statistical records provide a means of discovering the principal factors responsible for the wastage of human material, the degree of success attending the introduction of various health measures, and promote research with the view of reducing sickness, controlling disease, and prolonging the average span of human life. Although vital statisticians of various countries are engaged upon the study of similar problems, the information sought by the various national schedules, and the methods of procedure and classification, etc.,

differ so essentially that the resulting data are not comparable between one country and another. The official records of many European States contain serious and remediable defects, which increase the difficulties of securing comparability of data between one country and another.

## DUBLIN.

**Royal Dublin Society, Mar. 27.**—H. H. Dixon and T. A. Bennet Clark: The influence of temperature on the responses of plant tissues to electrical stimulation. The view is put forward, on the basis of the work of Höber and McClendon in particular, that the sudden change in the electrical resistance of a tissue, brought about by the passage of an electric current through it, is caused by an increase in the permeability of the protoplasmic membranes and not by alterations in the concentrations of ions. Previous work on the relationship between the voltage and energy-content of the stimulus and the magnitude of the resulting change in permeability has been confirmed and extended. The sensitivity decreases extremely rapidly during November and increases as rapidly in December and January, after which a rather slow increase in sensitivity occurs. The response is of a dual nature. At a temperature of 0° C. the negative reaction is the greater; as the temperature is raised to 20° C. the positive reactions are increased more than the negative; further raising of the temperature causes marked predominance of the negative reactions. Continued previous exposure to various temperatures does not alter the sensitivity of tissues at a fixed temperature of experiment. It does, however, temporarily alter their resistance.—W. D. Davidson: (1) The rejuvenation of the Champion potato. The downfall of the Champion and other old varieties was, in all probability, due to the presence of one or more of the diseases included in the mosaic group. Almost all Champion stocks had become affected to the extent of 100 per cent. In an effort to propagate a healthy nucleus stock, nine plants were with great care selected from the best stocks procurable. These plants were apparently healthy, and were dug early to minimise the risk of infection. A tuber from each plant was tested for freedom from mosaic. The produce of all plants found to be healthy were grown in units among turnips well isolated from each other and from all other potatoes. This system of planting was followed for three seasons. During the first two seasons no trace of any of the mosaic diseases was discerned. In the third season a few plants had to be removed from three units. It is confidently believed that the selected stock is now quite as healthy as when it was put in the market more than fifty years ago. (2) A review of literature dealing with the degeneration of varieties of the potato.

## PARIS.

**Academy of Sciences, Mar. 19.**—J. Costantin: Contribution to the biological study of *Picea excelsa*. Two fungi would appear to grow in symbiotic association with the roots of this tree, *Polyporus ovinus* and *Pholiota caperata*. The fact was noted in the Savoy Alps, but direct experiments are necessary to prove the influence, if any, of the mycelium of each of these fungi on the development of the trees.—Ch. Lallemand: Against the legal creation of a new gold franc of reduced value.—Amé Pictet and H. Vogel: The synthesis of cane sugar (*v. p. 689*).—Alex. Froda: The ensemble of discontinuities of the first species.—A. Kovanko: Some generalisations of nearly periodic functions.—G. Vranceanu: Periodic solutions with very long periods.—Belzecki: The case of equilibrium of elasticity of a hollow cylinder.—R. Wavre: The figures of

equilibrium of a heterogeneous fluid mass.—V. G. Siadbey: The orbit of Finsler's comet, 1924 II. For this comet several systems of parabolic elements, and one hyperbolic, have been calculated by various authors. Taking the whole of the published data, a recalculation of the elements has been made. The most probable system appears to be hyperbolic, the constants of which are given.—Al. Proca: Some reflections on the foundations of dynamics. The fifth dimension.—Nageotte: The Brownian undulations of thin plates and of filaments in myelinic formations.—Mlle. M. Chenot: Higher order oscillations in an oscillating circuit.—Mlle. St. Maracineanu: Phenomena resembling those of radioactive substances presented by metals.—A. P. Rollet: The existence of the oxide of silver  $\text{Ag}_4\text{O}_3$ . The anodic oxidation of silver in an alkaline electrolyte of higher concentration than normal gives a peroxide  $\text{Ag}_4\text{O}_3$ , which is very stable in alkali solution.—Paul Mondain-Monval and Paul Schneider: The temperature of transformation of liquid sulphur into viscous sulphur. Curves are given showing the viscosity of sulphur, and of sulphur containing various proportions of various organic substances in solution, as functions of the temperature. The temperature of transformation of pure sulphur is  $160^\circ\text{C}$ ., and this is raised by the presence of organic substances in solution.—Mlle. Suzanne Veil: Yellow ferric hydroxide, the result of the controlled oxidation of ferrous sulphide in suspension. An application of the changes in the magnetisation coefficient to the study of ferric hydroxides produced under differing conditions.—P. Vaillant: The composition of the Kundt displacements in an absorption spectrum with several maxima.—Pierre Auger: The directions of emission of the photo-electrons.—Maurice Billy: The composition of titanium peroxide. In an earlier paper the author indicated that the hydrate precipitated from a pertitanic salt had the composition  $\text{Ti}_2\text{O}_5$ , Aq. Schwartz and Sexauer, repeating these experiments, come to the conclusion that the composition is  $\text{TiO}_3$ , provided that the temperature is kept about  $0^\circ\text{C}$ . Additional experiments are given showing that at  $0^\circ\text{C}$ . there is more oxygen than corresponds to the formula  $\text{Ti}_2\text{O}_5$ , although far removed from  $\text{TiO}_3$ .—A. Duboin: The introduction of bromine and iodine into silicates. Definite crystals have been prepared of the composition  $\text{KBr}$ ,  $\text{K}_2\text{O}$ ,  $\text{CoO}$ ,  $4\text{SiO}_2$ , and  $\text{KI}$ ,  $\text{K}_2\text{O}$ ,  $\text{CoO}$ ,  $4\text{SiO}_2$ .—Raymond Quelet: The action of magnesium on some parabromoethylene derivatives of benzene.—Marcel Godchot and Mlle. G. Cauquil: The dehydration of the pinacone of cycloheptanone.—J. Orcel and Gil Rivera Plaza: The microscopic study of some metallic minerals of Peru.—Louis Barrabé: The tectonic of the region comprised between the Manambao and the Manambolo (west of Madagascar) and on its relations with eruptive phenomena.—J. Thoulet: The densimetric study of Humboldt's current and of the sea of Easter Island.—J. Aloy and Jacques Aversenq: The radioactivity of some springs in the Pyrenees region.—L. Éblé and J. Itié: The values of the magnetic elements at the Val-Joyeux station (Seine-et-Oise) on Jan. 1, 1928.—A. Eichhorn: The various stages of mitosis of *Hyacinthus orientalis* and, comparatively, of *Allium cepa*.—H. Belval: The genesis of starch in cereals, glucides of leaves, and the stems of rice.—Volmar and Jermstad: Sclareol, the principal constituent of essential oil of sage. This substance, of the composition  $\text{C}_{54}\text{H}_{68}\text{O}_3$ , is a tertiary, polyhydric alcohol, unsaturated and similar to the phytosterins and cholesterins.—Lucien Daniel: New observations on the variations of descent in grafted Jerusalem artichokes.—Cl. Fromageot: The deviations which may occur in the hydrogen ion concentration of the soil at points close

together.—Tchéou Tai Chuin: The absence of strobilisation and persistence of budding during the winter in artificially fed scyphistomes.—E. Roubaud: The reactivating anhydrobiosis in the evolutive cycle of the *Pyralis* of maize.—A. Giroud: The structure of the chondriosomes.—Mme. Phisalix: The power of destroying the virus of rabies *in vitro* of the venom from the aspic viper. This snake poison, heated to a temperature which destroys its toxic power, still possesses the power of destroying the virus of rabies *in vitro*.—A. and B. Chauchard and J. Hurynowicz: The measurement of the excitability of the vasoconstrictor nerves in man.—Marcel Brandza: Morphological and experimental researches on the sclerotes of the calcareous Myxomycetes.—J. Magrou and Mme. M. Magrou: The action at a distance of *Bacterium tumefaciens* on the development of the egg of the sea urchin.—Lecomte du Noüy: A spontaneous modification of the viscosity of blood serum. Some results obtained with an apparatus permitting a continuous observation of the variation in viscosity.—H. Carré: Acute parasitic infections.—Ed. and Et. Sergent and A. Catanel: A new parasite of paludism of birds.

## GENEVA.

Society of Physics and Natural History, Mar. 15.—R. Wavre: The deviation from the vertical with depth. The author extends the formula of the deviation from the vertical to the case where there may be movements in the interior of the planet.—Pierre Dive: A generalisation of a formula useful in geodesy. The author shows that the rigorous formula for the increase of gravity with depth given by M. Wavre extends to any permanent rotation of a planet round its polar axis.—R. Chodat and H. Evard: The distribution and localisation of tyrosinase in the higher plants. By means of the reagent *p*-cresol in 10 per cent. sugar solution, the authors have been able to prove the presence of tyrosinase, which is found localised in different parts of plants (leaves, peduncles, roots).—R. Chodat and A. Senglet: The *sapécage* of 'Maté' and the presence of ferments in *Ilex paraguariensis*. True 'Maté' is furnished by *Ilex paraguariensis* (the 'Matés' of botanical gardens are more frequently plants other than this). *Ilex paraguariensis* contains oxidising ferments; the operation of singeing, called *sapécage*, to which the plant is submitted, neutralises the action of these ferments. The blackening of the plant and of the liquid obtained from it is thus avoided.—L. Duparc and E. Rogovine: A new indicator for the volumetric estimation of phosphoric acid. By the use of uranyl acetate with sodium salicylate as indicator, the authors were able to carry out an estimation of phosphoric acid which can be applied to the examination of urine.

## ROME.

Royal National Academy of the Lincei, Jan. 15.—F. Severi: Simple and double algebraic integrals (3).—N. Parravano and G. Malquori: Investigations on the sulphides of molybdenum (2). Equilibrium of the reduction of molybdenum disulphide by means of hydrogen. This reduction,  $\text{MoS}_2 + 2\text{H}_2 = 2\text{H}_2\text{S} + \text{Mo}$ , is a reversible reaction, equilibrium being established the more readily if the disulphide and hydrogen are taken as starting materials. The values of  $\text{Ps}_2$  are calculated from the experimental values of  $\text{PH}_2\text{S}/\text{PH}_2$  at different temperatures by means of the equation  $\log \text{Ps}_2 = 2 \log \text{PH}_2\text{S}/\text{PH}_2 + \log K$ , and the isochor equation gives for the tonality at the reaction,  $Q = -20,000$  cal. at  $805^\circ-910^\circ$ ,  $-28,000$  cal. at  $910^\circ-1005^\circ$ , and  $-24,000$  cal. at  $1005^\circ-1100^\circ$ .—L. Sabbatini: Pharmacological experiments with sodium permanganate injected endovenously. When injected directly into the veins

of the ordinary experimental animals, sodium permanganate acts simultaneously on the blood plasma, the histological elements of the blood, and the endothelium of the vessels, but the greater portion is fixed on the red corpuscles, causing intense hæmolytic, hæmoglobinæmia, hæmoglobinuria, and anæmia, which, within certain limits, are proportional to the doses injected. At the same time, the salt undergoes reduction to manganese dioxide, which remains colloidal. Thus, the action of the permanganate is at first limited to a local effect on the blood, which then reduces the salt and acts as an antidote, preventing it from diffusing as such to the tissues and organs and from giving the general action of permanganate. If the dose is small, the animal survives, since the hæmatic lesion is slight. In a washed red globule from the blood of the rabbit hæmolytic is produced by  $7.9 \times 10^{-16}$  and complete mineralisation by  $3540 \times 10^{-16}$  gm.-mol. of the permanganate.—G. Palozzi: Projective invariants of contact between plane curves at a point of flexion.—P. Nalli: Integral equation of the third species and applications to differential equations (i).—G. Wataghin: The general integrals of some differential equations of mathematical physics. An attempt was made previously to overcome some of the difficulties attending the explanation of luminous interference on the basis of the hypothesis of the corpuscular structure of light by considering the light quanta as resulting from the superposition of ordinary, plane, or spherical electromagnetic waves. This decomposition of the quantum into harmonic components makes it possible to show that the quantum hypothesis is not contradictory to the undulatory theory of interference and may serve as a foundation for the interpretation of the whole complex of optical phenomena. A demonstration is given of a theorem on the solutions of the equation

$$\Delta_2 f - \frac{1}{c^2} \frac{\partial^2 f}{\partial t^2} = 0,$$

which permits of the construction of models of the light quantum in conformity with the above views.—E. Raimondi: Complements relative to the calculation of the dynamic action of a current flowing between a strip and an indefinite plane wall.—G. Vranceanu: The geodesic displacement in anolonomous varieties.—E. Persico: Molecular velocities, conditions of excitation, and probability of transition in a degenerating gas.—A. Quilico: Action of aminosulphonic acid on unsaturated compounds. When heated at  $140^\circ$ - $150^\circ$  with excess of anethole, aminosulphonic acid gives a good yield of the ammonium salt of an acid, which is converted quantitatively into anisic, acetic, and sulphuric acids when boiled with alkaline permanganate solution and has the constitution,  $\text{CH}_3 \cdot \text{O} \cdot \text{C}_6\text{H}_4 \cdot \text{CH} \cdot \text{C}(\text{CH}_3) \cdot \text{SO}_3\text{H}$  or  $\text{CH}_3 \cdot \text{O} \cdot \text{C}_6\text{H}_4 \cdot \text{C}(\text{SO}_3\text{H}) \cdot \text{CH} \cdot \text{CH}_3$ .—G. Malquori: The systems,  $\text{Cd}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ ;  $\text{Zn}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ , and  $\text{Mg}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$  at  $20^\circ$ . The salt  $\text{Cd}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  is in equilibrium with solutions containing up to 52.95 per cent. of  $\text{HNO}_3$ , the corresponding concentrations of the acid for  $\text{Cd}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ ,  $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ ,  $\text{Zn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ , and  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  being respectively 60.01, 34.45, 59.21, and 49.12 per cent. Thus, whereas tetrahydrated cadmium nitrate may be completely dehydrated at ordinary temperature by nitric acid ( $d. 1.52$ ), hexahydrated zinc nitrate loses only two molecules of water, and hexahydrated magnesium nitrate remains unchanged, under the same conditions.—F. P. Mazza: The rotatory dispersion of the alkyl aspartates.—Giambattista Dal Piaz: The geissic digitation of Val Inferno (Gran Paradiso).—B. Monterosso: Observations on the sexual biology of the Seytoidoids.

## Official Publications Received.

## BRITISH.

- Report of the Department of Industries, Madras, for the Year ended 31st March 1927. Pp. vi+84. (Madras: Government Press.) 12 annas.  
The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 276, April. Pp. 341-452+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.  
Department of Agriculture: New South Wales. Science Bulletin No. 29: Veterinary Research Report, No. 3. By Dr. H. R. Seddon. Pp. 53. (Sydney, N.S.W.: Alfred James Kent.)  
Commonwealth of Australia. Journal of the Council for Scientific and Industrial Research. Vol. 1, No. 3, February. Pp. 133-192+6 plates. (Melbourne: H. J. Green.) 1s. 6d.  
Union of South Africa: Department of Mines and Industries. Geological Survey Memoir No. 26: The Iron Deposits of the Union of South Africa. By Percy A. Wagner. Pp. 268 (45 plates). (Pretoria: Government Printing and Stationery Office.) 10s.  
Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1927. Pp. 8. (Zomba: Government Printer.)  
Board of Education. Vacation Courses in England and Wales, 1928. Pp. 23. (London: H.M. Stationery Office.) 6d. net.  
Reports of the Progress of Applied Chemistry. Vol. 12, 1927. Pp. 743. (London: Society of Chemical Industry.)  
Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1118 (Ae. 291): A Survey of Longitudinal Stability below the Stall, with an Abstract for Designers' Use. By S. B. Gates. (T. 2504.) Pp. 27+23 plates. 1s. 3d. net. No. 1128 (E. 27): Motoring Losses in Internal Combustion Engines. By Dr. H. Moss. (I.C.E. 616.) Pp. 7+2 plates. 6d. net. (London: H.M. Stationery Office.)  
Proceedings of the Royal Society of Edinburgh, Session 1927-1928. Vol. 48, Part 1, No. 5: Reflex Postural Adjustments of Balance in the Duck. By D. Noël Paton. Pp. 9+2 plates. 1s. 6d. Vol. 48, Part 1, No. 6: The Theory of Jacobians, from 1885 to 1919. By Sir Thomas Muir. Pp. 37-54. 1s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

## FOREIGN.

- Department of the Interior: Bureau of Education. Bulletin, 1927, No. 35: Achievements in Home Economics Education. By Emeline S. Whitcomb. Pp. ii+26. (Washington, D.C.: Government Printing Office.) 5 cents.  
Société des Nations: League of Nations. Institut international de Coopération intellectuelle: International Institute of Intellectual Co-operation. Bulletin des Relations scientifiques. 3<sup>e</sup> année, No. 1, Février. Pp. ii+49. (Paris: Les Presses universitaires de France.) 8 francs.  
Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 131: Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung. Jahrgang 1924. Neue Folge, Band 61. Pp. xx+A42+B46+C40+D11+19+6 Karten. (Wien.)  
Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. O café e os factores meteorologicos. Pelo Dr. J. de Sampaio Ferraz. Pp. 19. (Rio de Janeiro.)  
Instituts scientifiques de Buitenzorg: "s Lands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 1, Novembre 1927. Pp. 35+2 plates. 2.50 f. Vol. 10, Livraison 1, Février 1928. Pp. 144+6 plates. 2.50 f. (Buitenzorg.)  
Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1927. (Chemical Section, Publication No. 50.) Pp. iv+30. (Khartoum.)  
University of California Publications in Zoology. Vol. 30, No. 8: The Muscular Anatomy of the American Badger (*Taxidea taxus*). By E. Raymond Hall. Pp. 205-219. 25 cents. Vol. 30, No. 9: Variation within a Brood of Pacific Garter Snakes. By Edna M. Fisher. Pp. 221-229. 25 cents. Vol. 30, Nos. 10 and 11: A New Race of Black Bear from Vancouver Island, British Columbia, with Remarks on other Northwest Coast Forms of *Euarctos*, by E. Raymond Hall; and Records of Supernumerary Teeth in Bears, by E. Raymond Hall. Pp. 231-242+plates 11-12+243-250+plates 14-15. 25 cents. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)  
Proceedings of the Imperial Academy. Vol. 4, No. 1, January. Pp. vi+29. Vol. 4, No. 2, February. Pp. vii-viii+31-83. (Tokyo.)  
United States Department of Agriculture. Technical Bulletin No. 58: Parachlorobenzene Experiments in the South for Peach-Borer Control. By Oliver I. Snapp and Charles H. Alden. Pp. 40. (Washington, D.C.: Government Printing Office.) 10 cents.  
Smithsonian Miscellaneous Collections. Vol. 80, No. 9: Aboriginal Wooden Objects from Southern Florida. By J. Walter Fawkes. (Publication 2960.) Pp. 2+3 plates. (Washington, D.C.: Smithsonian Institution.)

## CATALOGUES.

- "Sunic" X-Ray Apparatus for use with Metalic Tubes. (Bulletin No. 93.) Pp. 28. (London: Watson and Sons (Electro-Medical), Ltd.)  
A General Catalogue of the Manufactures of Adam Hilger, Ltd. Pp. 8+D22+E36+F36+H32+K2+L7+M28+N14+iv. (London: Adam Hilger, Ltd.)  
Classified List of Second-hand Scientific Instruments. (No. 92.) Pp. vi+58. (London: C. Baker.)  
Eastman Organic Chemicals. List No. 18, March. Pp. 79. (Rochester, N.Y.: Eastman Kodak Co.)  
The Holway Dual Control Unit for Rapid Radiography. (Publication No. 283.) Pp. 8. (London: Newton and Wright, Ltd.)

## Diary of Societies.

SATURDAY, APRIL 28.

- ROYAL SANITARY INSTITUTE (at Guildhall, Worcester), at 10 A.M.—T. Caink and others: Discussion on The Worcester Activated Sludge Plant.
- INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (W. Midland District) (at Borough Hall, Stafford), at 11 A.M.—W. Plant: Recent Municipal Work in Stafford.
- NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (jointly with Graduate Sections of North-East Coast Institution of Engineers and Shipbuilders, and Institution of Electrical Engineers) (at Neville Hall, Newcastle-upon-Tyne), at 2.30.—L. H. Forster: Notes on the Conversion of Main Pumping from Steam to Electricity, with Special Reference to the Plant Installed at Messrs. The Stella Coal Company's Clara Vale Pit.—Papers open for Discussion:—Some Notes on Accidents from the Use of Explosives, by W. B. Brown; Roof Control on Longwall Faces, J. F. C. Friend.

MONDAY, APRIL 30.

- INSTITUTE OF ACTUARIES, at 5.—P. C. Crump: War-time Finance—A Résumé of Financial Conditions during and after the War as they affected Life Insurance Companies.
- ROYAL SOCIETY OF ARTS, at 8.—A. G. Huntley: Applied Architectural Acoustics (Dr. Mann Lectures) (III.).

TUESDAY, MAY 1.

- ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. P. Poulton: An Experimental Study of certain Visceral Sensations (Oliver-Sharpey Lectures) (I.).
- ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Annual General Meeting.
- ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. G. M. Vevers and R. A. Smith: Exhibition of Flint Implements, Flakes, and Cores of Human Origin but of Uncertain Age collected at the Society's Estate at Whipsnade.—H. B. Cott: Report on the Zoological Society's Expedition to the Zambesi, 1927.—O. W. Richards: The Species of *Notogonia* (Hymenoptera, Laridae) occurring in the Mediterranean Basin.—Dr. J. Waterston: The Mallophaga of Sand-Grouse.
- LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Dr. S. A. Neave: Mt. Mlange in Nyasaland and its Insect Fauna.
- ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—The late Mr. Greenall: Southern Italy.
- INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Section) (at Royal Hotel, Luton), at 7.30.—G. D. Ricketts: Modern Methods of Engineering Inspection.
- DIESEL ENGINE USERS' ASSOCIATION (at 19 Cadogan Gardens, S.W.3).—M. Gercke: Some Considerations regarding the Peak Load Problem and High-powered Peak Load Diesel Engines.

WEDNESDAY, MAY 2.

- ROYAL SOCIETY OF MEDICINE (History of Medicine Section) (Annual General Meeting), at 5.—Papers on the Sources of Harvey:—Prof. F. J. Cole: The History of Embryology.—Dr. J. F. Prendergast: Galen.
- INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—M. G. Scroggie and others: Informal Discussion on Screened-grid Valves.
- SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—A. L. Williams: Locust Kernel Gum and Oil.—Dr. W. R. Schoeller and E. F. Waterhouse: Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. XII. Observations on the Pyrosulphate Hydrolysis Method.—D. B. S. Evans and S. G. Clarke: A New Precipitation Method for the Determination of Vanadium, and its Application to Steel Analysis.—Dr. P. Houseman: Method for the Analysis of Liquorice Mass.
- ROYAL SOCIETY OF ARTS, at 8.—W. Taylor: Standardisation in Apparatus for Science Teaching.
- ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, MAY 3.

- IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 A.M.—Presentation of Bessemer Gold Medal to C. M. Schwab.—Presidential Address: The History and Latest Development of the Basic Open-Hearth Process.—E. C. Evans and F. J. Bailey: Blast-Furnace Data and their Correlation.—J. H. Jones, J. G. King, and F. S. Sinnatt: Reactivity of Coke.—T. Thomson: The New Plant of the Appleby Iron Co., Ltd.—J. E. Holgate and R. R. F. Walton: Blast-Furnace Practice in Natal.
- At 2.30.—H. J. Tapsell: The Fatigue Resisting Properties of 0.17 per cent. Carbon Steel at Different Temperatures and at Different Mean Tensile Stresses.—J. A. Jones: The Properties of Nickel Steels with Special Reference to the Influence of Manganese.—A. B. Everest and D. Hanson: The Influence of Nickel in Iron-Carbon-Silicon Alloys containing Phosphorus.—J. Swan: The Effect of Silicon on Tungsten Magnet Steel.—A. Westgren, G. Phragmén, and Tr. Negroscio: On the Structure of the Iron-Chromium-Carbon System.
- CERAMIC SOCIETY (at Atlantic Hotel, Newquay), at 10.30 A.M.—Prof. D. A. Moulton: Refractory Material used as Mortar for Laying up Refractories.—W. J. Rees and W. Hugill: The Effect of Substituting High Silica Sand for some Grades in Lime-bonded Silica Bricks.—G. M. Gill: New Developments in Gas Works Carbonising Plant, with Special Reference to Refractory Materials.—A. T. Green: The Vitrification of Clay Products.—P. Cooper: Refractory Formers for Electric

- Heating Elements; Some Problems in the Manufacture and Use.—W. Emery: Notes on Refractories for Salt Glaze Kilns.
- ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. P. Poulton: An Experimental Study of certain Visceral Sensations (Oliver-Sharpey Lectures) (II.).
- CHEMICAL SOCIETY, at 5.30.—P. D. Coppock, V. Subramaniam, and T. K. Walker: The Mechanism of the Degradation of Fatty Acids by Mould Fungi. Part II.—A. Robertson and R. Robinson: Experiments on the Synthesis of Anthocyanins. Part V. A Synthesis of 8-β-glucosidyl-pelargonidin Chloride which is believed to be identical with Calli-stephin Chloride.—Dr. H. J. Emeléus: The Phosphorescent Flame of Sulphur.—A. J. Berry and Prof. T. M. Lowry: Studies of Valency. Part IX. Molecular Structure of Thallium Salts. (a) Thallium Triiodide (with Mrs. R. R. Goldstein); (b) Alkyl-derivatives (with F. L. Gilbert).
- INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—F. H. Rosencrans: Practice and Progress in Combustion of Coal as applied to Steam Generation.
- ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.15.—Annual General Meeting.

FRIDAY, MAY 4.

- IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 A.M.—Report of the Committee on Heterogeneity of Steel Ingots.—V. Harbord: A Comparison of the Most Important Methods Employed in the Cleaning of Blast-Furnace Gas.—Dr. W. H. Hatfield: Heat-Resisting Steels. Part II. Mechanical Properties. At 2.30.—T. Swinden and P. H. Johnson: Chromium Steel Rails.—Dr. J. Newton Friend: A Study of the Resistance of Over-Stressed Wrought Irons and Carbon Steels to Salt-Water Corrosion.—W. E. Woodward: The Rapid Normalising of Overstrained Steel.—A. L. Norbury and T. Samuel: The Recovery and Sinking-in or Piling-up of the Material in the Brinell Test and the Effects of these Factors on the Correlation of the Brinell with certain other Hardness Tests.—H. O'Neill: Twin-Like Crystals in Annealed α-Iron.
- ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion: Meteors.—Mr. Whipple, Prof. Lindemann, and others.
- ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Annual General Meeting.
- BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5.30.—J. A. Thorburn: Is there a Logic of the Imagination?
- ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.
- JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. C. Dain: The Application of Electricity to Domestic Purposes.
- GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—G. M. Lees: The Chert Beds of Palestine.—Dr. P. K. Ghosh: The Mineral-Assemblage of the Falmouth Granite.
- PHILOLOGICAL SOCIETY (at University College) (Anniversary Meeting), at 8.—Prof. D. Jones: Report on Progress of Phonetics.—N. B. Jopson: Report on Board of Comparative Philology.
- ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Rt. Hon. R. McKenna: Credit and Currency.

SATURDAY, MAY 5.

- ROYAL SANITARY INSTITUTE (at Guildhall, Preston), at 10 A.M.—Prof. F. E. Wynne and others: Discussion on The Present Position of the Milk Supply.
- BRITISH MYCOLOGICAL SOCIETY (at Cheshunt).—Phytopathological Meeting.

## PUBLIC LECTURES.

TUESDAY, MAY 1.

- LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Prof. F. Oppenheimer: Tendencies in Recent German Sociology. (Succeeding Lectures on May 2 and 3.)
- UNIVERSITY COLLEGE, at 5.—Dr. J. H. Burn: The Pharmacological Evidence for Current Methods of Treatment. (Succeeding Lectures on May 2 and 3.)—At 5.30.—Dr. D. R. Fox: Civilisation in Transit.
- GRESHAM COLLEGE, at 6.—Sir Robert Armstrong-Jones: Physic. (Succeeding Lectures on May 2, 3, and 4.)

WEDNESDAY, MAY 2.

- LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Dr. H. Hall: Some Common Factors in the Economic and Social Development of England in Medieval and post-Medieval Times. (Succeeding Lectures on May 9, 16, 23, and 30.)
- KING'S COLLEGE, at 5.30.—Dr. W. B. Brierley: Present Tendencies in the Study of Plant Disease.

THURSDAY, MAY 3.

- EAST LONDON COLLEGE, at 3.—Prof. W. C. McC. Lewis: Some Physico-chemical Aspects of Malignant Tissue (Cancer).
- INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, at 5.—Prof. D. W. Carmalt-Jones: Iodine in Relation to Goitre.

FRIDAY, MAY 4.

- OXFORD UNIVERSITY, at 5.—Prof. D. M. S. Watson: Palæontology and the Origin of Man (Romanes Lecture).
- ROYAL COLLEGE OF SCIENCE, at 5.—Prof. G. Elliot Smith: Conversion in Science (Huxley Memorial Lecture).
- KING'S COLLEGE, at 5.30.—Dr. J. A. Bierens de Haan: Animal Psychology for Biologists. (Succeeding Lectures on May 9 and 11.)