NATURE

SATURDAY, MAY 30, 1925.

## CONTENTS.



*Editorial and Publishing Offices :*

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.



## University Grants in Great Britain.

THE University Grants Committee, appointed in 1919 "to inquire into the financial needs of university education in the United Kingdom and to advise the government as to the application of any grants that may be made by parliament towards meeting them," has grown into a position of authority and influence greater than its terms of reference seem, at first sight, to imply. In pursuing its inquiries year by year, not only does the Committee obtain a completer knowledge of the conditions of university work at a given moment, but it also acquires an ever deeper insight into the dynamics of university economy. Inevitably, and to the great advantage of the universities, attention is concentrated less on the problem how to "carry on" and more on the trends of existing activities, their fitness for the purposes they are supposed to serve, and the values of those purposes. While the Committee is careful to disclaim the wish to impose, or, indeed, the ability to propound, an ideal common policy, it cannot escape the necessity of attempting to evaluate conflicting university ideals. Each year since 1920 it has published statistical returns submitted by the universities and university colleges in receipt of Treasury Grant, and has prefaced the returns with introductory notes. This year the returns (for 1923–24) are published as an appendix to a comprehensive report,[1] forming a sequel to the Committee's first report dated February 3, 1921.

The present report surveys the whole field of university education in Great Britain in the light not only of the statistical returns, but also of observations made in the course of a series of visits of inspection carried out by the Committee in 1924 with the object of seeing what progress had been made since the similar visitation of 1920. The Committee found that these four years have been years of real progress in regard to conditions of service of university staffs, the standards of teaching and research, the provision of adequate buildings and equipment, and the development of the social life of the students. Further improvement under all these heads is, however, urgently called for, and it is therefore a matter of urgent necessity that the universities and colleges should do all in their power to raise additional funds from local public bodies, industries, and private benefactors. In order to stimulate such efforts, the Committee announces that in distributing any additional money that may be voted it will continue to take serious account, wherever that can fairly be done, of the extent to which local support has been forthcoming, without, however, being bound to any

[1] University Grants Committee. Report, including Returns from Universities and University Colleges in Receipt of Treasury Grant, Academic Year 1923–1924 Pp. 44. (London: H.M. Stationery Office, 1925.) 3*s*. 6*d*. net.

precise formula. It concludes with an exhortation to regard endowment funds as the central source of revenue, as only by the consolidation of a stable and substantial income from independent sources can the autonomy and progressive development of a university be assured.

Although there are now 57 per cent. more full-time students at British universities and colleges than before the War, their number is still comparatively small. The President of the Board of Education has lately directed attention to the fact that as yet less than 4½ per cent. of all the children in grant-aided secondary schools go on to a university, and less than 9 per cent. of elementary school children go on to secondary schools. Both of these proportions are likely to increase. The Committee points out that the increase in the flow of students from the secondary schools to the universities will inevitably tend to heighten the importance of close co-operation between the university and school authorities upon questions of curriculum and teaching method, and, it may be added, the importance of the methods of admission. At present it seems impossible for the schools to satisfy the university teachers, because these cherish two apparently conflicting ideals. On one hand, they decry "premature" specialisation in the schools and say they prefer students to come up to the university with a good foundation of general education. On the other, they want the schools "to relieve them of some of the less advanced work which they consider is now unduly taxing their time and energies, to the detriment of the higher studies which are the university teachers' proper business."

In the United States of America, where co-operation has been so close that admission has been largely by certificate of the completion of so many hours of high school work, there is urgent need, says the President of the Carnegie Foundation for the Advancement of Teaching, for the recasting of the existing entrance requirements so as to prevent the wholesale admission of the unfit and the consequent lowering of the plane of intellectual life. The Committee states explicitly that it does not think that in Great Britain there is any immediate danger of such evils, but adds that it may be well to remember, as we develop our plans, that there will be constant need for a clear conception of the true functions of university education. The Committee proceeds to indicate its own views on the question of these functions with reference to certain practical questions.

For careers in the higher branches of commercial and industrial business administration, as for the upper administrative divisions of the civil service, a university training is valuable, in the opinion of the Committee, rather for the alertness of mind and capacity for taking broad views which it fosters than for specialised knowledge of the details of business. Dealing with the subject of the growth of specialisation, it notes with approval the policy of broadening the basis of the studies in all faculties, of breaking down the rigid barriers that specialisation tends to erect between subjects, and of insisting on giving students a clear sight of the wood as well as of the trees. The old antagonism of science and the humanities is giving place to a recognition of the fact that their proper relationship is one of active friendship, manifested, not by giving science students a smattering of the humanities, and vice versa, but by "the teaching of science and the humanities in such a way as to reveal their relationship to one another and their respective places in the wide world of human knowledge and endeavour." It would be difficult to find a more apt formula for expressing the philosophic point of view which should characterise the work of institutions of university standing.

From a consideration of the prospects of increased demands for university education, the Committee passes to the question of supply. The paragraphs which deal with this question will be read with dismay by those, if there be any, who have been looking to the Committee for encouragement of schemes for establishing new universities or colleges. First and above all, says the report, universities stand for quality, and although the capacity of organisations the essence of which is spiritual cannot be satisfactorily measured by money standards, the progress of university work under modern conditions is largely controlled by material factors.

For some years ahead, all the material support that can be expected from the State, from local authorities, and from private benefactors will be barely enough to keep British universities in a state of efficiency and provide for their expansion on a reasonable scale; nor are there sufficient grounds for believing that, given such expansion, they will not be able to meet all the needs likely to arise at much less cost than would be incurred in creating new universities or raising to the university level institutions which are now below it. In this connexion the Committee specifies 150,000*l.* a year as the minimum income for maintaining a university of the modern civic type with moderate-sized faculties of arts, pure science, medicine, and technology at the level of efficiency demanded by the requirements of the present day. It is perhaps in meeting with a steadfast and uncompromising "No" proposals with the objects of which the Committee is fully in sympathy, but which imperil the integrity of university standards, that the

Committee performs its greatest, if most disagreeable, service to the community.

Discussing the application of the policy of respecting the autonomy of the universities and, accordingly, recommending block grants in aid of general income rather than grants for specific purposes or to particular departments, the Committee makes some trenchant criticisms of the system under which the University of London is not in any real sense master in its own house: "Nowhere does the familiar problem of overlapping and duplication need to be more carefully and constantly watched than in London University, with its multiplicity of teaching institutions, and nowhere is the central machinery for dealing with it so inadequate." Perhaps the Departmental Committee now sitting will provide a solution of this problem.

Residential halls now accommodate only about 14 per cent. of the total number of full-time students of universities and colleges in Great Britain outside Oxford and Cambridge, and there is a strong demand for additional accommodation. Of the various types now in existence, the Committee favours that which approximates most nearly to the colleges of the older universities, providing not only board and lodging, but also a library and such amenities as gardens and tennis-courts, including among its residents some of the unmarried members of the university staff, and being under the supervision of a Warden of good academic standing. It specifies in some detail what experience suggests as the most important elements in halls of this type.

In the equipment of faculties of technology some institutions have endeavoured to provide full-scale apparatus, and thus to save their students from having to get experience and training in outside workshops and factories. The Committee discountenances such attempts, and holds that a selection of up-to-date plant sufficient for a thorough training in technological principles is all that a good university teacher needs.

The present needs and problems of universities in respect of these and many other matters, such as the status of university teachers, libraries, appointments boards, post-graduation scholarships, and adult education, are dealt with in the twenty-seven pithy and readable pages of this report in a way which gives it great value, not only for the institutions directly concerned, but also for universities in all parts of the Empire. It is an authoritative statement of the present position and prospects of the universities of the British Isles, and as such it should receive the earnest consideration of all who are in any way concerned with university or other higher education.

## Mendeliana.

(1) *Carl Correns: Gesammelte Abhandlungen zur Vererbungswissenschaft aus periodischen Schriften*, 1899–1924. Pp. ix+1299+4 Tafeln. (Berlin: Julius Springer, 1924.) 96 gold marks.

(2) *Gregor Johann Mendel: Leben, Werk und Wirkung.* Von Hugo Iltis. Pp. viii+426+12 Tafeln. (Berlin: Julius Springer, 1924.) 3·60 dollars.

(1) IN honour of Prof. Correns's sixtieth birthday, the German Society for the Study of Heredity has reprinted most of his papers relating to genetical subjects. They compose a very substantial volume of 1300 pages. The subjects of this prolific labour have been numerous, but after his large work on cross-breeding the varieties of Maize, Correns has mainly been occupied with two of the most intricate problems of botanical genetics, the transmission of variegation and the determination of sex in plants. Regarding the first of these phenomena, owing to the vast diversity in the physiological nature of the several kinds of chlorophyll defect, general expressions are obviously unattainable. Variation, in fact, is a symptom. Everything depends on diagnosis, which though sometimes easy is commonly difficult and evasive. Through contemporary work, especially that of Correns, those who come after will at least find the facts set out ready to be disentangled.

The problem of sex-determination in plants is still more complex, and no simple and generally acceptable solution is yet in sight. The tendency of modern opinion is in favour of the view which Correns himself has advocated, that in dicœcious plants the male is the heterogametic sex, but this interpretation is not wholly free from objection. In plants, as also to some extent in animals, an outstanding difficulty is the complete absence of any satisfactory account of the relationship of the hermaphrodites to the sexual forms. Correns was the first to observe the remarkable fact that in gynodicœcious plants the offspring of females are generally in a large majority females, those of the hermaphrodites consisting predominantly, sometimes entirely, of hermaphrodites. This is now recognised as being only a special case of a system of inheritance governing that of a great variety of characters. The essential phenomenon is genetical inequality between the eggs and pollen-grains of the same plant, of which many examples are now familiar, the inheritance of double flowers in the Stock being the original and classical illustration. The simplest interpretation, to which many of us in England have inclined, is that a segregation, probably somatic, has occurred prior at least to maturation, but those who, like Correns, are unwilling to admit anything which conflicts with the

strict chromosome-theory, seek for some other account. Much ingenuity has been devoted to an attempt to demonstrate the existence of the missing class of pollen-grains, and the numerous papers dealing with this vexed question form a prominent feature of the present volume. Even if it were proved that pollen-grains of the missing classes—always recessive by the way—are produced by the plant in the normal proportion, the peculiarity in their behaviour would remain to be accounted for.

Correns was, of course, one of the rediscoverers of Mendel, in a sense, perhaps, *the* rediscoverer. The earliest papers in this volume recall that curious and diverting episode, and the cryptic nature of the first announcements. In view of all that has happened since, he may, in any case, find satisfaction in remembering that in 1902, some time before linkage had been observed as an actual fact, he made a suggestion (p. 304 in this collection) as to the linear arrangement of elements in chromosomes and as to the exchanges between them, now spoken of as crossing-over, which in all essentials is that now adopted by the orthodoxy of the day.

The frontispiece reproduces a portrait-drawing of the author by Hans Meid, which is a very brilliant performance, both as an exact and penetrating portrait and as a piece of artistic workmanship. In spite of its high price many libraries should get this book, for several of the papers here assembled from various journals will be in requisition for some years to come.

(2) Contrasted with the imposing length of Prof. Correns's output, the slender memoir which, by the piety of Dr. Iltis, of Brunn, tells us all we are ever likely to know of Mendel himself, makes a modest appearance. The story of his life is in outline familiar. Any details about such a man are welcome, and the few new facts and anecdotes now first made known help us in some measure to reconstruct his personality, but the generation that knew him during the years of his scientific work had almost passed away before his fame began, and as to many essentials we have nothing but surmise.

It is the old story of the boy of sturdy peasant family noticed by an intelligent teacher and selected for education and promotion. We learn that in his village school some natural history was taught at the instance of the great lady of the place, an advantage which no Gymnasium would have supplied. The children even saw something of fruit-growing and bee-keeping in a garden attached to the school, so much so that an inspector, reporting on the school to the Archbishop's Consistory, complained of this disorder (*Wachsthum dieses Unfugs*), which he said was chiefly due to the machinations of a certain Pfarrer Schreiber. That gentleman had done much to promote fruit culture in the district, and as it is also known that Mendel's father took special interest in fruit-growing, we may take it that nature and nurture seem thus to have combined happily for once. Regarding the later stages of his education, details are tolerably full. As a curiosity may be mentioned two fragments of an academic poem in praise of Gutenberg, which, though rather wooden and rough, is not without imagination. It was written when Mendel was seventeen or eighteen, and is interesting as containing the following lines, addressed to the movable types:

> Ihr sollet nach des Meisters Wunsche
> Des Aberglaubens finistre Macht,
> Die lastend sich auf Erden wälzt,
> Zerstreun.

an ominous beginning for a future Prälat, as Dr. Iltis observes.

The funds for his further education were provided by a sort of mortgage of the small paternal property to Mendel's brother-in-law—a remarkable document which survives. It gives a full inventory—two horses, four cows, one heifer-calf, one bull-calf, etc.—so that a clear picture of the family circumstances is before us. Being destined for orders and the teaching profession, he was sent for his continued education in "Philosophy" to an establishment at Olmütz, where his health seriously broke down more than once. Financial difficulties also supervened, and, as Dr. Iltis says, it hung by a hair whether there should be one peasant the more and one immortal discoverer the less in the world. Money was found by the devotion of a sister, then unmarried (whose three sons afterwards became Mendel's especial charge). But the strain to health lasted, and Mendel, when his course of "philosophy" was at length over with distinction, felt unequal to renewing such an effort and consulted a certain Prof. Franz as to his future. Franz had some influence with the Brunn cloister, and, having great confidence in Mendel's character and abilities, got him admitted to the brotherhood.

The chief authority for this part of Mendel's career is a brief autobiography which he prepared later on (*æt.* 28) when he was a candidate for a permanent post as a teacher in the Znaim Gymnasium. He had already a post as assistant in this Gymnasium, but in order to become permanently appointed, he required a certificate of official recognition. The procedure on this occasion (1850) strikes us as singular. He had first to supply a full and intimate history of his career, mental development, etc., together with an inquisitory report on his behaviour from the teaching staff of Znaim. They speak well of him, the only charge they have against him being that he had been six times to the theatre,

admittedly a venial error since on each occasion he had gone in the company of a colleague. The next step was the preparation of what must have been almost small treatises, one on meteorology, the other on a geological subject, for which six or eight weeks was allowed. These were referred to experts, and, in addition, to a literary assessor, who all reported upon them at elaborate and pedantic length. Ultimately, on the unfavourable verdict of the geologist, he was rejected. The papers with the reports have been preserved. We get the impression that if the business of academic education was always conducted on those lines, he was well out of it. He would have had little time for peas. So he returned to the Brunn fraternity, teaching without a qualification. The failure anyhow had one very good consequence, for it led indirectly to his being sent to the University of Vienna for two years, apparently with a subsidy from his cloister. In 1856 he made a second attempt to obtain the official qualification necessary for the teaching profession (p. 59), offering then physics and natural history. The result is not clearly recorded, but he was evidently rejected, for until he became Prälat he always figures as "Supplent," not lecturer or professor like his colleagues. None the less his fame as a very successful teacher still survives in Brunn, and these incidents provide ironical commentary on the public utility of a highly regulated educational system.

Mendel's pupils contribute the interesting reminiscence that at some early date one of his two rooms at the cloister was given up to birds and to mouse-breeding, and his biographer conjectures that possibly dominance and segregation were first seen in the mice. Dr. Iltis points out that some experiments with peas must have been already in progress in 1854, for in that year Mendel published an observation on *Bruchus pisi*, which had been damaging peas near Brunn. His interest in the species problem was probably aroused by Gärtner's experiments, though that must be uncertain. How the work fell unnoticed we all know. In spite of an exchange list of 120 copies which went to the various libraries and 40 private *separata*, not one soul took any heed of it. He remained alone. After his immense labour he found not a single creature who understood, not one who believed him. As bad luck would have it, he then started on Hieracium, and then in an evil moment he tried to interest Nägeli, whereupon ensued that tragic correspondence which completed the catastrophe. Nägeli understood him no better than the citizens of Brunn, and, after waiting two months, replied from Olympian heights that the pea experiments seemed to have only just begun, and that he had better go on with Hieracium. The later letters all relate to Hieracium. Nothing more is said about the peas. Nägeli is known to have sown the peas which Mendel sent him, but there is never a word as to how they behaved. Hieracium must have been a crushing disappointment, for apogamy was not discovered until long after. That was not Nägeli's fault; but perhaps we may draw the moral that a discoverer of something really new, wishing to find sympathy and encouragement, does not act wisely in appealing to the highest established authority on that particular subject. Dr. Iltis pessimistically remarks that his remedy would have been to have published it all in a "stattliches Buch," as no modern investigator would have neglected to do—something more like Correns's, in fact. This course, nevertheless, has also been known to fail.

All attempts to find the records of Mendel's experiments on bees have failed. We have only the plan of his hives, preserved by the carpenter. He worked on many other subjects, notably Fuchsia, but of these investigations also the results are lost.

We have next a full account of Mendel's meteorological observations, and the life concludes with a detailed history of his "fight for right" against the vindictive taxation of religious houses which was instituted by the Austrian Government in 1874, another painful story. At first he was backed up by the heads of other convents and by the brethren in his own, but after a while they all abandoned the struggle. Once again, in this last enterprise, he was utterly deserted and alone. His obstinacy was such that doubts of his sanity were professed. Whether he was right or wrong it is hard to say, but at least he bore himself throughout as a brave and resolute man should.

The second half of the book gives an account of Mendelian doctrine and its later developments up to the present time. This is very well done, and it supplies in a compact form as good an epitome of the modern science of heredity as has yet appeared.

Dr. Iltis is convinced that Mendel was virtually a freethinker, and only officially a Catholic, interpreting various details in this sense. That he had no special call to clerical work is clear. In his early days this was commented on by a superior who, reporting to the Bishop that he led a modest, religious life, combined with much zeal for the sciences, adds that he had little aptitude for the care of souls. Ministration to the sick and dying distressed him so much as to induce serious illness, presumed to have been a sort of hypochondria. Without much stronger evidence I should hesitate to accept Dr. Iltis's judgment, which is tantamount to a charge of active insincerity. Rather I should suppose that Mendel's position was that of numberless honest men in all ages the world over, who can take things as they find them. Nothing at all suggests that

considerations of faith or doubt had much interest for him, or that he was ever in the position of having to take a side on such questions. Probably they never troubled him one way or the other. I imagine Mendel as a man full of practical good sense, with an exceedingly clear head, thinking in well-divided compartments, rarely disturbed by the eccentricities of genius. We are told that he was not given to brooding or to sentimentality, that he was devoid of music and cared nothing for "Belles Lettres." But when roused he showed, nevertheless, that he had in him a strong element of the martyr, as appears very plainly from the protracted resistance to authority which embittered the last ten years of his life; and *prima facie* such a man is scarcely one whom we need suppose consciously guilty of long-continued sophistry or dishonourable compromise. With this reservation we may be grateful to Dr. Iltis for a masterly book, in which all too scanty materials have been used to the greatest advantage, and not least for having rescued one most excellent photograph (p. 53), from which we can at last see exactly how Mendel looked at about the time of his discovery.

W. BATESON.

## Tropical Medicine in the Far East.

*Far Eastern Association of Tropical Medicine. Transactions of the Fifth Biennial Congress held at Singapore 1923.* Edited by the Hon. Dr. A. L. Hoops and Dr. J. W. Scharff. Pp. xx + 974 + 86 plates. (London: J. Bale, Sons and Danielsson, Ltd., 1924.) 40*s.* net.

THE report of the transactions of the fifth biennial congress of the Far Eastern Association of Tropical Medicine, held at Singapore in September 1923, forms an imposing volume. Since time and distance rendered it impossible to send proofs of the various papers to the authors for correction or revision, a very high meed of praise is due to the editors, Dr. A. L. Hoops and Dr. J. W. Scharff, for the excellent way in which they have performed their arduous work. Previous congresses had met in Manila (1901), Hong Kong (1912), Saigon (1913), and Veltevreden (1921). The president-elect for this, the fifth congress, was Dr. A. E. Horn, who, however, had in the meantime been appointed medical secretary at the Colonial Office and was, therefore, unable to be present, the chair being taken by Dr. A. L. Hoops.

Of the seventy-eight papers submitted, all except five are reproduced in this volume. In a review such as this it is obvious that all cannot be mentioned in detail, and where there is such a feast of good things, it is a somewhat invidious duty to have to make a selection.

The presidential address is an example of what such an address should be—not a detailed account of some special matter to which the author has particularly devoted himself and which may be of little interest to a large proportion of his audience, and, from its very nature as a presidential address, not open to criticism and discussion; it is an introduction on matters of general interest, in this instance "The Prevention of Disease in the Tropics." A series of papers dealing with malaria and cognate matters occupies the foremost place among the more detailed scientific communications. The opening address, by Sir Malcolm Watson, constitutes an excellent brief review of a vast subject and points out the important fact, too often forgotten or neglected, that all malarious districts cannot be dealt with by a single uniform method, that the prevalent idea of indiscriminate clearing of jungle or bush may do more harm than good by getting rid of non-malarial mosquitoes and facilitating invasion by malaria vectors. This is well exemplified in a concrete instance by the succeeding paper on the "History of Malaria at Gemas." Dr. Howard deals with control of the disease on Malayan rubber estates, and Dr. Walch's paper is stimulating as paving the way for investigations into the reasons why one species of Anopheles may carry malaria in a district while others fail to do so. Lieut.-Col. Christophers contributes an enlightening paper on a method of more accurately measuring and expressing the results of examination for splenic enlargement in children than that generally in vogue, in that the notation recommended shows not merely the degree of enlargement but also that of displacement. The paper on the "Treatment of Dementia paralytica by Malaria Inoculation" will be read with interest by alienists in England and other places where the method is now on its trial.

Dr. Fitzgerald writes on the fascinating, though little understood, conditions of amok and latah, and Sir David Galloway follows with a more detailed account of the former of these. Dr. Stanton sheds further light upon the vexed question of beriberi and its control. He discusses briefly various theories which have been advanced from time to time, and, so far as is possible in the case of a disease of still undetermined etiology, bases the measures of control on a scientific foundation. Dr. Noël Bernard contributes an account of his researches into the relation, or possible relation, with beriberi of the organism isolated by him from the blood of certain patients with febrile and asthenic symptoms, and denominated the *Bacillus asthènogénes*. Further evidence will be needed to convince the impartial critic of its causal connexion with beriberi. As the last of the beriberi series, Lieut.-Col. Megaw summarises the beriberi problem in a paper which will be of interest to research workers and practitioners alike. He points out that not only isolated cases but also explosive outbreaks of this disease occur in which food deficiency

can apparently be excluded, and he also stresses the fact that the question of possible poisons in rice has not yet been efficiently studied.

Another group, of six papers, are devoted to ankylostomiasis. The paper by Prof. de Langen on the toxic origin of the anæmia in this infection is of outstanding scientific interest. Dr. Wu Lien-Teh writes as interestingly as ever on pneumonic plague, a subject which he has made peculiarly his own. There are six contributions on leprosy. Two of these deal more particularly with medicinal treatment, three with statistical and administrative aspects, and one with the ocular conditions and complications. This last is good reading, but partakes rather of the nature of a compilation.

The latter half of the report will be widely read by tropical practitioners. It comprises thirty-five papers of a miscellaneous character. Unfortunately, space will not permit of our referring to all of them. They range from a paper proposing the question, "Has Parasitology a Place in the Medical Curriculum?" to one on the chemical composition of gall-stones. The title of the former should be "Ought Parasitology to have a Place?" Considering that the audience consisted of tropical practitioners, the answer might be expressed in a single word. Of the remainder, special mention must be made of the following:—(1) The article "L'Ascaridiose chirurgicale," by Prof. Le Roy des Barres, since this subject has of late been frequently brought to the notice of those practising in temperate climates also; (2) that on the interpretation of the microscopic picture in dysentery, which covers more than the title would lead one to infer, and points out the great importance for all medical men working in the tropics to have some degree of laboratory experience; (3) pseudo-typhus of Sumatra; (4) two papers on Encephalitis lethargica, the first from the clinical, the second from the experimental point of view; (5) Prof. Toyama's interesting and instructive paper on lacquer dermatitis; (6) lastly, Sir David Galloway's paper on opium-smoking. The last named does not appear from the report to have elicited as much discussion as it deserved. The reputed harmful effects of this habit, or rather custom, are matters about which we would have liked to hear more at such a gathering as this, where many of the audience must have had first-hand experience. We are more than glad to see that he maintains the view that opium-smoking is comparatively innocuous; at all events considerably less harmful than the habits which the opium-smoker develops when this indulgence is denied.

As regards the work in general, the misprints are remarkably few for so large a production, as are also mistakes in nomenclature, of which we may cite *Ankylostoma canium*. The papers from Japan lose something of their value by treating too much of the historical aspects of the subjects, after the manner of a German doctorate thesis, and we note that in an article on recent progress in parasitology made by Japanese investigators, such matters as the mode of infection by Ancylostoma larvæ (1912), that of Ascaris discovered by Stewart in 1917, the discovery of *Metagonimus yokogawai* which occurred in 1910, and the life-history of *Paragonimus westermanii* worked out ten years ago, all receive detailed accounts. This might have been omitted and the space thus set free could have been profitably given up to an index, which would further enhance the value of a volume such as this. The photographs and illustrations are mostly good and are excellently reproduced, and the standard of the various contributions is, on the whole, so high that the Far Eastern Association, if future conferences maintain the standard of the last, will gain a world-wide reputation for advancing materially the solution of the many still obscure problems of tropical medicine.

H. HAROLD SCOTT.

## Electrical Instruments.

*Electrical Measuring Instruments.* By Dr. C. V. Drysdale and A. C. Jolley. Part 2: Induction Instruments, Supply Meters and Auxiliary Apparatus. Pp. 475. (London: Ernest Benn, Ltd., 1924.) 55*s.* net.

THE first volume of Messrs. Drysdale and Jolley's work on electrical measuring instruments, which was noticed in NATURE of August 30, 1924, p. 304, dealt with commercial and indicating instruments. In the second volume, which has recently appeared, the authors carry the work a stage further, covering supply meters, induction instruments and auxiliary indicating instruments.

The opening chapter contains a detailed description of the various types of supply meter and demand indicator. There have been several books published already on electricity meters which cover the same ground, and one is inclined to criticise the inclusion of some types of meter which are now almost obsolete. As in the previous volume, the instruments are described in great detail and much practical information is given about their mechanical construction. The tables of temperature coefficients of supply meters and the curves showing the effect produced by tilting will be of value to Central Station engineers who have to use them.

"Induction" instruments are dealt with in the next chapter, which is one of the most complete and exhaustive studies of this type of apparatus that have yet been published. The theory of the induction ammeter and voltmeter and of the induction type wattmeter and energy meter (including the Sumpner

wattmeter) is given. A valuable table showing the torque exerted and the power consumed by induction supply meters is included, and a considerable section of the chapter deals with the "shaded pole" type of instrument. The simplicity of the induction type supply meter has encouraged its use, but, as the authors point out, these meters require the most careful design if they are to give accurate records of the energy used in a supply circuit. This chapter is characterised by the same care and thoroughness of treatment as the preceding parts of the book.

The chapter on recording instruments is also very complete. Not only are the more usual types of recording instruments mentioned, in which the record is made by a moving pen, but also those giving intermittent records by the puncturing of paper by a spark.

A chapter is given to the various forms of frequency and phase meters. The types of frequency meters described include those with vibrating reeds as well as the electro-magnetic type; power factor meters are discussed and the chief types described. Devices for increasing the range of alternating current instruments occupy another chapter, which is concerned mainly with the various forms of potentiometer, and with potential and current transformers. The literature of this subject is very meagre, and the information included will be of value to those who have to deal with the design of these instruments.

A very important chapter deals with devices for mechanical testing, that is, with tachometers, stroboscopic instruments, brakes (including the well-known eddy current brake), and torque recorders. Later, a description is given of synchronising devices and synchronoscopes, and leakage indicators, ohmmeters, and the well-known "megger" are described.

The final chapter deals with test-room equipment, and includes a description of the apparatus necessary for the calibration of indicating instruments, the most important of which is the A.C. potentiometer. Methods of checking the accuracy of meters and a description of some standard forms of wattmeter are given. The last few pages give a short account of some of the bridge methods now used so extensively in connexion with telephone work for measuring capacity, self-induction and mutual induction, as well as apparatus for testing the magnetic quality of iron.

Although the two volumes cover a wide field, the work is still incomplete. If the authors could see their way to publish a third volume, such as is suggested in the preface, which would deal with laboratory instruments, the value of the book would be much increased. The two volumes that have been published already, however, are a mine of information on electrical measuring devices.

## Our Bookshelf.

*Psychology and the Sciences.* Edited by Dr. William Brown; with Contributions by Dr. J. S. Haldane, Dr. R. R. Marett, Dr. F. C. S. Schiller, Dr. L. P. Jacks, Rev. A. E. J. Rawlinson, Dr. M. W. Keatinge, Dr. William Brown, Dr. T. W. Mitchell. Pp. vii+184. (London: A. and C. Black, Ltd., 1924.) 7*s.* 6*d.* net.

IT was a happy inspiration of the Wylde reader of mental philosophy at Oxford to gather together the views of representative thinkers in various branches of science with regard to the relations of psychology to the kindred sciences which they represent, either on the philosophical or biological side, as well as to certain applications of psychology to education and medicine. Though written on popular lines, the volume is an interesting one; for the authors of the essays, which were originally delivered as lectures at Oxford, have taken their several tasks seriously; and, writing from quite different points of view, have emphasised several important conclusions. One of these is that psychology must be regarded as a legitimate science, following its own scientific methods by using interpretative categories peculiar to itself; and another, that it provides a viewpoint necessary as a completion to those of the other sciences represented by the writers of the essays.

Dr. Haldane's contribution is noteworthy, as stressing the necessity of psychological categories of interpretation as well as biological ones, and denying the possibility of expressing the facts of either science in physical terms. Dr. Mitchell's paper is a guarded statement of the relation of psychology to the facts and conclusions of psychical research. The editor's own essay is a reasoned justification of the claims of applied psychology, in one of its principal departments, to an unprejudiced hearing. The sciences with which psychology is compared in the volume are biology, anthropology, logic, ethics, theology, education, medicine, and, if it may be called a science, psychical research. As a symposium on these relations "Psychology and the Sciences" is worth attention; though, of course, it is not the last word on the subject.

*Handbook of the Geology of Ireland.* By Dr. Grenville A. J. Cole and T. Hallissy. Pp. viii+82. (London: Thomas Murby and Co., 1925.) 8*s.* 6*d.* net.

THE work is based on the late Prof. Cole's contributions to the "Handbook of Regional Geology," published some years ago in Heidelberg, and revised and brought up-to-date by him in collaboration with Mr. T. Hallissy. It is an authoritative and concise statement of the broad features of the geological structure and history of Ireland, and though the size of the volume does not allow of much detail, lists of the various papers dealing with the subject-matter are given at the end of each section.

The general morphology of the island is dealt with, and then follow a number of chapters each dealing with the stratigraphy, distribution, and lithology of a system. Tables giving the correlation of the Devonian rocks of Ireland with those of Britain and the Continent of Europe are included.

Under the heading "Quarternary" is given a

description of the glacial deposits of the country, and the authors support the views held by Close with regard to the centres of distribution of the ice, and those of Hull on the origin of the sands and gravels which sometimes occur between two layers of boulder clay. Both these views have been placed in grave doubt by recently published work, and though some of the papers are included in the bibliography, they are not discussed in the text.

Section III. is an account of the general geological history, and contains much that is calculated to stimulate thought, as does also the following section on orographic elements. The volume concludes with an account of the principal minerals of economic value found in the country.

The illustrations include a geological map of Ireland and several sections, but during perusal the lack is felt of a map showing the positions of the various topographic features and towns mentioned in the text.

*The Year-Book of the Universities of the Empire*, 1925. Edited by W. H. Dawson. (Published for the Universities Bureau of the British Empire.) Pp. xii+808. (London: G. Bell and Sons, Ltd., 1925.) 7*s*. 6*d*. net.

THIS Yearbook, published for the Universities Bureau of the British Empire, has established a claim to be considered not only a useful but an indispensable work of reference for all who are concerned with higher education and research.

The latest edition has just come to hand. Included in a little more than 800 pages are a general survey of the British universities, very full particulars of all the universities within the Empire, as well as some shorter notes regarding the other universities of the world. The book contains also among its valuable appendices information regarding the conditions of entrance to the professions, the various matriculation and other entrance examinations, inter-university scholarships, grants for research, etc., and, what is particularly useful, a list of subjects for specialised study in the universities of the United Kingdom.

A considerable amount of hard work must have gone to the compilation of this volume. The universities of the Empire alone now number 67, and to obtain information regarding their affairs would, in the absence of a volume such as this, necessitate the consultation of a set of calendars constituting in themselves a library of formidable dimensions. The possessor of the volume is spared such a laborious task, and the condensation of so much information has been made possible by a system of abbreviations which is ingenious and easily followed.

We have tested the volume by frequent reference and found it remarkably accurate. It reflects credit alike upon the editor and the publishers.

*North Manchuria and the Chinese Eastern Railway*. Pp. xiii+454+13 plates. (Harbin, China: C.E.R. Printing Office, 1924.) 6 dollars.

THIS volume was first published in Russian in 1922, but the present edition has not only been well translated, but has been thoroughly revised and considerably extended. It deals mainly with the country traversed by the Eastern Chinese Railway in its course of some nine hundred miles from the Siberian railway to the Ussuri railway on the way to Vladivostock. In this northern part of Manchuria, settlement, mainly by Chinese, dates almost entirely from the opening of the railway in 1903, which allowed the Manchu authorities to carry out their policy of colonisation which had been initiated a few years previously. For through traffic between east and west the Chinese Eastern railway is the shortest route, but it no longer has a monopoly since the earlier designed but later constructed Amur line was built entirely within Russian territory.

A short chapter on the physical geography of Manchuria is followed by long and full accounts of the economic development of the country and the waterways and railroads. A concluding chapter deals with the operating of the railroads. The rapid growth of prosperity and the great food-producing possibilities of the country are well brought out. There are a number of illustrations, but the maps are weak. Altogether it is a useful volume on a country about which authoritative information is not too easy to obtain.

*Algebraic Geometry: a First Course, including an Introduction to the Conic Section*. By M. P. Meshenberg. Pp. xi+127. (London: Sidgwick and Jackson, Ltd., 1924.) 3*s*. 6*d*. net.

THIS is one of the best introductions to algebraic geometry that we have seen. It is mainly intended to be used as a class-book by senior courses just beginning analytical geometry in secondary schools. Within the compass of a hundred pages the author has contrived to give a thorough treatment of the co-ordinate geometry of the straight line and circle, together with a short but very satisfying introduction to the conic sections. The student is evidently given the benefit of much practice in teaching the subject; very many pitfalls which often disturb beginners are pointed out, and the summaries will be found most helpful to learners. We confidently recommend Mr. Meshenberg's book both to teachers and to private students; it is worthy of being used very widely. W. E. H. B.

*Australasia and New Zealand*. By B. C. Wallis. (Macmillan's Practical Modern Geographies.) Pp. x+350. (London: Macmillan and Co., Ltd., 1924.) 5*s*.

THIS is a useful addition to the series to which it belongs. Australia and New Zealand receive rather scant notice in most English textbooks, but Mr. Wallis's work fills the gap. He has produced a book which is full of accurate information and is particularly valuable in its chapters on climate—a difficult part of the subject, and one which is too often shirked by writers of textbooks. A great deal of statistical information is given throughout the book. This may not attract some teachers, but certainly should help to give greater precision and respect for facts in the study of geography. The book contains more than one hundred admirable maps, and above a hundred and fifty well-selected illustrations. These features alone give value to the volume.

## 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.*]

### Wegener's Hypothesis and the Distribution of Micro-Lepidoptera.

ON the suggestion of a friend, I have tested the credibility of Wegener's hypothesis of continental displacement in the light of my knowledge of the geographical distribution of the micro-Lepidoptera, and some observations on the subject may be of general interest.

The term micro-Lepidoptera is a popular and not a scientific one, and has various acceptations, but I use it here to denote the Tortrices and Tineæ only, and (except that I shall have occasion to mention one genus of Pyrales) I shall not call evidence in support of my case from other groups of animals and plants; the different modes of distribution, periods of origin, and other conditions appropriate to these would tend rather to confuse the issue than to elucidate it. I have always thought that these fragile little insects offer especially trustworthy testimony to former land-connexion; their weak flight forbids even a short voluntary sea-voyage; though they may be carried long distances by gales, their most constant impulse is to avoid this by taking shelter, and those that fail to do so would usually be lost at sea, whilst a large proportion of the species, being restricted by habit to certain food plants in the larval stage, would be unable to establish themselves in a new country where these plants did not exist; and their mode of life is such that other means of distribution (such as ocean currents, transmission by birds, etc.) are in general entirely inoperative. Further, the extent of the group is adequate (I am acquainted with probably 30,000 species, constituting some 35 families and 2000 genera) to afford a sufficiently broad basis for reasonable argument. Naturally a full treatment is here impracticable, but it is possible to develop a few striking and well-ascertained facts.

Wegener gives three maps, reconstructing the globe at different periods. The first of these, representing the Carboniferous era, does not concern us here, since there is no evidence of the existence of any Lepidoptera before the Jurassic. It is probable (and let it be admitted) that in the Jurassic period only primitive forms of Lepidoptera existed; that in the Cretaceous the principal families, as now known, came into being; and that in the Eocene the larger existing genera (those the great specific development and extensive geographical range of which compel us to assign them an origin far back in time) were definitely established. The second map shows the hypothetical relations of the continents in the Eocene, and we see Africa (below the Sahara) and South America in near approximation, and even touching above the equator. There ought, then, to be generic evidence of this. Now Ceromitia (belonging to the "long-horned" Adelidæ, of early type) contains at present 45 African species, being the largest micro-Lepidopterous genus especially characteristic of Africa (which has not been so prolific of large genera as the other continents), and undoubtedly originated there; it also includes 7 species from the Amazonian region of Brazil, and is unknown elsewhere. This is a very remarkable distribution. Tiquadra (Tineidæ), a very distinct form of peculiar aspect, consists of 18 South American species (extending to Mexico), and also 3 African; it is found nowhere else, and its home is clearly American. Polyhymno (Gelechiadæ) is also a genus of striking appearance, and probably of South American origin; it contains 10 American species (North and South), 16 African, and 1 Indian, which may have been derived from Africa. So far as concerns the connexion of Africa and South America, this is evidence as good as could be expected; it demands nearly some such explanation.

We must now consider the more difficult and critical problem presented by Australia and New Zealand. These are represented in the Eocene map as forming one land-mass, completely united also with Antarctica, and by an isthmus-like extension of the latter with South America, the Antarctica portion lying beneath but rather widely remote from Africa, and the Australian portion still more widely remote from India and Asia, but terminally rather approaching the Malay Archipelago. Antarctica is thus brought up into a temperate climate.

Wegener rightly recognises three elements in the Australian fauna—Indian, Malayan, and South American—and describes this feature as being "in most beautiful agreement" with his displacement theory. The South American element is expressly stated to have reached Australia through Antarctica, and as on his theory the width of the Pacific Ocean is much increased, it could scarcely arrive otherwise. Machimia (Œcophoridæ) is a considerable genus, commonly attracting attention by its rosy or crimson tints; its distribution is very striking, namely, South and Central America 73 species, North America (to Canada) 10, Japan 1, Australia (almost all East Australia) 47. Not a single New Zealand species! This is by far the best example of generic intercommunication between Australia and South America, and yet New Zealand, theoretically served by the same means of communication, has absolutely no share in the result. My explanation (and it seems to me the only possible one) is that the Japanese species gives the clue, and that the passage was made by the north; the Japanese micro-Lepidoptera are very inadequately known, and I anticipate that more of the genus will be found there. If, however, as is essential on the Wegener hypothesis, Machimia travelled by way of Antarctica, then New Zealand must at that time have been already disconnected and remote. But since the other evidences of relationship between Australia and South America are only small, fragmentary, or dubious (as being otherwise explicable), the evidence of relationship between New Zealand and South America should in that case be still more inconsiderable. Let us now examine that.

I mentioned above my intention to quote one genus of Pyrales, because it is particularly illuminating. Crambus is a genus of perhaps nearly 400 species, of which the larvæ feed usually on the roots of grass or sometimes in moss, and therefore find pabulum in all regions; it includes the familiar "grass-moths" of Great Britain (where there are 26 species), and is well represented generally throughout the world except that it thins out in the Indo-Malayan region, and is reduced in Australia to two or three wide-ranging exotic forms; there is no endemic Australian species. In New Zealand there are more than 40 endemic species, forming a very prominent feature of the fauna; they constitute a homogeneous group, with no specific affinity to Australasian forms, but akin to those of South America, which is their only possible place of origin; and I hold, as Wegener would, that they travelled

thence by way of Antarctica (though in my opinion the connexion was made westward of America, and not eastward as he puts it). Then why are there none in Australia? On Wegener's hypothesis this is altogether unaccountable.

There is, however, a further phase of the same question. If New Zealand and Australia are supposed on the hypothesis to be connected with South America by the same Antarctic isthmus, much more therefore are they connected with one another. Those characteristic Australian genera, whencesoever derived, the large development of which indicates antiquity (such genera, older than the American and Malayan elements, must be presumed to be of Indian stock), might confidently be expected to have flourishing colonies in New Zealand. The largest family in either area is the Œcophoridæ; Australia already possesses 1500 described species. Philobota (containing mainly insects of fair size, and often conspicuously coloured) has 278 Australian species, 1 South African, 1 Indian, 2 New Zealand (one of which closely approaches a Tasmanian form); the non-Australian species can only be regarded as chance stragglers. Eulechria has 232 species in Australia (including New Guinea), 4 Indo-Malayan, 1 South African, and 1 New Zealand. In the Gelechiadæ the principal Australian genus Protolechia has 122 species and (with several minor derived genera as well) is wholly endemic, not a single species being found in New Zealand. On the other hand, the characteristic New Zealand Œcophorid genera Izatha (15 species) and Gymnobathra (14 species), both apparently of South American type, are quite unknown from Australia. The amount of community shown here is then no greater than might be expected if the conditions had always been as at present, with New Zealand separated from Australia by 900 miles of sea, but stretching for nearly 1000 miles parallel to its coast, so as probably to catch occasionally a stray insect blown out to sea; indeed, I should have expected a little more than is actually found. Of course there is closer relation displayed in some of the other families, which cannot be discussed here and does not affect my argument; I will only say that it can be explained generally by comparatively recent intercommunication taking place between New Zealand and Queensland by way of New Caledonia.

My conclusion is, then, that if, as appears to be the case, Wegener's views on Australia and New Zealand are an integral part of his scheme, the hypothesis is disproved by facts. I consider that there must anciently have been some better communication between South America and Africa, and that this was probably equatorial and not southern; to that extent I am in accord with him.

EDWARD MEYRICK.

Thornhanger,
Marlborough, Wilts.

---

### The Intensities of Lines in Multiplets.

THE relative intensities of spectral lines belonging to the same multiplet appear to be determined by quantum conditions. The formulæ here briefly presented have been derived from the theoretical conditions imposed by the correspondence principle, and give results in close accordance with the existing observational data in all known cases.

Landé's quantum numbers, $R$, $K$, $J$, have been found to be best adapted to the problem ($2R$ is 1, 2, 3 for the singlet, doublet, triplet systems: $2K$ is 1, 3, 5, 7 for the $S$, $P$, $D$, $F$ series; and $J$ is equal to the ordinary inner quantum number $j$ in systems of even multiplicity, but to $j+\frac{1}{2}$ in those of odd multiplicity). Combinations between terms characterised by the quantum numbers $K_1$, $R_1$ and $K_2$, $R_2$ may occur when $R_1-R_2$ is 0 or $\pm 1$, and when $K_1-K_2$ has any value up to $\pm 3$, but the inter-system combinations for which $R_1-R_2=\pm 1$, and the few groups for which $K_1-K_2$ is $\pm 2$ or $\pm 3$, usually give faint lines and will not be considered here. It is convenient to set $K_1+K_2=2K$.

The more important multiplets show three types of structure (illustrated by examples from the quintet system):

| *Ordinary.* | *Rhomboid.* | *Symmetrical.* |
|---|---|---|
| $x_4\ y_3\ z_2$ | $x_3\ y_2\ z_1$ | $x_4\ y_3$ |
| $x_2\ y_1\ z_0$ | $x_1\ y_0\ z_{-1}$ | $y_3\ x_2\ y_1$ |
| $x_0\ y_{-1}\ z_{-2}$ | $x_{-1}\ y_{-2}\ z_{-3}$ | $y_1\ x_0\ y_{-1}$ |
| $x_{-2}\ y_{-3}$ | | $y_{-1}\ x_{-2}\ y_{-3}$ |
| $x_{-4}$ | | $y_{-3}\ x_{-4}$ |

Ordinary multiplets occur when $K_1-K_2=1$ and $K>R$: that is, when the terms involved have their maximum or "permanent" number of components. "Rhomboid" groups occur when $K_1-K_2=1$ and $K<R$, so that the terms have less than the maximum number of components (these groups appear to have no recognised name, which may excuse coining one). Symmetrical groups occur when $K_1=K_2$. The intensities of the lines are denoted by $x$, $y$, $z$, the subscripts being the values of $l$, when $l=J_1+J_2-2K$ when $K>R$, and $l=J_1+J_2-2R$ when $R>K$.

The equations given below have been derived by application of the principles of Sommerfeld and Heisenberg (*Zeitschrift für Physik*, 11, 131, 1922) to Landé's vector-model (*Zeitschrift für Physik*, 15, 189, 1923), using the means of the values of $J$ and $K$ in the initial and final states. This is found to define completely all the terms of the highest order in $K$, $R$, $l$. The terms of lower order are fixed by the condition that the formulæ shall give zero intensity for the fictitious lines which fall into the same rows or columns as real lines, but outside the limits of the multiplet. Very similar formulæ for ordinary multiplets have recently been published by Ornstein and Burger (*Zeitschrift für Physik*, 31, 355, 1925).

*Ordinary Multiplets* ($K>R$).

$$x_l-u_l=4RK^2(8K^2+4Kl+l^2-4R^2-1)$$
$$y_l+u_{l+1}+u_{l-1}=4RK^2(4R^2-l^2)$$
$$z_l=u_l=\frac{1}{4}\frac{RK}{2K+l}\{(4R^2-l^2-1)^2-4l^2\}.$$

*Rhomboid Multiplets* ($K<R$).

$$x_l-u_l=2KR(R+K)(l+2K-1)(l+2K+1)$$
$$y_l+u_{l+1}+u_{l-1}=4KR^2(4K^2-l^2)$$
$$z_l-u_l=2KR(R-K)(l-2K+1)(l-2K-1)$$
$$u_l=\frac{1}{4}\frac{RK}{2R+l}\{(4K^2-l^2-1)^2-4l^2\}.$$

*Symmetrical Multiplets* ($K>R$).

$$x_l+y_{l+1}+y_{l-1}=4RK(4K^2-1)(2K+l)$$
$$y_l=2RK\left\{2K-\frac{4R^2-l^2}{4(2K+l)}\right\}(4R^2-l^2).$$

*Symmetrical Multiplets* ($R>K$).

$$x_l+y_{l-1}+y_{l+1}=4RK(4K^2-1)(2R+l)$$
$$y_l=2RK\left\{2R-\frac{4K^2-l^2}{4(2R+l)}\right\}(4R^2-l^2).$$

The sum-rules of Burger and Dorgelo (according to which the sums of the intensities in successive

rows or columns are proportional to the corresponding values of $J$) follow as deductions from these formulæ. The sum of the intensities for the whole multiplet is in all cases $16R^2K^2(4K^2-1)$. The formulæ for symmetrical groups give intensity zero for the last $x$-line when $K=R$. This is the line excluded by Landé's rule, both inner-quantum numbers being zero; so that this rule too (in the present case) appears as a deduction from the correspondence principle. In symmetrical groups, when $R>K$, the later $x$-lines come out very faint, and when $2K=5$, $2R=7$, $x_{-2}$ comes out zero. This is an excellent agreement with observed facts, previously quite unexplained.

The few published quantitative measures of line intensities are in excellent agreement with the theory. A more comprehensive test is found in King's extensive series of estimates of intensities in arc spectra. Comparison for the doublet and triplet systems shows that King's tabular numbers are very nearly proportional to the square roots of the actual intensities.

Results for some of the most characteristic and important groups are given below. For the measured groups, the sum of the computed intensities has been made equal to that of the observed. For King's estimates the sum for each multiplet has been multiplied by such a factor as to make it 100 $R$; means taken of the results for groups of the same type, and the square roots of the observed intensities have been similarly treated for comparison.

The $x$'s are given first, then the $y$'s, then the $z$'s (separated by semicolons); means have been taken of those observed $y$'s in symmetrical groups which should theoretically be equal. (The observed differences are not serious.)

QUANTITATIVE MEASURES.

*Triplet System:*

| | | |
|---|---|---|
| *PD* | Obs. | 100, 54, 25; 19, 18; <1. |
| | Comp. | 100, 54, 24; 18, 18; 1·2. |
| *DD′* | Obs. | 100, 56, 37; 14·5, 13. |
| | Comp. | 102, 57, 37; 13, 12. |

*Quintet System:*

| | | |
|---|---|---|
| *DD′* | Obs. | 100, 46, 19·5, 3, 0; 24, 34, 24, 13·7. |
| | Comp. | 108, 50, 18, 3·6, 0; 22, 29, 25, 14·4. |

KING'S ESTIMATES.

(The figures in parentheses denote the number of groups combined to form the mean values.)

*Triplet System:*

| | | |
|---|---|---|
| *PD* | Obs. | 47, 36, 25; 19, 19; 4. |
| (15) | Comp. | 48, 35, 23; 19, 19; 5. |
| *DD′* | Obs. | 41, 30, 25; 14, 13. |
| (5) | Comp. | 40, 30, 24; 14, 14. |
| *DF* | Obs. | 48, 36, 35; 14, 14; 3. |
| (13) | Comp. | 48, 40, 32; 14, 14; 2. |
| *FF′* | Obs. | 42, 35, 29; 11, 11. |
| (8) | Comp. | 42, 35, 30; 11, 10. |
| *FG* | Obs. | 50, 40, 36; 10, 10; ? |
| (9) | Comp. | 48, 42, 37; 11, 11; 1·3. |

*PP′ Groups.*

| | | |
|---|---|---|
| *Triplets:* | Obs. | 44, 18, 0; 24, 20. |
| (10) | Comp. | 41, 19, 0; 24, 21. |
| *Quartets:* | Obs. | 52, 20, 13; 28, 28. |
| (3) | Comp. | 48, 17, 13; 31, 30. |
| *Quintets:* | Obs. | 57, 10, 17; 44, 39. |
| (2) | Comp. | 56, 16, 22; 39, 39. |

*PD Groups.*

| | | |
|---|---|---|
| *Quartets:* | Obs. | 50, 35, 23; 27, 28, 25; 7, 5. |
| (7) | Comp. | 50, 36, 23; 24, 26, 23; 8, 10. |
| *Quintets:* | Obs. | 55, 40, 23; 32, 31, 26; 10, 16, 17. |
| (9) | Comp. | 54, 40, 24; 28, 31, 27; 11, 15, 18. |
| *Sextets:* | Obs. | 70, 46, 25; 31, 35, 31; 15, 22, 24. |
| (7) | Comp. | 62, 45, 27; 33, 38, 33; 14, 21, 27. |

*DD′ Groups.*

| | | |
|---|---|---|
| *Quintets:* | Obs. | 53, 31, 18, 6, 0; 17, 22, 19, 13. |
| (6) | Comp. | 43, 29, 17, 8, 0; 19, 22, 20, 15. |
| *Sextets:* | Obs. | 46, 26, 16, 1, 9; 26, 27, 26, 20. |
| (4) | Comp. | 47, 31, 17, 3·5, 11; 22, 26, 26, 21. |
| *Septets:* | Obs. | 50, 36, 18, 0, 20; 28, 29, 33, 24. |
| (1) | Comp. | 53, 34, 17, 0, 18; 26, 32, 31, 25. |

*DF Groups.*

| | | |
|---|---|---|
| *Quintets:* | Obs. | 54, 39, 33, 22, 13; 15, 20, 17, 15; 6, 8, 8. |
| (12) | Comp. | 47, 39, 31, 24, 17; 17, 21, 20, 17; 5, 6, 6. |

Full details will be published in the Proceedings of the National Academy of Sciences.

HENRY NORRIS RUSSELL.

Mount Wilson Observatory,
Pasadena, California,
April 20.

---

For the benefit of readers of NATURE interested in the subject, it may be convenient to record here the fact that Prof. Russell's formulæ for the intensity ratios in multiplets agree with those given recently (and clearly independently) by Kronig, *Zeit. für Phys.*, 31, p. 885, published April 14, 1925. The final formulæ of Kronig and Russell differ only in superficial algebraic form; they are based on slightly different types of appeal to the Correspondence Principle. The present letter analyses far more experimental material than Kronig's paper. [EDITOR OF NATURE.]

---

## The Positive Electrical Drift in the Air.

THE only reason advanced by Dr. Chree (NATURE, April 11, p. 531) in support of his contention that smoke is responsible for atmospheric electricity in towns, is the fact that atmospheric pollution is worst when the potential gradient is abnormally high.

The conditions under which pollution accumulates—the absence of convection currents—are the same for all variable locally produced constituents of town air.

Of these variables I have indicated those which possess an electric charge, namely the positive gas ions poured out by steam locomotives, as the chief cause. I can find no positive charge on smoke. It possesses the property of discharging positively and negatively charged conductors, due to accompanying ionised air, still noticeable some metres to leeward; hence the potential gradient near chimneys is *lowered* in that direction.

The potential gradient at my laboratory at Plaistow ranges from 50 to 300 per cent. higher with N.W. winds than with N.E., E., or S.E., due to the presence of Stratford Station and its extensive connexions 1½ mile distant in the former direction. Smoke pollution as judged by horizontal visibility appears to be much the same in either direction.

The electrical properties of mists and clouds indicate that the natural positive gradient is due to positive gas ions distributed throughout the lower atmosphere—the dominating effect of the artificially produced ions near steam railways being due to their relative nearness to the earth in the neighbourhood of the source.

Country fogs exhibit a very high positive potential at ground level. The gradient is normal a little above the mist. The positive gas ions act as Aitken centres of condensation for water vapour. The positively charged water droplets, simulating the behaviour of Millikan's oil-loaded electrons, settle down in still air, and the potential gradient at the earth's surface increases owing to the inverse square law. On

dispersal of the mist the positive gas ions regain their mobility, and in consequence of mutual repulsion and aqueous convection currents, uniform distribution is re-established.

The positive envelopes attracted to and surrounding isolated negative clouds and their aqueous discharges, when they descend from the electron-charged upper air into the lower atmosphere, afford striking proof of the presence of positive ions in the latter.

The violent fluctuations seen as successive low clouds approach an observer can be interpreted in terms of envelopes and central zones or their precipitates. The unstable electrical systems so formed may result in electrical discharge along the surface of separation in the cloud, or the surface and the earth, according to circumstances.

For purposes of international comparison, all measurements of potential gradient should be excluded when mist, clouds, and locomotive drift are present. They are merely local phenomena.

I believe trustworthy readings are only occasionally obtainable within thirty miles of London, or five miles of a railway line. The Channel or Scilly Isles, or some south-western promontory, might provide a suitable site.

I do not doubt that curves plotted from such restricted data would show a nightly minimum and a daily maximum. If the natural potential is due to photoelectric ionisation of the air, with electronic concentration by diffusion in the outer low pressure regions, and a corresponding accumulation of positive ions in the lower, in a manner somewhat analogous to the diffusion potentials in electrolytes investigated by Nernst in 1889, the cessation of the process, and some recombination at night, and a maximum activity during daylight, are to be expected.

If homogeneity is as important a factor in long range electrical transmission as in acoustical, daylight ionisation may be partly responsible for the superior nightly reception by wireless at distant stations.

WILLIAM C. REYNOLDS.

"Wharfedale," Upminster, Essex,
April 28.

---

### Ultra-violet Radiations and Antirachitic Substances.

IN *Science* (1924, 60, 274) Kugelmass and McQuarrie published a preliminary account of experiments they had carried out which led them to think that substances like cod liver oil which possess antirachitic properties emit ultra-violet light on undergoing a process of auto-oxidation. Their technique was briefly as follows. The cod liver oil was made alkaline with caustic potash, and oxygen was bubbled through; the oxidised oil saturated with oxygen was then placed in a beaker, and over it was placed an air-tight photographic plate-holder made of lead containing a sensitised plate. The plate-holder had let into it two windows, one made of quartz and the other of glass. The face of the plate-holder containing these windows was placed directly over the oxidised oil, which was kept in the dark for twenty-four hours. On development the plate showed an image corresponding to the position of the quartz window. It was concluded that this effect was produced by ultra-violet radiations emitted by the oxidised oil since no image was produced where the glass window had been, and the possibility of direct chemical action was excluded by the plate-holder being air-tight.

Working independently, we have both failed to confirm this work. As Russell (Proc. Roy. Soc., B., vol. 80) and others have shown, many substances undergoing auto-oxidation will cause fogging of a photographic plate directly exposed to the material itself, and it can easily be shown that the reacting substance is a vapour obeying the laws of diffusion, etc. If care be taken to exclude this vapour or gas from coming into direct contact with the plate, no fogging will take place. We conclude, therefore, that either the plate-holders used by Kugelmass and McQuarrie were not gas-tight, or that their results are attributable to the quartz used as a window in their apparatus, for the following reasons.

We have observed that fused silica objects after exposure to ultra-violet light emit a phosphorescence which will fog a plate. Generally we have found that fused silica ware shows this property, and that optically worked articles do not; it being possible that this is due to the inclusion of small bubbles in the fused quartz. We have been privately informed that both Lord Rayleigh and Prof. E. C. C. Baly have previously observed the phenomenon, but but we have not been able to trace any statements about it in the literature.

The phosphorescence is really very remarkable if a piece of fused silica be exposed to the radiations of a quartz mercury vapour lamp for several minutes and then warmed to accelerate the emission in a darkened room. The important point from the point of view of the experiments we are considering is, however, that quartz which has been exposed to ultra-violet light may continue to emit rays capable of fogging a photographic plate after twenty-one days at room temperature.

We think it of interest to direct attention to this property of silica, expecially as it seems to provide a possible explanation of the results of Kugelmass and McQuarrie, which we have been quite unable to confirm when we took care to use silica which was not emitting a phosphorescence.

J. C. DRUMMOND.

University College,
London.

T. A. WEBSTER.

National Institute for
Medical Research,
Hampstead.

---

### Luminescence of Solid Nitrogen and the Auroral Spectrum.

WITH regard to the statements made by Prof. McLennan in a letter to NATURE of January 10, I shall be glad if space can be afforded me for a few remarks.

1. From my first experiments of January 1924 I found that $N_1$ was a band extending between λλ 5525 and 5670, and that this band had some structure. Spectrograms taken with a spectrograph of high dispersion, which I obtained in March of the same year, showed that the $N_1$ band consisted of three maxima. From my point of view, however, this fact was not regarded as anything essentially new, and the material for accurate wave-length measurements was collected for later treatment. Thus I observed the three maxima of $N_1$ several months before Prof. McLennan announced the fact at the International Congress of Refrigeration on June 17.

2. The essential point in our discussion is whether Prof. McLennan is right in assuming that each of the three maxima of $N_1$ is to be regarded as a spectral line with a definite wave-length. With regard to this point, I can refer to my previous publications and to more complete publications which are soon to appear, from which it will be evident that the maxima are moving and that the band $N_1$ approaches the auroral

line by diminution of the size of the particles. The correctness is also confirmed by a number of experiments recently carried out at the laboratory of Leyden. A preliminary note on some of these results is communicated to the Academy of Science of Amsterdam and to the French Academy of Sciences.

3. My remark in my letter to NATURE of November 15 regarding the experimental arrangement had, of course, no reference to the general equipment of the Toronto laboratory, but only to the special arrangement used for exciting and studying the luminosity from solidified gases, and I directed attention to the experimental arrangement to explain our points of divergence, and of course not on account of those facts on which we agree, such as the structure of the $N_1$ band from pure, solid nitrogen. So, for example, I thought that in this way I might possibly explain why Prof. McLennan had come to the wrong conclusion, that the $N_1$ band originated from a *gaseous* state of nitrogen, and that he had not been able to interpret rightly the luminescence from argon.

4. For a more complete discussion of the nature of the luminescence from solidified gases and its connexion with cosmic phenomena, I must refer to my publications. L. VEGARD.

Physical Institut, Oslo.

### The Elimination of Mental Defectives.

IN the May issue of the *Nineteenth Century* Prof. Punnett describes in an interesting way the general scope of the recent advances in genetic research, a subject on which the public certainly need much instructing. He repeats certain figures, however, all doubtless perfectly correct, which were calculated for him by Prof. G. H. Hardy, and on this subject we should like to direct his, and his readers', attention to the comments thereon made by Mr. R. A. Fisher in vol. 16, page 114, of the *Eugenics Review*. If those criticisms are correct, and no arguments to the contrary have been forthcoming, the elimination of the feeble in mind by segregation might, at first at all events, be a far more rapid process than Prof. Punnett's figures would lead us to suppose.

The argument is too long here to be reproduced in full, but I may mention that whilst it is truly said that on certain assumptions it is seen that it would be possible only to reduce the proportion of defectives by segregation or sterilisation from 1 in 1000 to 1 in 10,000 in 68 generations, yet on the same assumptions it can be proved that it could be reduced by more than 17 per cent. in a single generation. Moreover, the assumptions made are very questionable, and a more probable hypothesis indicates that the reduction might be so much as 36 per cent. in a single generation. Prof. Punnett also regards genius as probably a quality dependent on a recessive factor, a conclusion in regard to which doubts may also reasonably be expressed. LEONARD DARWIN.

The Eugenics Education Society,
11 Lincoln's Inn Fields,
London, W.C.2,
May 19.

### Exaggerated Resonance.

IT is well known that the amplitude of response of a syntonic arrangement to a properly timed periodic stimulus, however feeble, is limited only by friction or resistance or other source of dissipation of energy, and that if the resistance could be reduced to zero the response would be theoretically infinite.

In radio telegraphy the response of a syntonised circuit is already very considerable, and I employ a freely oscillating circuit (which I call an *N* circuit) to receive conductive stimulus in a special way from an aerial, and to magnify it until it operates on the grid and filament of a valve. The tuning required is very precise; no reaction or inductive connexion with the aerial is permitted; and alien vibrations can be automatically excluded. The resistance of the *N* circuit is kept down by stranded wire and perfect connexions, but hitherto no attempt has been made to reduce the resistance to nearly zero by liquid hydrogen or helium. I imagine that if such a circuit could be cooled to near absolute zero the response would be something astonishing. I am not acquainted with any convenience for trying the experiment in Great Britain, but perhaps Prof. McLennan at Toronto has facilities.

OLIVER LODGE.

### Quantum Radiation.

IN supplement to my brother's letter in NATURE of May 23, I should like to point out how naturally the radiation formula is obtained, and how inevitably $RT$, the average energy of the atom between two emissions, enters into it, on the single assumption that the energy of each individual atom increases at a rate proportional to itself, combined with the recognised fact that energy is radiated in quanta (the quantum being called $h\nu$, and being presumably dependent on some arrangement or frequency step inside the atom unknown to me).

Let a quantum be radiated when the individual atomic energy of the right kind attains the value $E_1$, and let this energy grow continuously from $E_0$ to $E_1$, its average value between these limits being $RT$.

Then, assuming that $dE/E = kdt$, where $k$ is some constant, and $t$ is the controlling variable whether time or otherwise (probably otherwise), two equations follow, namely:

$$E_1 - E_0 = E_0(e^{kt} - 1) = h\nu$$

and $$E_1 - E_0 = k\int E dt = k \,.\, RT\int dt = RT \,.\, kt.$$

Thus $kt = h\nu/RT$, and everything follows.

ALFRED LODGE.

### Huxley's Contributions to the Study of the Invertebrata.

I REGRET to find that in the article on "Huxley's Contributions to the Study of the Invertebrata" in NATURE of May 9, p. 734, I inadvertently did injustice to other naturalists past and present.

Thus I praised Huxley for having seen that Peripatus was an arthropod; but the credit for this conclusion really belongs to the late Prof. Moseley, who made preparations and dissections of this animal which clearly showed its arthropod nature and these he demonstrated to Huxley.

Then I credited to Huxley's insight the view which has been sustained by later embryological research, that the formation of the endoderm by delamination is a secondary modification of its original mode of formation by invagination, and also the view that the development of mesoderm by the outgrowth of masses of cells is a modification of its original mode of formation by enterocœlic pouches.

These two theories adopted by Huxley we owe to the penetration and genius of Sir Ray Lankester.

E. W. MACBRIDE.

# The Yeasts: a Chapter in Microscopical Science.[1]

By A. CHASTON CHAPMAN, F.R.S.

THE word "fermentation," from *fervere*, to boil or seethe, was at first applied to all cases of chemical change the cause of which was unknown, and which were accompanied by the formation of large quantities of gas, giving the liquid the appearance of boiling or seething. In its widest sense the word is still occasionally applied to a number of chemical processes in which micro-organisms are the active agents, such, for example, as the souring of milk, the conversion of alcohol into vinegar, the production of butyric acid, and similar processes. In its restricted sense, however, it is applied to the conversion of sugar into (mainly) alcohol and carbon dioxide gas by means of the organism known as yeast.

In 1680 Leeuwenhoek addressed to the Royal Society a communication headed "De Fermento Cerevisiæ," in which he announced that he had discovered that yeast consisted of small ovoid globules. Of these, which he appeared to regard as consisting chiefly of batches of six, he gives several excellent drawings. When we remember the nature of the magnifying apparatus with which he had to work, and that the average diameter of the yeast-cell is only $\frac{1}{120}$ millimetre ($\frac{1}{3000}$ in.), it will, I think, be realised that Leeuwenhoek had accomplished a very remarkable feat. He did not, however, push the discovery any further, and in this position, curiously enough, the matter remained for more than a century.

In the year 1814 Kieser, in the course of a paper by Döbereiner, described yeast as consisting of small spherical corpuscles, but this statement does not appear to have attracted attention, and about the year 1837 the microscopical character of yeast was again made the subject of investigation, and the true nature of the yeast organism was definitely and independently discovered by three observers, Cagniard de Latour, Schwann, and Kützing. These observers recognised that yeast is composed of a vast number of small transparent globules which reproduce by budding, and consist of a cell wall with granular contents. A year or two later Schwann appears also to have observed the formation of ascospores. These observers, and Cagniard de Latour in especial, put forward the view that it was owing to the vegetation of these cells that the disengagement of carbon dioxide gas and the formation of alcohol were due.

The microscope having definitely shown yeast to consist of minute living cells—that is to say, of a living organism—it became of high interest and importance to study its life-history, and to ascertain what connexion, if any, there was between the vital functions of the organism and the phenomena of fermentation.

In 1897 Buchner made the very important and interesting observation that the liquid contents of the yeast cell, when added to a fermentable liquid, are able to excite fermentation without the presence of any cells at all. He showed that the production of alcohol and carbon dioxide were the result of the activity of an enzyme secreted by the cell, to which he gave the name zymase. As in the case of other enzymes, zymase is very sensitive to external conditions, and is also highly selective in respect of its chemical activities. Thus, so far as is known, the hexoses alone, and of these, only four (*d*-glucose, *d*-mannose, *d*-galactose and *d*-fructose) are directly fermentable; and before the fermentation of other sugars, such as maltose and cane sugar, can take place, it is necessary that they should be converted into one or other of these hexoses. This is, in all cases, effected by enzymes which are secreted by the yeast, and it is very interesting to note that certain yeasts, whilst secreting invertase, and therefore capable of fermenting cane sugar, do not secrete maltase, and are therefore incapable of fermenting maltose. Then again, there are a few yeasts which, in addition to secreting invertase and maltase, secrete lactase, and are therefore capable of fermenting milk sugar.

We will now turn for a moment to the consideration of yeast as a living organism. The yeasts, as is well known, belong to the great family of the fungi, and may be described as unicellular fungi, reproducing by budding, and capable also of forming ascospores. This latter function is of importance from the point of view of classification, as it serves to differentiate between what are regarded as the true yeasts and certain other closely allied organisms, such as the torulæ and mycoderma. In the common process of budding, the bud, which occurs first as a small protuberance on the surface of the cell, quickly increases in size until it has attained roughly the dimensions of the parent-cell, after which it usually becomes detached, leading a separate existence, and reproducing in turn by the same process. It often happens that before the offspring cell has separated from the parent-cell it has itself commenced to bud, and so chains or clusters of connected cells may frequently be seen.

In the second mode of reproduction to which reference is made above, the yeast cell becomes changed into an asc, in which are formed a number of spores which may vary from one to as many as twelve, but is usually from two to four. The conditions which favour this mode of reproduction are the employment of young and vigorous cells, a moist surface, plenty of air, and a suitable temperature, usually about 25° C. The line between budding and ascospore formation is not very sharp, and it often happens that budding and sporulation may be taking place simultaneously. As a general rule the spores are spherical, but in some of the yeasts they have very characteristic forms. It would seem that spore formation is a provision on the part of Nature for securing the persistence of the species under conditions in which active budding is impossible. It appears, at any rate, to play an important part in the hibernation of yeasts, rendering it possible for them to live through the winter in the soil, or on surfaces from which very little nutriment can be extracted.

In addition to reproducing by budding and by ascospore formation, yeasts are capable of reproducing by still a third method, namely, that of true conjugation. In these yeasts, constituting the genus Zygosaccharomyces, certain of the cells form, instead of

[1] Abridged from the presidential address delivered to the Royal Microscopical Society on January 21, and published in the Journal of the Society for March 1925.

ordinary buds, long beak-like processes. When the "beaks" of two adjacent cells touch one another a union takes place, the tips of the "beaks" disappear, and a tubular connexion is established between the two cells, one or both of which then proceed to produce ascospores. Of these conjugating yeasts a number of different species have been described, and this sexual process in one form or another appears to be much more common than was until recently supposed.

Finally, there is a group of organisms, usually included among the Saccharomycetes, which are capable of reproducing by the process of fission. In these so-called Schizosaccharomycetes the fission of the cell, often accompanied by conjugation, is preceded by the formation of a septum which at once commences to divide into two lamellæ. Budding does not occur, but the cells form spores, usually from two to eight. It will be seen, therefore, that in the great family of the yeasts many types of reproduction are exhibited—from true conjugation (heterogamic and isogamic) in the case of some, through isogamic conjugation of ascospores formed in the same asc, in others, to complete parthenogenesis, as in the case of many of the better known cultivated yeasts. The industrial yeasts, which appear to be entirely asexual, may perhaps be regarded as retrograde forms descended from higher types in which sexuality was quite clearly marked. On this point I do not consider myself qualified to express an opinion.

As may well be supposed, in the case of a group of organisms which, although presenting some very important differences, are yet so closely allied, and in which there are very many transitional forms, a great deal of confusion exists in respect of their classification. The system at present generally adopted is one based upon that suggested by Hansen in 1904, but it is customary to include the Schizosaccharomycetes which he excluded, and there has been, of course, a natural tendency to include a number of subdivisions. The great family of the Saccharomycetes is capable of being subdivided into a number of groups or genera, each of which in turn includes a number of species, considerably more than one hundred of which have been described.

From the foregoing it will have been gathered that the division of the yeasts into more or less well-defined genera has been based almost entirely upon differences in their morphological and physiological characters. For the further differentiation into species it was found necessary, in many cases, to adopt other methods of investigation, such as the behaviour of the yeasts towards certain selected carbohydrates, and observations on the optimum conditions required for the formation of ascospores and of films.

Of the very large number of yeast species known, it may be said at once that only a comparatively few are of industrial importance, and it is customary to divide the various yeast species for technical purposes into the "cultivated" and the "wild" yeasts. The former include brewers' and distillers' yeast in all its varieties—that is to say, yeast which has from the earliest times been used for the production of alcoholic beverages, and has in a sense been cultivated for the purpose. This yeast represents, so far as is known, one species, namely, *Saccharomyces cerevisiæ*, although there are many races and varieties which differ considerably in certain respects, as, for example, in the rapidity with which they bring about fermentation, the degree of attenuation which they can effect, and the flavour of the finished product.

The "wild" yeasts are yeast which occur wild in Nature, frequently having their habitat on the surface of ripe fruits, and often finding their way into the brewery. Some of these yeasts, such as the wine-yeasts, are capable of fulfilling useful functions; others again are, so far as is known, without effect good or bad; whilst others are industrially pathogenic—that is to say, give rise to products which are unpleasant in respect of flavour or smell, or exhibit some other defect, such as pronounced and persistent turbidity.

The importance of these observations in connexion with industrial fermentation processes may easily be imagined. Prior to the isolation and study of the various yeast species, and to the microscopical control to which it naturally led, industrial fermentations were very largely a matter of chance. Sometimes the results were good, sometimes they were bad, but none could say precisely why. Now all that is changed, and when it is remembered that the industrialist who is concerned with any fermentation process is threatened on all sides by intruding organisms which may have the effect of reducing his yields or spoiling his products, the need for scientific control and for the constant employment of the microscope will be evident.

I now propose to consider briefly the cytology, or, if the expression may be permitted, the anatomy of the yeast cell. For a great many years after yeast had been subjected to microscopical examination, there was much uncertainty as to whether the cell did or did not contain a true nucleus. Although the existence of a nucleus is now well established, there is still some doubt as to the precise nature—to say nothing of the functions—of certain of the internal structures which the microscope reveals. Wager and Peniston, Guilliermond, Fuhrmann, Henneberg, Meyer and others have published important papers dealing with the cytology of the yeast cell, and have shown that it possesses a well-defined and complex internal structure.

In addition to a nucleus with a clearly differentiated structure and a nucleolus, the cell contains cytoplasm, a chondrium, metachromatic granules, a nuclear and other vacuoles, and certain thread-like structures. The cell wall, about which a good deal of uncertainty exists, appears to consist as a rule of a single membrane, and to have a complex chemical composition.

In addition to these elements, which may be regarded to some extent as structural, there exist in the cytoplasm accumulations of materials concerned in the nutrition or metabolism of the cell, such, for example, as glycogen and fat.

With regard to the functions of these various cell elements it is not yet possible to speak with very great certainty. As in all cells, the nucleus is the main seat, or rather the directing organ, of the physiological functions of the cell. It is all-important in cellular reproduction and division; it plays apparently a prominent part in nutrition, and doubtless in it reside the properties which are hereditary, and in virtue of which one species may be distinguished from another. The chondrium, consisting of two forms of mitochondria, appears to be concerned in processes of nutritional

elaboration, and the nuclear or main vacuole appears to be largely concerned with metabolic processes, and is, according to some observers, the seat of fermentative activity. This latter function has, moreover, been observed to be dependent on the amount of metachromatic granules contained in the cell, the larger the amount of metachromatin (volutin) the greater the fermentative activity; and Henneberg has gone so far as to suggest that the metachromatic granules may be the parent substance from which the enzyme zymase is derived. From this necessarily brief and sketchy account of the yeast-cell anatomy, it will at least be gathered that our knowledge is very imperfect and that we have much to learn, and it may be hoped that expert cytologists may be induced to turn their attention to the elucidation of the subject. There can be very little doubt that the results would be of important industrial as well as of purely biological value.

The ordinary microscopical examination of cells which have been subjected to the drastic processes of fixing and staining obviously has its limitations, and modifications of structure, such as must almost inevitably be brought about by the above processes, may very easily give rise to incorrect conclusions in regard to the internal structure of such a delicate organism as the yeast cell. It would almost appear, in fact, that we have gone as far as it is possible to go in this direction, and some improved method of investigation will have to be resorted to if many of the questions which are at present in doubt are to be satisfactorily solved. It is possible, for example, that a very careful microscopical study of the unstained cell by means of ultra-violet light may be helpful in giving us a better insight into its internal structure, and Mr. Barnard has already carried out some interesting experiments of a preliminary character in this direction.

When one remembers that the whole of a miniature solar system is comprised within the compass of an atom, it is not, perhaps, altogether fanciful to suppose that the yeast cell—small as it is—may have a much more highly developed internal organisation than has been revealed with our present imperfect means of investigation, and that there may be more or less distinct localisation of the different functions of the cell. In this connexion two sets of facts may be briefly referred to.

In the first place, it is well known that the yeast cell, like other living organisms, may be made to perform different functions according to the conditions under which it is compelled to carry out its activities. Thus, whilst the ordinary *Saccharomyces cerevisiæ* normally decomposes sugar with the production of alcohol and carbon dioxide, and only about 3 per cent. of glycerin, it has been found that when the fermentation is conducted in the presence of a considerable quantity of sodium sulphite, the main products of the fermentation consist of acetaldehyde and glycerin in roughly equal molecular proportions, and that instead of the normal 3 per cent. so much as 36 per cent. of glycerin can be produced. In other words, it would appear that the well-known equation representing fermentation, namely,

$$C_6H_{12}O_6 = 2C_2H_6O + 2CO_2$$
alcohol

has, when the process is carried out in the presence of sulphite, to be written in the following very different and unfamiliar form,

$$C_6H_{12}O_6 = CH_3COH + CO_2 + C_3H_8O_3.$$
acetaldehyde glycerin

In the next place, it is of considerable interest to note that the behaviour of the enzymes within the cell appears to differ materially from that of the same enzymes in the expressed juice. Thus, the acceleration of fermentation by the addition of aldehydes is much greater in the expressed yeast juice than in the case of the living cell, and there are other respects in which the actions proceeding in the juice differ from those occurring within the cell. This seems to suggest that the mechanism of fermentation is in some way directly connected with the organised structure of the cell. In the living cell, again, the velocity of fermentation is much greater than in the expressed juice, and it would seem that, in its natural surroundings within the cell, zymase is free to act without the disturbing influences which probably exist in the expressed juice where all the cell contents are mingled, and some substances may well interfere with the activity of others.

Cramer (Proc. Roy. Soc., 1915, 88, B, 584) has dealt with this important and interesting point, and has shown that the most striking difference between the action of enzymes within the living cells and their action after extraction is the extreme sensitiveness with which, in the former case, they respond to very slight changes in the surrounding medium, being sometimes retarded, sometimes accelerated, and sometimes reversed. According to Cramer, surface tension would appear to be an important factor, such surface tension being operative, for example, at the periphery of the cell and at the boundaries of the nucleus, vacuoles, granules, colloidal aggregates, etc. Thus the conditions for enzyme action may be very different in one part of the cells from those occurring in another part. Under the influence of very slight changes in external conditions there may, for example, take place within the cell a movement of the cytoplasm, or changes in the concentration of the cell constituents which, by altering the surface tension at different parts, may altogether change the conditions for enzymic action.

Even assuming Cramer's explanation to be correct, it still means that the great variations in the physiological and chemical activities of the cell are dependent on internal structure, and it is to this problem that future research may usefully be directed. Any great increase in our knowledge of this subject might prove to be of the highest importance, not merely in regard to industrial operations, but also as affording a deeper insight than we yet possess into the true character of the vital activities of the living cell. The results of such an investigation might well prove to be of fundamental importance. In the living cell we have, in fact, a chemical laboratory of the highest efficiency, and of the most remarkable character; and could we but understand and imitate artificially the processes of building-up and breaking-down which are so quietly and so regularly occurring in a single cell of yeast, we should be not only within measurable distance of a new organic chemistry, but we should also be appreciably nearer to an understanding of that greatest of all problems, the nature of life.

## Dacca: an Experiment in University Education in India.

THE transition phase, now in rapid progress in all matters connected with government in India, has also exercised a profound effect on university education. In many directions experiments have been made during the last few years. Eight new universities have come into being, a number of others are being discussed, while in the older institutions, notably Calcutta and Lahore, an effort is being made to raise the standard of teaching, particularly in science. When it is remembered that many of these developments have taken place during a period of acute financial stringency, the strength of the national movement which has given birth to these changes will be evident.

FIG. 1.—University of Dacca. University Court House.

In many respects the new University of Dacca, which was opened on July 1, 1921, is of special significance to those interested in the development of higher education in India. This university owes its foundation to the Calcutta University Commission, presided over by Sir Michael Sadler, and is an attempt to remedy, by means of an actual example, the abuses which had gradually grown up in India round the purely examining bodies of the older type. To many of the present university students in India, collegiate life, such as exists in Europe and the United States, is unknown; there are little or no facilities for sports and other forms of recreation, while the inevitable examinations exercise far too great an influence on the teaching. It was felt by the members of the Sadler Commission that a new university, organised on the model of modern British universities, was essential if any real progress was to be made in higher education in India. Dacca was accordingly selected for the experiment, and one of the members of the Commission, Dr. P. J. Hartog, formerly Academic Registrar of the University of London, was appointed the first vice-chancellor.

While these decisions were being arrived at, the prospects of a really notable advance in Indian education were most hopeful. A number of suitable buildings, covering nearly a square mile in area, were immediately available. These had been erected, provided with roads and suitably laid out, for the Government of Eastern Bengal and Assam, which came to an end in 1912 on the re-partition of the Provinces of Bengal, Bihar, and Assam. Included in these buildings were the premises of the Dacca College. The area assigned to the University is situated to the north-west of the city of Dacca and alongside the public park of Ramna, and is admirably suited to the needs of a modern residential university. Besides the site and the buildings, a large sum of money, amounting to some 60 lakhs of rupees (about 400,000*l.*), had been set aside by the Government of India for the needs of the new undertaking.

Steps were also taken to recruit the very best staff possible, and to make the teaching of science one of the main features of the University. Unfortunately, by the time Dr. Hartog arrived in India in 1920, the financial situation had reached such a position that the Government of Bengal was compelled to stop all new developments. An era of severe retrenchment ensued, and the new University found itself sadly crippled. The sixty lakhs found its way into the treasury of the Bengal Government when the Reforms Scheme came into operation. Bengal, however, has admitted the moral claim of the University of Dacca to this sum, and has been releasing it at the rate of four lakhs of rupees a

FIG. 2.—University of Dacca. Curzon Hall and Physics Laboratory.

year for capital in addition to a recurring grant of five lakhs. The total annual income and expenditure of the University are now about seven and a half lakhs of rupees (about 50,000*l.*).

In spite of the shortage of funds, however, the University came into being in 1921 with nearly a thousand students and every year the numbers have steadily increased. At the present time nearly 1400 students are in residence divided among the three faculties of Arts, Science and Law. The students, other than those who stay with relatives in the town, live in three residential colleges—known as the Dacca Hall, Muslim Hall and Jagannath Hall—round which the social and athletic life of the University mainly centres. Recently, a new and interesting development has taken place as a result of the residential system. Social service organisations, designed for the uplift of the degraded and the enlightenment of the ignorant, have taken firm root in the University and are doing good work.

On the teaching side, Dacca has broken new ground in several directions. A tutorial system has been established, and the students are taught how to use a library. The tutorial class, as designed at Dacca, is intended to counteract the inevitable evils of the examination room. Examination tends to discourage originality. The tutorial system is designed to foster individual effort, to ensure that each student shall be enabled to learn something of intellectual production as well as of reproduction, so that when he enters the world he will not find himself for the first time confronted with problems to which he had not been taught the answers beforehand. Besides the institution of the tutorial system, the University possesses a good library, the use of which forms an important part of the training of the students. The Sadler Commission in its report stated that in the colleges of some Indian universities, students of university courses read little more than their text-books. This cannot be said of Dacca. The last report shows that 33,982 books were borrowed from the University library during the year. These reforms in the teaching have had their inevitable result. Many of the advanced students have taken up research, and every year a growing number of original papers in languages, history, philosophy, economics, chemistry and physics are being published.

At the Convocation of the University of Dacca on March 6 last, His Excellency Lord Lytton, the Governor of Bengal, in conferring the degree of Doctor of Laws on the vice-chancellor, referred to Dr. Hartog's great services in having successfully established a modern university at Dacca, which though only four years old had already made a name for itself in the world. Lord Lytton stated that the establishment of the tutorial system was largely due to Dr. Hartog, who had worked with patience, with courage, and with industry, and their reward was the appreciation of all his colleagues. They greatly regretted that that would be the last Convocation at which they would see him as their vice-chancellor.

## Obituary.

### Prof. Albin Haller, For. Mem. R.S.

ALBIN HALLER was born on March 7, 1849, the eldest of a family of eleven children, at Felleringen, a small village in the Vosges, near Mulhouse. His father was a master carpenter and cabinet-maker, and his mother carried on a small hardware business. In due course he entered his father's workshop as an apprentice, but two years later, and as the result of a conference between his father and a pharmacist of the neighbourhood, young Haller left his native village and became a student in a pharmacy at Münster; his new master, Achille Gault, undertook the literary as well as the scientific education of his pupil, and later installed him with his brother, Léon Gault, a pharmacist at Colmar.

Thanks to the wise counsels and benevolent interest of these two pharmacists, Haller was able to pass his bachelor of science examinations at Strassburg in May 1870. He volunteered at the outbreak of the war of 1870, was assigned to the army medical service, and was drafted to a hospital at Lyons. The close of hostilities found Haller in a difficult position; his father died, and his mother, left with a large family, decided to open a small hotel in order to set her eldest son free to continue his training; whilst the mother thus became a German subject, the son remained a Frenchman, and rejoined his first teacher, Achille Gault, in a pharmacy at Nancy. When the staff of the University of Strassburg was transferred to Nancy in 1872, he became a student in the School of Pharmacy, and was awarded his diploma as a pharmacist in 1873.

The training of a pharmacist in France often led, and still often leads, to a career in pure chemistry; this arises from the excellent chemical education given to the French pharmacist. Further, the fact that Alsace was the seat of many flourishing chemical industries had already attracted to chemistry many young Alsacians such as Wurtz, Friedel, Schutzenberger and Ch. Lauth. Haller's tastes and his many talents impelled him to forsake pharmacy and to devote himself to chemical science; he soon became well known as a chemical investigator, and took his degree of doctor of science at Paris in 1879. He was appointed professor of chemistry at Nancy in 1885, and professor of organic chemistry in 1898; in 1899 he succeeded Friedel in the chair of organic chemistry at the Sorbonne, a position which he retained until his retirement last year under the age limit.

During the 'seventies of last century our chemical knowledge of camphor was but slight, partly because of the comparatively small number of camphor derivatives known; Haller attached himself particularly to the problems relating to this ketone and prepared large numbers of new derivatives. His first work related to the behaviour of sodiocamphor, and he was the first to prepare iodocamphor and cyanocamphor; the latter compound led to many new derivatives, such as homocamphoric acid, the study of which threw light on the constitution of camphor itself. He made an exhaustive

study of the condensation products of camphor with aldehydes and ketones, and gave an elegant method of preparing sodiocamphor by the aid of sodamide; he effected the partial synthesis of camphor from camphoric acid, and characterised the isomeric borneols. His study of cyanocamphor led him to investigate the remarkable behaviour of the cyano-derivatives of carboxylic esters and ketones in general, and enabled him to provide a new synthesis of acetonedicarboxylic ester and of citric acid. He published important series of papers on the phthaleins, the anthrones, the indanones and the synthesis of anthracene derivatives; he introduced the idea that the alcohols could act upon esters in the presence of hydrogen chloride in the same way that water acts, and showed that the reaction leads to an exchange of the hydrocarbon radicle in the ester. He carried out a large amount of work on optical rotatory power and refraction constants of organic compounds.

Whilst Haller was a prolific contributor to organic chemistry, he was also an ardent worker in the cause of technical education in France; he recognised both the necessity for stimulating the scientific industries of his country and the hindrance to progress imposed by the tendency towards centralising higher scientific effort in Paris. Thanks largely to his efforts, the Chemical Institute at Nancy was founded, and in due course chairs in industrial chemistry and in tinctorial chemistry were instituted; this was the first of many similar institutions in France. During the war of 1914–1918 Haller acted as president of the French Explosives Committee, and, in this office and in many other directions, his incessant activity and his wide experience rendered invaluable service.

Haller was possessed of great charm of manner; his kindly courtesy, his modest bearing and his fine presence, coupled with the keen interest which he took in the work of his junior colleagues, endeared him to all who had the honour of his friendship. Like so many men of the same age and from the same province, his life had been saddened; he was an Alsacian who felt keenly the loss of his native land in 1870, and he had suffered family losses in the last war. The many honours which came to him could not obliterate these sad remembrances. He died on May 1 from influenza, following upon an accident in the laboratory.

Haller was a Grand Officer of the Legion of Honour; in 1900 he was elected a member of the French Academy of Sciences, and in 1923 became its president. He was well known in England, and had received honorary doctorates in the Universities of Leeds and Cambridge; he was awarded the Davy Medal of the Royal Society in 1917, and was elected a foreign member in 1921. He served several periods as president of the French Chemical Society, and was elected an honorary member of the English Chemical Society in 1908.

WM. J. POPE.

## MR. H. LING ROTH.

MR. H. LING ROTH, whose death on May 12 will be widely regretted, was born on February 3, 1855, and was a son of Dr. Mathias Roth, of Harley Street, London. He was educated at University College School and studied natural science and philosophy in Germany. Prior to going to Halifax in 1888, he had travelled extensively. He was engaged in business, but devoted the whole of his spare time to his studies. About twenty-four years ago he voluntarily undertook the work of superintending the Bankfield Museum, Halifax; about twelve years later he was appointed as half-time Keeper, and afterwards he gave his whole time to the Museum. When he first undertook the superintendence of the Museum, it, like other local museums of that time, was in a chaotic condition, but any one who has visited the Museum from time to time cannot but have been struck by the improvements which he made. It is now a model local museum. In particular it illustrates the growth of Halifax and possesses a remarkable series of appliances illustrating the development of the textile industries. The specimens are carefully chosen, well arranged, and most admirably labelled, so that the Museum is a teaching institution of prime importance. Not only has Mr. Ling Roth given time, knowledge, and skill to the Museum, but he has also enriched it with many donations.

By the death of Mr. Ling Roth the science of ethnography loses a student who has not received the recognition that was due to him. This was mainly owing to his quiet, unassuming disposition, and to the fact that he was not connected with a university or large public institution. His work was characterised by painstaking accuracy, and he had a *flair* for collecting specimens to illustrate the particular subject he had in hand. He was a master of the art of collating information and of presenting scattered records in a readable form, which has been of great use to his fellow-students, but in addition, by his own investigations, he has added considerably to ethnographical knowledge. Most of his memoirs and papers have been enriched by his clever draughtsmanship; his drawings bring out just those details which are essential, and thus really illustrate his theme.

The range of Mr. Ling Roth's interests is shown by the following imperfect list of some of his writings: "Crozet's Voyage to Tasmania, New Zealand, etc.," 1891; "The Natives of Sarawak and British North Borneo," 2 vols., 1896; "The Aborigines of Tasmania," London, 1890, 2nd ed. Halifax, 1899; "Great Benin: its Customs, Art and Horrors," Halifax, 1903; "The Genesis of Banking in Halifax," Halifax, 1914; "The Discovery and Settlement of Port Mackay, Queensland," Halifax, 1908; "Oriental Silverwork: Malay and Chinese," 1910; "The Yorkshire Coiners, 1767–1783, with Notes on Old and Prehistoric Halifax," Halifax, 1906; "Sketches and Reminiscences from Queensland, Russia and elsewhere," 1916; "The Maori Mantle," 1923.

Among numerous papers published by the Royal Anthropological Institute may be noted those on the origin of agriculture, salutations, the significance of the couvade, various memoirs on tatuing in Polynesia, Tierra del Fuego, and Tunis, and American quillwork. The series of articles in the Bankfield Museum Notes is of particular interest, among which may be noted the Fijian and Burmese collections; trading in early days; hand wool combing; hand card making; oriental steelyards and bismars; Bishop Blaise, saint, martyr, and woolcombers' patron; and the very valuable series on primitive looms from all parts of the world, which has been reprinted in a separate volume.

A. C. HADDON.

### MR. R. B. SEAGER.

WE much regret to announce the death of Mr. Richard B. Seager, the well-known American archæologist and explorer. According to a message from Sir Arthur Evans in the *Times* of May 14, Mr. Seager was taken ill suddenly while on the voyage from Egypt to Crete. He was landed unconscious at Candia, and died soon afterwards on May 12. Mr. Seager's achievements as an archæologist won for him a high place in studies connected with the Eastern Mediterranean, and he is probably to be regarded as one of, if not the most, distinguished of the archæologists from the United States who have been connected with the work of the American School at Athens. His excavations in Eastern Crete led to a series of discoveries which revealed much fresh material bearing on the earliest culture of the island, and afforded evidence of the state of the arts, as well as of the technology and artistic characteristics of the jewelry, lapidary work, etc., in that early phase of the development of Cretan civilisation.

In his telegram, Sir Arthur Evans alludes to the remarkable *flair* which inspired Mr. Seager's excavations in Eastern Crete. This will be admitted by all who have any knowledge of his work; but he gave ample evidence in his publications that he possessed a sound judgment which, in a sense, was no less remarkable. His published work included three substantial records of his excavations. The first, describing his excavations at Pseira in Crete, was published at Philadelphia in 1910. This was followed by an account of his excavations at Mochlos, published by the American School in 1912, while in 1916 he published a report on his work at the Cemetery of Pachyammos, Crete, as one of the Anthropological Publications of the University of Pennsylvania. Mr. Seager's personal character and charm won for him many friends, by whom his loss is deeply mourned.

---

A MESSAGE from the Beirût correspondent of the *Times* announces the deaths, in a motor-car accident, of Dr. N. V. C. Lothian, Dr. Samuel Darling, and Mlle. Besson, members of the League of Nations Malaria Committee. During the War, Dr. Lothian was Deputy-Assistant Director of Medical Services in the Near East, where he was employed mainly on anti-malarial work, and since then he has been with the League of Nations. Dr. Darling was connected with the Rockefeller Foundation for medical research.

---

WE regret to announce the following deaths:

M. Stanislas Meunier, honorary professor in the National Museum of Natural History, Paris, and author of numerous works on the earth, comparative and experimental geology and on meteorites, aged eighty-one.

Dr. G. L. Spenser, chemist to the Cuban-American Sugar Co. since 1906, and formerly chief of the Sugar Laboratory of the U.S. Bureau of Chemistry, on March 23, aged sixty-six.

---

## Current Topics and Events.

IN replying to the debate initiated by Lord Olivier in the House of Lords on May 20, on certain questions of land and labour policy in Kenya Colony, Lord Balfour, the Lord President of the Council, took occasion to make an announcement of the highest importance, going far beyond the particular problems of Kenya. After referring to the chapter on research in the report of the Ormsby-Gore Commission on East Africa, Lord Balfour pointed out that "what we want is some machinery by which the larger problems which we now see are presented to us by this vast area in East Africa, and other problems from other parts of our Empire may be more conveniently considered in their entirety." He went on to say: "His Majesty's Government are of the opinion that some institution bearing some resemblance to the Committee of Imperial Defence might be set up for dealing with the purely civilian problems which are becoming more and more insistent in connexion with imperial development."

FROM statements made by Lord Balfour and Mr. Baldwin, the Prime Minister, it appears that the Government has decided to set up a Committee of Imperial Research comparable with the Committee of Imperial Defence. This new body will not only be an instrument for acquiring new and needed knowledge, but it will also act as a clearing house of information and as a central co-ordinating organisation, in connexion with the larger problems—economic, racial, scientific—affecting the whole Empire and on the solution of which the future development of the Empire must depend. Like the Committee of Imperial Defence, the new institution will perform no executive action of itself; it will be the direct creation of the Prime Minister; it will advise the Cabinet and provide the machinery for examining problems with which there is at present no departmental method of dealing. That, in the barest outline, is the Government scheme.

IT is obvious that a step of first-class importance has been taken and that the potentialities for good of the Committee of Imperial Research can scarcely be exaggerated. What has been done and is to be done is something far greater than to add a mere annexe to the structure of the Department of Scientific and Industrial Research. Already, as was pointed out in a leading article in NATURE on November 15, 1924, the work of that department has made a good beginning in the evolution of a national scientific policy. The creation of the Committee of Imperial Research is the first necessary step in the development of an imperial scientific policy—imperial in that it is to take into view the needs of the whole Empire; scientific in its widest sense, embracing, not merely the application of all branches of science, as needed, to the varying problems presented by the different parts of the Empire, but also the methods and outlook of science. If from the start the members of this new Committee take a wide view and a far horizon, it may well turn out that more will be done

for imperial unity and imperial development than has been or can be done by the best laid political or military schemes. The announcement of the names of the members of the Committee of Imperial Research will be awaited with anxious interest.

IN the House of Commons on May 15, Mr. H. Williams asked the Financial Secretary to the Treasury for a statement of the total sum provided for scientific research of all kinds in the estimates for the present financial year. Mr. Guinness replied as follows: "Including the cost of buildings maintained by the Office of Works, but exclusive of the cost of administrative staff (except in the case of the Department of Scientific and Industrial Research), it may be stated that a sum of 4,045,000*l.* is provided in Estimates 1925–26 for scientific research of all kinds." No doubt this figure is accurate, but unless some indication is given as to what is included by the Treasury under the terms "scientific research of all kinds," Mr. Guinness's answer is liable to give a seriously misleading impression.

LET us turn to the Civil Service Estimates for the year ending March 31, 1926, Class IV. (H.M.S.O., Price 1*s.* 6*d.* net). There we find under the section devoted to the Department of Scientific and Industrial Research, that the estimate for the year of that Department, including the Geological Survey of Great Britain, the Museum of Geology, and a Grant in Aid, is 380,263*l.* Of this sum, 40,000*l.* is definitely allocated to "Grants for investigation and research." Estimates for the cost of actual research work, exclusive of the Geological Survey side, reach a total of 355,184*l.*, and against this is set 117,619*l.* as the estimate for Appropriations in Aid, comprised of fees for tests, charges for investigations, sale of maps, of by-products, and so on. These figures cover the work of the National Physical Laboratory, and the official work on building, fuel, and other research. Turning now to the Medical Research Council, another body with which the term "scientific research" is definitely associated, we find that the Grant in Aid of the expenses of the Council is 135,000*l.* Scientific societies, observatories, and so on, account for a further 65,187*l.*, though a large part of this cannot obviously be for scientific research as rightly understood. Our total now is well over half a million, but there is a big gap between this and four millions. The Fighting Services expend a considerable amount upon scientific work of various kinds, which is presumably included in this total, but details as to how the sum is made up would be illuminating. Mr. Guinness's reply requires considerable amplification before it can show anything of the real financial position of scientific research in Great Britain.

A DINNER was given at Christ's College, Cambridge, on Saturday, May 23, in celebration of the attainment by Dr. A. C. Haddon of his seventieth birthday, and on the eve of his retirement from the post of reader in anthropology and ethnology in the University. The chair was taken by Sir William Ridgeway. Among the large gathering present were Mrs. Haddon, the Vice-Chancellor (Prof. A. C. Seward), Sir Arthur Shipley, Prof. C. G. Seligman, Mr. H. Balfour, Prof. A. Francis Dixon, Prof. J. Graham Kerr, Prof. Hobson, Dr. C. S. Myers, Prof. Pearson, Mr. Martin White, and Mr. P. A. de Laszlo. Eloquent tributes were paid to Dr. Haddon's achievements as an anthropologist and as a teacher of anthropology. Sir William Ridgeway said that his researches in the field had made him one of the leading ethnologists of the day with a world-wide reputation. By his zeal and self-sacrifice he had done more than any man to forward the teaching of anthropology in the University. Mr. Balfour referred to his versatility; he had not been a specialist in any one branch, but was master of them all. Prof. Seligman spoke of his success as a leader of expeditions in the field. In replying, Dr. Haddon referred to the unvarying kindness he had met from his colleagues. In reviewing his life, he said his work as professor of zoology at Dublin had led to his expedition to the Torres Straits, where he had got to know the natives and had turned to study them. Though warned by Sir William Flower that there was no money in his studies—a fact he had afterwards verified—he had persevered, lecturing at Cambridge without stipend until his second expedition to the Torres Straits. In the University, anthropology is still going through critical times and the subject is not yet fully established. Portraits of Dr. Haddon have been painted by Mr. de Laszlo to perpetuate his work. Of these, one will be hung in Christ's College, another is to be given to the Museum, and the third will be presented by the artist to the family.

THE bird sanctuaries in the Royal Parks in London owe their existence in the first instance to the War, for when the gardeners were away, certain enclosures used by them became overgrown with nettles and brambles. In these several kinds of birds, which on migration usually make but a short stay, found suitable cover and remained to build their nests and rear their young. Mr. Rudge Harding sent a note to the *Field* recording the nesting of the willow warbler and the lesser whitethroat in Hyde Park, and Mr. Harold Russell, who saw this, wrote to the Office of Works and suggested the formation of bird sanctuaries. Lord Crawford, then H.M. First Commissioner of Works, appointed a Bird Sanctuary Committee, with Sir Lionel Earle as chairman, and Mr. E. Batch as secretary, and sanctuaries were made in Hyde Park, Kensington Gardens, St. James's Park, and Greenwich Park, in which suitable undergrowth was planted and bird boxes were put up. The experiment continues to be successful. It is on the south side of the bird sanctuary in Hyde Park, which lies just north of the line joining the Superintendent's Lodge and the Powder Magazine, that the memorial to W. H. Hudson has been recently erected. A good many years ago, when Sir Schomberg MacDonnell was the Secretary to the Office of Works, nesting boxes were put up in Hyde Park and Kensington Gardens and Richmond Park at the request of the Selborne Society, which provided the boxes. The results in this case were also satisfactory, and in Richmond Park the first record was obtained of a woodpecker building in a nesting box in Great Britain. In this

park, where there are a heronry and considerable enclosures, the protection of birds has apparently been continued from the time of the first experiment, and received an additional impetus when the other sanctuaries were formed.

THE forthcoming celebration of the centenary of the discovery of benzene (NATURE, May 9, p. 685) will, it is hoped, interest and stimulate all who realise the value of science to the community. Though most famous as a physicist, Faraday was also a great chemist; moreover, he was a true natural philosopher, taking a wide and impartial view of things, and his character as a man was singularly beautiful. On June 16, 1825, he communicated to the Royal Society a paper entitled "On new compounds of carbon and hydrogen, and on certain other products obtained during the decomposition of oil by heat," in which he described the isolation and the properties of benzene and butylene (called by him, respectively, "bi-carburet of hydrogen" and "new carburet of hydrogen"), and this paper was referred to by Berzelius as incontestably the most important of the year. The raw material used was the oil which separated during the storage under pressure of the illuminating gas of that period (made by decomposing fish-oil at a red heat), and the hydrocarbons mentioned were extracted by purely physical processes, namely, fractional distillation and "freezing-out." The benzene obtained was substantially pure, containing 11·576 parts of carbon to 1 of hydrogen, as compared with 12 : 1 required by theory.

GREAT skill and patience were shown by Faraday in the discovery of benzene, but it was left to the future to disclose the great importance of the discovery. Not only has benzene played a leading part in the development of the theoretical foundations of organic chemistry, as a solvent and as a starting-point for the preparation of innumerable organic compounds in the laboratory, but it has become an indispensable raw material of industry. It is the parent substance of a host of dyestuffs and medicaments, and it is used in large quantities in the rubber, paint and varnish, vegetable-oil, and motor-fuel industries. As previously announced, the commemoration of the centenary of its discovery will include a reception, lecture, and a dinner. The reception will be held at 11 A.M. in the Royal Institution on June 16, when the following foreign delegates, among others, will be present: Prof. G. Bertrand (Paris), Prof. E. Cohen (Utrecht), Prof. F. Swarts (Ghent), and Prof. J. F. Norris, of the Massachusetts Institute of Technology. Sir William Pope will deliver the lecture at the Institution on Friday evening, June 12, at 9 P.M., on "Faraday as a Chemist." The centenary banquet will take place on the evening of June 16 at the Goldsmiths' Hall. Application for tickets of admission and for the banquet (two guineas) should be made to the Secretary, Royal Institution.

A SEVERE earthquake occurred at about 11 A.M. (about 2 A.M., G.M.T.) on May 23 on the north-west side of Japan. The towns most seriously affected are Kunihama, Kinosaki and Toyooka, and, as in 1923, the damage was more due to the subsequent fires than to the shocks. A first estimate puts the number of persons killed at 100, and of wounded at 1000, while 10,000 are said to be destitute. The railway services were suspended for a few hours, but rescue trains were not delayed. The shock was strongly felt at Kobe and Osaka on the opposite side of the island, and it was also perceptible at Kyoto, Okayama, Nagoya and Niigata, but not so far as Tokyo. One of the most interesting features of the earthquake is its occurrence on the Japan Sea side of the islands, which is much less frequently visited than the opposite coast. For example, of the ten most extensive and violent earthquakes since the fifth century, three have occurred in central Japan and seven off the south-east coast. On the Japan Sea side, during the same interval, five earthquakes were followed by small sea-waves; on the other side, great sea-waves swept in after twenty-three earthquakes. Again, during the years 1885–1905, according to the late Prof. Omori, 257 earthquakes disturbed areas of more than 25,000 square miles; and, of these, 145 originated off the east coast, and only 9 off the west side. The provinces (Tango and Tajima) chiefly affected by the shock of May 23 seem to have been disturbed by few earthquakes between the years 416 and 1867. In Sekiya's great catalogue, the province of Tajima is only once mentioned (in 1666) as the central district of an earthquake.

ON May 21, 1825, a hundred years ago, the Royal Society of Arts voted its large silver medal and a sum of thirty guineas to William Sturgeon for a number of pieces of apparatus for demonstrating the principles of electromagnetism, which he had presented to the Society. Among this apparatus was a horseshoe magnet made of a piece of round bar iron wound with some eighteen turns of copper wire. Sturgeon was the first to make such an electromagnet. To mark the hundredth anniversary of the presentation, Prof. J. A. Fleming on May 20 delivered a lecture to the Society on "William Sturgeon and the Centenary of the Electromagnet." In the course of the lecture, Prof. Fleming gave a few details of Sturgeon and also dealt with modern theories of magnetism and with the various important alloys which have magnetic properties. Among these is permalloy, which has very large permeability for very small magnetic forces and is being used for the uniform loading of the latest submarine cables, thus increasing the working capacity enormously. Permalloy consists of 78·5 per cent. nickel and 21·5 per cent. iron, and its preparation was due to the research work of two American companies. A section of the new cable is exhibited in the Science Museum, South Kensington. All Sturgeon's original apparatus has unfortunately been lost, but Prof. Fleming showed a replica of the electromagnet.

WHETHER we consider Sturgeon's upbringing, his station in life, or the state of scientific teaching at the time, his career was surprising. The son of an ingenious but idle bootmaker, Sturgeon was apprenticed

to a harsh master and then changed the cobbler's bench for the drill ground, passing from the Militia into the Artillery. With little help he learnt mathematics, Latin, and Greek, and on Woolwich Common made electrical experiments with kites. Leaving the army in 1820 on a pension of a shilling a day, he resumed his cobbling and his scientific experiments, and his merits led to his appointment as lecturer in science at the East India Company's College at Addiscombe. He was forty-two when he made his electromagnet. Later, he was connected with the Adelaide Gallery of Practical Science in the Strand and with the Victoria Gallery of Science at Manchester, but neither institution flourished, and his last years were spent in poverty. He started periodicals and continued to lecture, but found it hard to keep the wolf from the door. When sixty-two years of age he was given a small Civil List pension. No man more deserved such help, but he only enjoyed his pension for a short while, for he died in 1850. At the close of the lecture Prof. Fleming suggested that Sturgeon's work might be fittingly commemorated by the Royal Society of Arts by the foundation of a Sturgeon lecture.

DR. THORNE M. CARPENTER, in his discourse on Friday, May 22, at the Royal Institution on the Nutrition Laboratory of the Carnegie Institution of Washington, said that the greater portion of the researches of the Laboratory are conducted with humans, supplemented by studies on other animals. The development of apparatus for the direct measurement of heat elimination and production and for the determination of respiratory exchange has formed an important part of its work. Recent apparatus includes a gas analysis apparatus for the exact determination of carbon dioxide and oxygen in atmospheric and room air, and a modification of the simplest form of respiratory exchange apparatus so that the indirect determination of the heat of combustion or energy value of foods can be estimated indirectly by the measurement of the oxygen used in the combustion. A comparison of measurements of heat elimination and production by the direct method (calorimetry) and by the indirect method (respiratory exchange) has shown that the indirect method is the most practicable for the determination of basal metabolism. The observations on humans made by Prof. Francis G. Benedict, the Director, and his collaborators have resulted in establishing standards by means of which the normal basal heat production of humans from birth to old age can be predicted. These standards include factors for weight, height, age and sex, and their application in clinical medicine to diagnosis and the effect of treatment, illustrates how a purely abstract scientific study proves of practical value. Examples of recent special researches are the determination of the neuromuscular effect of ethyl alcohol correlated with concentration of alcohol in blood and urine, the metabolism of alcohol, lævulose, and dextrose when injected rectally, and the metabolism of steers, together with the composition of their excreta, as affected by prolonged fasting.

DR. J. S. BOLTON, professor of mental diseases in the University of Leeds, delivered the Maudsley Lecture before the Medico-Psychological Association of Great Britain and Ireland on Thursday, May 21, taking as his subject "Mind and Brain." In the first part of his address, Prof. Bolton discussed the evidence for the possession of mind by the lower animals, and criticised very severely the "anthropisation" of insects and birds. He declared that they obey instincts blindly and that their seeming wisdom is a mere illusion. Purposive action begins to appear with the mammals, but even among humans, intelligence is still in a very primitive state. "Fortunately for us, our recent origin, and the highly plastic state of our constituent parts which we inherit from our pre-human mammalian ancestry, will in the long run prove our salvation by enabling us rapidly to evolve from our present relatively infantile stage of mental development." In Prof. Bolton's opinion, "personality is the intellectual element of mind or cerebral function which exists in inverse proportion to the instinctive element common to mammals and to animals below them." The purpose of education is to replace instinctive reaction to environment by reasoned action, and that this end is not always achieved "is no reason for the retrograde enthroning of the basal instincts which serves as the foundation stone of Freudian psychology." Prof. Bolton later referred to what he termed "the myth of the unconscious mind," a conception based on Freud's theory of dream-interpretation. If it exists, it must be fully formed before even the necessary brain structure for such functions evolves. Prof. Bolton finds it impossible to frame a definition of the unconscious mind which is consistent with the theories of mind and brain he upholds.

ON Thursday, May 21, Capt. Amundsen set out on his flight to the North Pole from King's Bay, Spitsbergen. He proposed to journey along the coast for an hour and then, provided the two "flying-boats" were behaving satisfactorily, he would turn directly to the Pole. It was thought that the actual flight to the Pole would take seven or eight hours, and if the weather conditions were suitable, a stay of twenty-four hours would be made at the Pole for the purpose of making observations. Amundsen was thus due back during Saturday, but at the time of going to press, no news had been received of him. Fine weather appears to have prevailed over the Polar basin during the week-end, but it is feared that the good spell was breaking up. Capt. Amundsen is using two Dornier "Wal" flying boats and is accompanied by Mr. L. Ellsworth, Lieut. Dietrichsen (in charge of the second machine), Lieut. Riiser-Larsen, and Lieut. Omdhal. Both machines are carrying complete equipment, so that in the event of a breakdown, the party will be able to make its way on foot back to the base.

ON behalf of the Field Museum of Natural History, Chicago, Colonel Theodore Roosevelt, junr., and Mr. Kermit Roosevelt are leading an expedition, in other respects financed by Mr. James Simpson, through

central and southern Asia. Entering India at Bombay, the expedition will proceed to Srinagar in Kashmir. Thence crossing the Himalayas by way of Leh and the Karakoram Pass, it will make excursions into the Pamir region and then cross Turkestan to the Thian Shan Mountains. The duration and subsequent course of the expedition will depend on circumstances. The main object of the expedition is to obtain animals of different ages and sexes required for large habitat groups in the Field Museum, but no doubt collections will also be made with a more purely scientific object. It is intended, for example, to collect reptiles, amphibians, and freshwater fishes. Mr. George K. Cherrie will accompany the expedition from the United States, but other trained zoological collectors will be engaged in England or in India.

THE annual visitation of the Royal Observatory, Greenwich, will take place on Saturday, June 6. The Observatory will be open for inspection at 3 P.M.

PROF. W. MAGNUS, of Utrecht, will deliver the Croonian Lecture of the Royal Society on June 11, taking as his subject "Animal Posture."

MR. T. SHEPPARD, the curator of the museums at Hull, has received an intimation from Mr. J. Digby Firth, president of the Leeds Co-operative Field Naturalists' Club, one of the oldest field clubs in Yorkshire, that he has been elected an honorary life member in appreciation of the valuable work he has done and is doing to the cause of science, particularly in the north of England.

IN reply to a question in the House of Commons on May 25, Mr. Baldwin said: "In view of the decision to hold a general inquiry into the broadcasting system towards the close of the year, the Government have decided not to proceed this session with the Wireless Telegraphy and Signalling Bill. A short Bill will be introduced instead, with the single object of resolving any doubt as to the validity of the existing licence system."

DR. N. L. BRITTON, emeritus professor of botany in Columbia University and Director-in-Chief of the New York Botanic Garden; Prof. G. H. Parker, professor of zoology in Harvard University; Prof. F. Raffaele, professor of zoology in the Royal University of Rome; Prof. C. Shröter, professor of botany in the Federal Polytechnic, Zürich; and A. Zahlbruckner, of the botanical department of the State Natural History Museum, Vienna, have been elected foreign members of the Linnean Society of London.

THE following have been elected foreign members of the National Academy of Sciences, Washington, D.C.: The Hon. Sir Charles Parsons; Prof. A. S. Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge; Dr. Adolph Engler, professor of botany in the University of Berlin; Dr. Niels Bohr, professor of physics in the University of Copenhagen; M. Charles P. E. Schneider, a distinguished French engineer; Dr. Hans Speman, professor of zoology, University of Freiburg i. Br.

THE Pontificia Accademia Delle Scienze Nuovi Lincei at Rome organised this year, as two years ago, an "Academy Week" of lectures by members of the Academy, as part of a scheme for the spread of knowledge among scientific workers. The lectures were given in the historic halls of the Palazzo della Cancelleria and were much appreciated by the members of the University and the public. The following topics were discussed: History of mathematics (Prof. Gomes Teixeira, University of Oporto); aerodynamics and aeronautical constructions (Prof. Panetti, Royal Polytechnic School of Turin); graphic calculation and mechanical calculation (Prof. M. d'Ocagne, free academician of the Paris Academy of Sciences; geophysics (P. Algué, Director of the Central Observatory of the Philippine Islands); our knowledge of the ultra-microbes (Prof. Caronia, Director of the Clinical Surgery of the University of Rome). The lectures will be published in the Atti of the Papal Academy.

THE second Indian Plant Breeders' Conference was held at Surat on February 26-28, under the chairmanship of Mr. R. K. Bhide, Crop Botanist of the Bombay Presidency. The mere fact that such a conference, attended as it was by a dozen specialists and about twenty others, should be held in India, shows how rapidly that country is now moving along the path of scientific progress. Among the subjects discussed were probable error in field experiments, the problems of sterility and fertilisation, acclimatisation, stability of the performance of improved varieties, and standardisation of testing methods. The general opinion with regard to improved varieties was that they retain their superiority even under the conditions supplied by the ordinary cultivator. The Conference thought it desirable that the Director of Agriculture should get some one on the staff of his Department to specialise in biomathematics, to give lectures to men taking up plant breeding, and so to assist the plant breeders in interpreting their results.

THE National Physical Laboratory is distributing free copies of a useful pamphlet on the testing of weights and balances. It contains information on the conditions which weights intended for accurate work should satisfy, and describes a new form of certificate on a "weight in air" basis, which will secure an accuracy in weighing of one part in a million, in terms of either the International kilogram or of the Imperial standard pound. Balances are also tested as to general functioning and sensitiveness under various loads, and specific gravity balances of the sinker weighing type to an accuracy of one part in a thousand or in three thousand. Tables of fees for the various types of test are given.

IN a paper read to the Society of Engineers on May 4, R. C. S. Walters described some of the water-power exhibits at the British Empire Exhibition at Wembley in 1924 and gave some interesting data. An estimate is made of the fraction of their total water-power resources that several of the dominions have developed. Canada, which has immense resources, utilises 8 per cent. of them; Newfoundland, 30 per cent.; New Zealand (North), 20 per cent.;

New Zealand (South), 2 per cent.; Tasmania, 12 per cent.; and Ceylon, 3·5 per cent. A large part of this work has been done since the War and further large developments are in progress. Many British firms are specialising on hydro-electric equipment so as to be ready to meet the increased demand for this type of machinery. In Newfoundland there is a large water-power scheme in progress capable of being developed to 250,000 H.P., for the manufacture of paper. A hundred horse-power for a day is required to manufacture a ton of paper. At the Exhibition, impulse turbines capable of giving 60,000 H.P. were shown.

WE have received from the Canadian Department of Mines a copy of pamphlet No. 618 on "Fuels and Fuel Testing." The contents consist of six contributions to the subject; the carbonisation of lignite and sub-bituminous coals, survey of Maritime Provinces coals, nature of sulphur in coal and coke from the Maritime Provinces, gasoline survey (1923), the Hartman oil shale retort, and a report on the Ramage process for oil refining.

CATALOGUE No. 12, 1925, of "Old Books and MSS." just issued by W. H. Robinson, 4 Nelson Street, Newcastle-upon-Tyne, is worth obtaining by readers interested in early editions. Among the sections are Old Scientific Books, Voyages and Travels, and Medicine. Many of the works listed are very rare.

DR. SILBERSTEIN referred in his letter published in last week's NATURE, p. 798, to "a *Phil. Mag.* paper (1919)." Sir Oliver Lodge has been kind enough to send us the exact reference, namely, *Phil. Mag.*, February 1920, vol. 39, p. 161. He himself communicated the paper to the *Phil. Mag.*

LIEUT.-COL. E. GOLD informs us that the name of Capt. Wehrlé was inadvertantly omitted from the list of members of the sub-commission on balloons in the draft minutes of the meeting, and also from the list appearing in NATURE of May 16, p. 782, col. 2, in Lieut.-Col. Gold's article on the International Commission for the Investigation of the Upper Air.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Head of the Electrical Engineering Department of Rutherford Technical College, Newcastle-upon-Tyne—Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (June 8). A full-time lecturer in mathematics at the Wigan and District Mining and Technical College — The Principal, Library Street, Wigan (June 8). An assistant lecturer in mathematics and an assistant lecturer in geography in the University of Bristol—The Registrar (June 10). An assistant lecturer in biology at King's College for Women (Household and Social Science Department)—The Secretary, Campden Hill Road, W. 8 (June 12). A responsible science mistress (physics and chemistry) at the County School for Girls, Chatham—The Headmistress. The University professorship of geography at the London School of Economics—The Academic Registrar, University of London, South Kensington, S.W.7 (June 18). An assistant chemist in the Government Laboratories, Federated Malay States — The Private Secretary (Appointments), Colonial Office, Downing Street, S.W.1 (June 30). An assistant Government chemist, Zanzibar—The Private Secretary (Appointments), Colonial Office, Downing Street, S.W.1 (June 30).

## Our Astronomical Column.

RESEARCHES ON CEPHEIDS IN SPIRAL NEBULÆ.—The May issue of the *Observatory* contains an interesting summary of Prof. Hubble's paper describing his researches. One is filled with admiration for the skill which must be required in determining periods and approximate light curves of some 80 objects, which at their brightest are fainter than mag. 18, and in many cases are too faint at minimum to appear on the plates. Enough of the light curve has to be traced to determine that the type of variation is Cepheid, since Shapley's relation between absolute magnitude and period applies to these alone. The periods vary from 17 days to 50 days, the corresponding maximum magnitudes being 19·0 and 18·4; on plotting log P and maximum magnitude, a good agreement is found with Shapley's law, the average deviation in M 33 being 0·1 magnitude.

As a proof that the Cepheids are really in the spiral nebulæ and not merely projected upon them, considerable areas in the neighbouring sky were explored, without finding any Cepheids.

The presence of perceptible absorption of light by nebulous matter is rendered improbable by the fact that the Cepheids are scattered over large regions of the spirals, and all give fairly accordant values of the distance, which comes out as 285,000 parsecs or 930,000 light years for both M 31 and M 33. Variables have also been found in M 81, M 101 and N.G.C. 2403.

COMETS.—Dr. W. H. Steavenson found Orkisz's Comet still very conspicuous on May 20. It was easily visible in a small hand telescope, and at least of magnitude 7·5. A tendency to tail formation was noticed in P.A. 250°.

EPHEMERIS OF ORKISZ'S COMET FOR 0$^h$.

| | R.A. | N. Decl. |
|---|---|---|
| May 27. | 2$^h$ 10$^m$ 57$^s$ | 80° 19′ |
| June 4. | 6 13 29 | 81 43 |
| 12. | 8 31 18 | 76 45 |
| 20. | 9 24 13 | 70 58 |

Dr. Steavenson also observed Schain's Comet as follows:

| G.M.T. | R.A. 1925·0 | N. Decl. 1925·0 |
|---|---|---|
| May 10$^d$ 21$^h$ 51·9$^m$ | 10$^h$ 36$^m$ 24·82$^s$ | 4° 23′ 13·5″ |
| 12 21 53·6 | 10 34 29·60 | 4 25 14·3 |
| 20 22 22·0 | 10 27 40·20 | 4 28 53·7 |

From the first two observations, Mr. G. Merton has corrected the orbit as follows:

| | |
|---|---|
| T | 1925 Sept. 4·5379 G.M.T. |
| $\omega$ | 205° 19·14′ |
| $\Omega$ | 357 29·66 |
| $i$ | 146 43·12 |
| log $q$ | 0·62196 |

EPHEMERIS OF SCHAIN'S COMET FOR 0$^h$.

| | R.A. | N. Decl. |
|---|---|---|
| May 26. | 10$^h$ 24$^m$ 14$^s$ | 4° 29′ |
| 30. | 10 21 47 | 4 27 |
| June 3. | 10 19 36 | 4 24 |
| 7. | 10 17 46 | 4 19 |
| 11. | 10 16 11 | 4 14 |
| 15. | 10 14 52 | 4 7 |

## Research Items.

AN EGYPTIAN SURVIVAL.—In *Man* for May, Miss Winifred Blackman suggests an explanation, based on a modern custom, of the purpose of the clay balls found by Prof. Peet at Abydos, by Sir Flinders Petrie at Kahun, and by Prof. Garstang at Reqaqna. When those from Abydos were cut open, two were found to contain fragments of reed and one a square bit of linen cloth. Two from Kahun, when examined in 1916 by the Manchester Museum authorities, were found to contain a tuft of red-brown human hair, apparently infantile. These belonged to the XXth dynasty, while those found by Prof. Peet dated from the Old Kingdom. Further, in the Egypt Exploration Society's account of its excavations in 1921 and 1922, "The City of Akhnenaten," Pt. I., p. 66, it is stated that a common object among the finds was a small ball of mud, sometimes stamped with impressions of signet rings, containing a wisp of hair. In the course of researches among the *Fellahin* of Upper Egypt, Miss Blackman found that it is a custom for boys, both Kopts and Moslem, to undergo a ceremonial shaving of the tufts of hair which it is customary to leave on their shaven heads. This operation is performed either at the tomb of a sheikh, or a church if the boy is a Kopt, and the tufts are dedicated to the sheikh or a saint as the case may be. The ceremony is accompanied by a feast. The hair cut off is always buried outside the tomb or mosque, either loose or enclosed in a clay ball. A small piece of the dress of a devotee is sometimes suspended from cords hanging over the catafalque of a sheikh. The pieces of linen found in the clay balls may represent a similar votive offering.

INDUSTRIAL FATIGUE.—The Harveian Lecture on "Industrial Fatigue," given on April 23 by Dr. C. S. Myers, appears in the *Lancet* of May 2. Dr. Myers reviews the earliest work on fatigue problems, showing that the tests used, whether of efficiency or fatiguability, while interesting in themselves, were chiefly valuable in revealing the complicated nature of fatigue. When an application to industry is required, the theoretical studies of muscular metabolism or of the central nervous system fail to throw light on the output variations of the worker. In recent investigations industrial fatigue has been measured by its direct effects in output. Curves of total output and curves of spoilt work are studied; alterations in the environment are made and the effect of these on the work curve noted. By such means it has been possible to show the effect of improvements in lighting, ventilation, posture, arrangement of time, etc. Diminution in output may result not only from fatigue but also from lack of incentive or boredom or worry. In the majority of cases under present-day conditions, industrial fatigue is not to be reduced by shortening the hours of work but by the avoidance of too long uninterrupted spells of work, by the introduction of rest pauses, by adequate training of the worker, by the abolition of causes of needless resentment, irritation, and worry, etc. Industrial fatigue is too complex, and our knowledge of the physiology of the nervous system too rudimentary, to allow of a definition in physical and chemical terms.

THE VINE IN VICTORIA.—In "Problems of the Viticultural Industry" A. V. Lyon has collected in small compass much information with regard to the Australian industry in the irrigated lands of the Murray Valley of Victoria. The more important scientific and technical aspects are set forth, with the results of the research work carried out during the last four years by various bodies of workers. The processes and problems appertaining to viticulture are dealt with systematically from the establishment of a vineyard onwards, the whole scheme being clearly set out in a detailed table of contents. The points dealt with include the pruning and training of the vine, irrigation, drainage and manuring, fruit drying and the seasonal and routine work in the vineyards. A considerable section of the bulletin is devoted to a survey of the fungus and insect pests of the vine, suggestions for treatment and eradication being made in each case. Black spot (*Manginia ampelina*), downy mildew (*Plasmopara viticola*), and oidium (*Uncinula spiralis*) are the most serious fungus diseases, and phylloxera and the lesser dried fruit-moth (*Plodia interpunctella*) are the two insects that cause most concern in the Australian viticultural industry. The bulletin concludes with a review of various problems of general interest, including increase in production, cost of production, irrigation, plant breeding and selection, and pruning, on all of which further research is desirable, as investigations are not at present proceeding at a rate commensurable with the importance of the industry.

ORIGINS OF UNDERGROUND WATERS.—Volume 28 of the Bulletin of the Adriatic Society of Natural Sciences (Trieste) contains an interesting and very complete account, by Prof. Guido Timeus, of the various physical, chemical, and biological methods which have been suggested for the investigation of the origins, courses, etc., of underground waters. Full details are given of each method, including the fluorescein method of Prof. Timeus himself, and a description is included of a new procedure which, by the dyeing of strands of de-fatted wool, permits of the certain detection of $10^{-7}$ milligram of the colouring matter.

CARBONIFEROUS GONIATITES.—The zonal characters and distribution of the Carboniferous goniatites of the north of England have been worked out in detail by W. S. Bisat (Proc. Yorks. Geol. Soc., 20, Part 1, 1924, p. 40, pls. i-x). In this region goniatites appear first in the upper part of the Lower Carboniferous (Viséan), and continue through the Millstone Grit into the Lower Coal Measures; the main divisions of these beds are characterised by the appearance in succession of the genera Prolecanites, Goniatites (s. str.), Eumorphoceras, Homoceras, Reticuloceras, Gastrioceras. A full account is given of the species found, illustrated by collotype reproductions of photographs.

RADIOACTIVITY AND GEOLOGY.—In the Halley Lecture delivered last year, and now published by the Oxford University Press, Prof. J. Joly has summarised his views on "Radioactivity and the Surface History of the Earth." He shows that if the basaltic layer which forms the ocean floor and underlies the continents is as rich in the radioactive elements as those specimens of it which are available for study, then it must, in the course of some 30 million years, become fused at and below a certain depth. At the present time it is mainly solid, but beneath the continents and under the ocean floor the temperature must be nearly that of liquefaction, so that in time the accumulating radioactive heat will supply the latent heat necessary to change its state. It is supposed that in early Tertiary times widespread liquefaction due to this cause actually occurred. The resulting increase of volume caused the continents to be thrown into a state of tension, while the decreased density of the magma allowed the continents

to sink relatively to the oceans. Tidal forces were meanwhile acting on the crust, causing it to drift to the west in opposition to the direction of the earth's rotation. Specially hot magma from beneath the continents thus came to underlie the oceans to the east, and melting of the ocean floor would then occur until the loss of heat into the ocean itself was sufficiently rapid to bring the process to an end and permit recrystallisation to begin. As solidification would effectively proceed from beneath upwards, the continents would gradually be grounded on a more resistant foundation of newly made rocks and brought to a standstill. The decrease of volume attending this part of the cycle would promote severe compression on the continental margins, and corresponding to the deduction we find the mountains of Eurasia beginning to rise from the Miocene onwards. The latent-heat cycle thus comes to a close at about the present time, leaving the continents at a relatively high level and the interior effectively solid.

VELOCITY OF UPPER AIR.—The Meteorological Office, Air Ministry, gives a discussion of "The measurement of upper air wind velocities by observations of artificial clouds," by Mr. C. D. Stewart, in Prof. Notes, Vol. 3, No. 38 (H.M. Stationery Office. Price 9*d*.). The motion of clouds forms an important part of meteorological work, and the observations are of considerable use for forecasting and other branches of the science. During the War much attention was given to the movement of the upper air in relation to the firing of big guns, but for a time afterwards the observations fell into disuse. The inquiry has now received a fresh impetus, and the present discussion gives details to facilitate the necessary calculations. The principle of the mirror nephoscope is the method used for obtaining velocities of both natural and artificial clouds. For ordinary clouds two horizontal mirrors suitably mounted are used, but for artificial clouds where the height is known, one mirror only is required for the determination of their velocity. The method was originally used for clouds formed by the bursting of shells, but observations have recently been made on clouds liberated from aeroplanes. A tin is filled with stannic chloride, which when mixed with the air forms a dense white cloud. The tin or canister is opened and the liquid is ejected by a simple device which results in the formation of a cloud which lasts for about a quarter of an hour. Observations are believed to be effective to at least the height of 3 miles. The discussion contains diagrams of the Hill mirror and the method of observing.

THE FORCES CONCERNED IN NUCLEAR COLLISIONS.—In their paper in the *Physikalische Zeitschrift* of November 15,. 1924, Drs. H. Pettersson and G. Kirsch mention that they have obtained some evidence which tends to show that, in the case of aluminium, a colliding α-particle may unite with the nucleus of the metallic atom, the collision being inelastic. In a paper in the *Arkiv för Matematik Astronomi och Fysik*, communicated January 14, Dr. Pettersson considers the satellite hypothesis of Rutherford and Chadwick, which supposes that the proton liberated by bombardment with an α-particle existed in the nucleus as a kind of planet, revolving round the core at some distance from the centre. This implies attraction between like electrified particles at very small distances. Dr. Pettersson thinks that it may not be necessary to assume any such reversal of Coulomb's law, either to explain the constitution of the nucleus or the behaviour of the colliding α-particle, and directs attention to the fact that a charged particle, brought very near to the surface of a conducting sphere having a charge of the same sign, is *attracted* by it owing to electrostatic induction. A displacement of the protons and electrons in the nucleus may take place in a similar manner when the α-particle gets very close to it, and the force acting on the α-particle may become attractive. At the same time, the resultant force on a proton at the opposite side of the nucleus due to the other protons, the electrons and the α-particle may become repulsive, and it will leave the atom.

THE FLUORESCENCE OF DYE STUFFS IN CONCENTRATED SOLUTIONS.—It has been shown by Dr. S. J. Wawilow that the fluorescent output of dilute solutions can attain very large absolute values. In the *Zeitschrift für Physik*, March 21, he describes an investigation of the phenomenon observed by Stokes, who found that at high concentrations the fluorescent output was greatly diminished. The distribution curve for the energy of fluorescence was practically unchanged when the concentration was altered, which enabled a simple method of measurement to be used. In the cases examined extinction was observed to commence at a definite concentration $C_0$, proceeding from that point according to an exponential law which holds until the fluorescent output is very small, when it begins to fall off more rapidly. The curves of extinction and of electrical conductivity of the same solution show no parallelism, which is against any electrolytic explanation of extinction. It is explained provisionally by regarding the heavy molecules as subjected to Brownian movements, and supposing that, when two such molecules collide, one of which is excited, the energy of excitation may be transferred to the other molecule as kinetic energy, no radiation being given off. The theory is worked out in some detail.

PURE METHYL ALCOHOL.—The preparation of pure methyl alcohol is described by H. Hartley and H. R. Raikes in the March issue of the Journal of the Chemical Society. The alcohol is dehydrated by fractionating in Hempel columns until its boiling point is constant to within 0·05°. It is then refractionated once more, refluxed with aluminium amalgam (3 gm. per litre), and finally distilled at the rate of two drops a second, the first 50 c.c. and the final quarter being rejected. If required for electrochemical work, the alcohol is further fractionated and distilled over copper sulphate, a tin condenser being used. Alcohol with a conductivity of $0{\cdot}04 \times 10^{-6}$ r.o. was readily obtained in this way. An improved method of determining the water in methyl alcohol is described.

ALKALI-CHLORINE PRODUCTS.—An illustrated article in *Chemistry and Industry* for February 27 and March 6, by D. A. Pritchard and G. E. Gollop, describes the Canadian Salt Company's processes for the manufacture of alkali-chlorine products. Saturated brine is pumped from the wells and purified from magnesium and lime salts by the addition of the calculated quantity of sodium carbonate solution containing a trace of caustic soda, at 85°. The mother liquor is decanted off and fed, at 85°, into electrolytic cells of the Gibbs' type, where it is converted into caustic soda (120 gm. per litre) and chlorine (95 per cent.). The working-up of these products is described in considerable detail. The chlorine is liquefied by the tower system. The gas is passed up through a spray of strong sulphuric acid in a tower; it is then dry enough to be liquefied in iron plant. The manufacture of bleaching powder is also carried out by this company; the methods used, together with recent improvements, are given in full.

## Modern Investigations of Mental Imagery.[1]

By Prof. T. H. PEAR.

IT is necessary to distinguish at the outset between several types of revived experience. First there is the *after-sensation* (sometimes called the after-image), which is probably not revived at all but a persistence of the effect of the original stimulus. In vision this phenomenon is familiar to us as the positive after-sensation which reproduces the colour and brightness of the original stimulus, and the negative after-sensation in which the colour and brightness are complementary to those of the stimulus. Equally well-known phenomena are the memory images proper; those revivals of experience which may occur in the form of visual, auditory and other images; in fact there are probably as many types of such imagery as there are types of sensation.

Intermediate between these is the type of image which is the subject of this paper. In the last century it was described by Fechner and called by him the *memory after-image*. Until recently it has been called either by this name or the *primary memory image*. Only lately, however, has it been specially studied and in rather special circumstances.

These studies have been chiefly carried on at Marburg under the direction of C. R. Jaensch. These researches claim to have found certain unique and hitherto unrecognised characteristics of imagery in children. Some of the work has been repeated and the conclusions carefully checked by G. W. Allport of Cambridge. From his article on "Eidetic Imagery" (*British Journal of Psychology*, 15, 1924, 99-120) much of the present summary has been taken.

The modern investigators call the image which they are describing an "eidetic image." It differs from an ordinary visual memory image in many ways. Most common among these is that while in the case of a visual image a former visual perception is merely imagined, in the eidetic image the original object is actually "seen" projected in space. It can be seen particularly well when the eyes are closed in a dark room.

Results show that approximately 60 per cent. of all children between the ages of 10 and 15 are able to produce eidetic images. During adolescence this ability retreats. There seems, however, a considerable probability that a large number of poets and artists are in this respect "grown-up children." If this be true, it explains several puzzling points in connexion with poets' and artists' description of their own imagery.

Characteristics of the eidetic image may be summarised thus:

It is literally and truly "seen."

Attention when observing it is directed outwards.

It is usually localised against any background and is never entirely unlocalised.

Though possessed of an outer character like a true perception, it is always recognised as a distinctly subjective phenomenon. It differs both from the memory image and the after-image by its extraordinary richness in detail. This richness in detail is much less dependent upon the structuration in its contents. (The structuration is observable in an ordinary memory image, when a detail particularly interesting to the observer, acting as a nucleus, tends to collect around itself characteristics depending upon it.) In the eidetic image details are frequently observed which do not appear to have this dependence upon the observer's interest. Children have reported details with extraordinary fidelity; *e.g.* the length and direction of the lines of shading in a stretch of roadway, details unrelated to any "nucleus" in the original picture.

The eidetic image is unusually persistent and often returns. When it does return its details are often extraordinarily accurate. It may be that the so-called hypnagogic images which appear to many normal people just before falling asleep are of the eidetic type. But apparently the exclusion of borderline and pathological phenomena from this conception of the eidetic image makes it impossible at present to discuss this connexion.

There appears to be little doubt of the importance of the study of this eidetic image both for an understanding of the mentality of the developing individual and for a better comprehension of certain questions connected with literature and art. In the realm of applied art it is not impossible that a knowledge of this type of imagery and its occurrence among adults might be of use in the work of the poster artist. For many posters are seen while the observer is in motion, and their details, therefore, are possibly apprehended after the poster has disappeared from the visual field.

The relation of this work to psychopathology, more particularly to the question of pseudo-hallucinations and the type of mentality subject to them, is of the first importance.

[1] Summary of paper read before the Manchester Literary and Philosophical Society, April 28.

## Periodicity in Weather and Solar Phenomena.[1]

ALMOST any series of numbers when plotted shows indications of more or less regular sequences; meteorological statistics are no exception to this rule. These recurrences can be investigated by some method of periodogram analysis, and the result is a periodicity or cycle. There exist, however, certain mathematical criteria which can be applied to the results, and when this is done, it is found that the greater number of meteorological periodicities either vanish or at least become highly suspect. According to orthodox views, a cycle should remain constant in length; if it breaks down for a time, it should reappear at the correct phase, and meteorological periodicities do not often behave in the orthodox fashion. Even solar periodicities suffer from this defect, the well-known eleven-year sunspot cycle undergoing marked variations in length.

Mr. H. W. Clough attempts to get over the difficulty by considering the wave-length of a periodicity as itself a periodic function. In 1905 he found that the length of the sunspot cycle has a periodicity of about 36 years, the "Brückner cycle"; this 36-year periodicity, however, is itself not constant, its length varying during a longer cycle, estimated at 300 years. He has now investigated a shorter periodicity in sunspots, pressure and temperature, to which various investigators have assigned lengths ranging from 2·5 to 3·5 years, and he finds that it behaves in the same way, its length averaging 2·33 years and varying from 1·5 to 3·5 years according to its position both in the 11-year cycle and in the 36-year cycle. The material which he employs consists of composite series of temperature (1730-1924) and pressure (1743-1924) in

[1] "A Systematically Varying Period with an Average Length of 28 Months in Weather and Solar Phenomena." Washington, *Monthly Weather Review*, vol. 52, 1924, pp. 421-441.

Europe, temperature in the United States from 1780 and sunspots from 1750. From the monthly data, two 12-month means per year were formed, one centred on January 1 and the other on July 1. These means were plotted and the maxima and minima were picked out from the graphs. They were also studied statistically in various ways, and the first conclusion was reached, that there is real evidence for the recurrence of maxima and minima at an average interval of about 2·5 years.

The strongest part of this evidence is provided by the method of correlation, or rather of contingency, since the coefficients are calculated from the signs of the variations only, irrespective of their magnitude. These coefficients are theoretically the same as those calculated by the full method of correlation, but there is a larger possibility of error due to small accidental variations, and it would have been better to have adopted the full method. Each set of data was correlated with the same data 6, 12, 18, etc., months later, and the coefficients showed maxima after 2·5, 5 and 7·5 to 8 years, with intervening minima; this is clear evidence of the existence of a periodicity of about 2·5 years, and is far more convincing than the periods which are derived graphically.

This point being established, the lengths of successive intervals between maxima and between minima were regarded as "observations," and themselves examined for periodicity. It is shown that the average difference between the lengths of successive intervals is significantly less than would be expected on the basis of a chance distribution, indicating a tendency towards grouping, and other statistical evidence to the same effect is found. The lengths of the intervals were accordingly plotted and smooth curves were drawn showing the variations of length with time; these indicated that the intervals between epochs are generally least near the rainfall maxima of the Brückner cycle. The origin of these variable meteorological cycles is sought in solar conditions, especially in a 2·5-year period in the mean latitude of sunspots, which also varies in length according to its position in the eleven-year sunspot cycle and in the Brückner cycle. The author derives this period graphically (though to the present writer the graph is more bewildering than convincing), and he considers that the epochs of sunspot latitude fit in well with those of temperature in the United States.

Prof. C. F. Marvin, in a critical discussion, appears to accept the results as sound, and at first sight they appear to be so. Further consideration shows certain objections, which may or may not be valid. The graphical method leaves a certain amount to the judgment of the investigator, and however conscientiously the work may be carried out, there is always a danger that personal bias will weight the result. The method as adopted is unsound for another reason, since the combination of two simple periods of the same amplitude, treated by Clough's method, may also give the appearance of a single period which varies in length systematically. The second difficulty concerns the validity of the data. Both in Europe and the United States the length of the temperature cycle shows a secular increase from nearly two years to more than 2·5 years. This may be real, but it is what one would expect from a progressive increase in the trustworthiness of the data as the stations became more numerous and the observations better.

The author does not give his original data for Europe and North America, so that his conclusions cannot be checked directly. In a later table he gives epochs of maximum and minimum pressure at Batavia, which indicate a variable cycle with an average length of 2·6 years. C. Braak found a pressure cycle at Batavia which runs its course in three or occasionally four years, resulting in a "periodicity" of slightly more than three years. The present writer investigated the Batavia pressures by ordinary harmonic analysis and by the "difference-periodogram"; both methods gave a periodicity of 3·15 years, and he could find no trace of a 2·6-year cycle. This result throws doubt on the corresponding periods for Europe and North America.

To sum up, we know that there are frequent examples of recurrence in meteorological phenomena which suggest relationship to solar cycles, but when they are submitted to exact mathematical analysis, the results are usually negative. We infer that either the phenomena are not real, or their true nature is complex. H. W. Clough adopts the latter view, but the solution which he puts forward is not very plausible, and he does not go far enough towards proving it. C. E. P. B.

## The Tactile Sensory Reflex.

THE investigation of the physiology of the special senses is fraught with difficulties which do not obtrude themselves to the same extent in the case of the other systems of the body. Whereas in the latter the end result of a stimulus is some objective phenomenon, possibly accompanied by a sensation, in the case of the special senses, the subjective sensation is the main effect produced by the stimulation and the accurate description of his sensations by the subject of an experiment requires both training and intelligence, if fallacies are to be avoided. The method of investigation also is not without importance, and should be capable of producing stimuli of known force if any accurate comparison between the degree of stimulation and the resulting sensation is to be obtained.

The method of investigating the sensation of touch by means of hairs of varying degrees of stiffness, while giving information as to the spots in a given area sensitive to this form of stimulation, is unsatisfactory, since it is difficult to estimate the actual degree of force applied. F. Allen and A. Hollenberg (*Quart. J. Exp. Physiol.*, 1924, vol. 14, p. 351) have applied a method used in investigations on visual and auditory sensations, to the elucidation of further facts relating to the tactile sensation. A blast of air at a known pressure is interrupted by means of a rotating disc with openings in it and the resulting puffs directed upon the area in which the sense of touch is to be examined, *e.g.* the palmar surface of the tip of the forefinger. Just as in the case of light, the puffs of air will be fused into a single sensation at a certain rate, which may be described as the critical frequency of percussion. Experiment has shown that there are *two* fusion points at any given pressure of the air pulsations up to a pressure of about 5·0 cm. of mercury, at which these two points coincide. It is possible that they represent the superficial and deep tactile sensations respectively. The duration of the stimulation at the critical frequency was found to be related to the pressure by the formula $D = -K \log P + C$, where $D$ is the duration of the stimulus, $P$ the pressure, and $K$ and $C$ constants. The minus sign shows that the critical frequency has a higher value, that is, the duration of the stimulus becomes shorter as the pressure rises.

It is of great interest to note that similar expressions relate the duration and intensity of stimulation in the case of both light and sound, when interrupted stimuli are used. The constants are different for the

two fusion points and vary also according to the sensitiveness of the skin: thus a dry skin is less sensitive than one kept moist and supple by a thin film of vaseline. Moreover, although the curves obtained by plotting $D$ against log $P$ are straight lines, they show a change of slope at a certain value of $P$, in an opposite direction in the case of the two fusion points, so that they finally intersect. This change of slope occurs also with visual and auditory sensations. As might be expected, fatigue decreases sensitiveness, raising the value of $D$ for a given $P$.

Perhaps the most important point, however, which emerges from this research is the discovery of the opposite process—an enhancement of the tactile sensation, either by fatigue of an adjacent area, or by very light previous stimulation of the actual area under study; it is seen also in a fatigued area when the fatigue has passed off. The process appears to be a reflex effect through the central nervous system; and its existence gives an explanation of the phenomena of itching and tickling. In the former case, scratching relieves the itching, but adjacent areas become more sensitive and the process is transferred to them: this, together with the subsidence of its own fatigue, causes enhancement of the sensitiveness of the original area, and so a vicious circle is set up; in the latter case, the effect is probably due to an enhancement of sensitiveness by means of a light stimulus: a stronger stimulus fails to arouse it. The critical frequency is highest in the case of the tactile sensation, but the actual energy necessary to stimulate is greatest for this sense, being least in the case of light. Thus the effect produced by any tactile stimulus is the resultant of the two processes, a direct fatigue of the area stimulated and the reflex enhancement of its sensitiveness: the latter is only visible if the stimulus is so light that fatigue does not occur, or if time is allowed for the fatigue produced to pass away.

## The Liming and Chalking of Soils.

THE second of a series of conferences arranged by the Rothamsted Experimental Station was held on Friday, May 22, when the subject discussed was the liming and chalking of land. Prof. H. E. Armstrong, vice-chairman of the Lawes Agricultural Trust, presided over a gathering of about sixty people, including landowners, farmers, county advisors and organisers, and representatives of firms interested in the supply of chalk and lime.

The morning session was occupied with papers by Dr. J. A. Voelcker, Dr. J. A. Hanley and Mr. E. M. Crowther. Dr. Voelcker dealt with his pot and field experiments at Woburn, the results of which indicate that lime exercises more benefit than the equivalent quantity of chalk. (A full account of these experiments will shortly be published in the Report of the Woburn Experimental Farm for 1923–24.) Dr. Hanley described the striking effect of applications of chalk on the acid areas of Yorkshire, and Mr. Crowther explained some of the errors inherent in all laboratory methods designed to measure the "lime-requirement" of acid soils. The principal difficulty is that soil acidity is made up of an "intensity" and a "quantity" factor, which, on the close analogy of ordinary acidity, may be regarded as the expression of the degree of dissociation and total titratable acidity respectively. Lime requirement methods endeavour to express these two factors by a single value, and hence to this extent are imperfect.

The afternoon session, at the suggestion of the chairman, was devoted to a discussion of the present economic position of liming and chalking, as the urgent need for this operation on large areas of land is obvious. Col. Fenwick gave an account of the cost of preparing lime from chalk available on his estate; this works out at 10s. per ton exclusive of interest on capital expended in building the kilns. The operation is economically possible for a large farm where chalk is obtainable on the site and ordinary farm labour available. Mr. Dampier Whetham alluded to the lasting effect of chalking and pointed out that the relative merits of lime and chalk should be carefully considered before any extensive national developments are planned, in order to decide whether available capital should be used for erecting lime-kilns or chalk-grinding mills. This point was also emphasised by later speakers. Mr. Garner, of the Hertfordshire Farm Institute, said that in the case of the large areas of land dangerously near the border line of acidity, he recommended one ton of lime per acre once in a rotation. The cost of this spread over four or five years is not serious. Some discussion arose as to the best time in the rotation for application of lime, and although there were individual preferences, it appeared that any crop was suitable with the obvious exception of potatoes.

Sir John Russell, in winding up the discussion, suggested that the immediate problems were: (1) to decide between the relative merits of lime and chalk; (2) to prepare a survey of areas needing treatment; (3) to supplement the geological maps by a survey of the relative accessibility of known deposits; (4) to decide what percentage of magnesium could be safely allowed in the deposits of magnesium limestone should these be used. The conference expressed its approval of these suggestions and was unanimously of opinion that this urgent problem of soil acidity should be dealt with on a national basis, and that some form of loan or financial assistance to farmers is imperative if remedial measures are to be carried out under present economic conditions.

## University and Educational Intelligence.

CAMBRIDGE.—Mrs. Marshall has offered to the University, towards the expenses of the Marshall Library in Economics, the sum of 250*l.* annually during her lifetime, the profits from the sale of the "Memorials of Alfred Marshall," which is about to be published, and a further sum dependent upon the profits from the sale of her husband's books.

The director of the Rockefeller Foundation has written an important letter to the University, giving to the University freedom to modify the plans with regard to the school of pathology which the Foundation recently endowed, should changed conditions or subsequent experience prove the modifications to be desirable. The terms in which this wise provision is made are worth recording; a clause is added to the deed of gift: "with the understanding that the University will in good faith give a full and complete trial over a period of years to its plan for which these funds are contributed but will not be obligated to continue in perpetuity any particular type of organisation or method of instruction."

The Vice-Chancellor announces the resignation on December 31 next of Dr. J. N. Keynes, Pembroke College, from the office of Registrary of the University.

Mr. V. C. Robinson, Gonville and Caius College, has been appointed assistant to the Superintendent of the Museum of Zoology.

The Goldsmith's Company has announced that it is prepared to offer certain senior studentships to the total value of 750*l.* a year for post-graduate study.

EDINBURGH.—At the meeting of the University Court on Monday, May 18, the resignation was

intimated of Mr. William McClelland, lecturer in education, as from September 30, on his appointment to the joint post of professor of education in the University of St. Andrews and director of studies at the St. Andrews and Dundee Training Centre.

Major W. S. Patton, lecturer in zoology (entomology and parasitology), was granted leave of absence until October 1, 1926, in order to take charge, at the request of the Royal Society, of an investigation into kala azar in North China, in conjunction with Dr. Edward Hindle.

Mr. K. P. Brown was appointed lecturer in clinical surgery and Dr. G. Buchanan lecturer in bacteriology.

LONDON.—Dr. E. C. Dodds has been appointed to the University chair of biochemistry tenable at Middlesex Hospital Medical School. Dr. Dodds studied at Middlesex Hospital Medical School and in 1918 was appointed demonstrator in physiology. In 1920 he was appointed assistant in the Bland-Sutton Institute of Pathology, and since 1921 he has been lecturer in biochemistry in the Institute. He obtained the B.Sc. degree by research in physiology in 1922, and his doctorate in 1925. He has published numerous papers, either independently or in collaboration with others, in *Jour. Physiol.*, 1921–24; *Jour. Exp. Path.*, 1921–24; *Lancet*, 1921–25; *B.M.J.*, 1922–24, etc.

The title of emeritus professor of bacteriology in the University has been conferred on Prof. Richard T. Hewlett as from August 1 next, on his retirement from the University chair of bacteriology in consequence of the closing of the Department of Bacteriology and Public Health at King's College. The resignation of Sir Halford Mackinder, University professor of geography at the London School of Economics, as from July 31, is announced.

Birkbeck College will be recognised as a School of the University in the Faculties of Arts and Science for evening and part-time students, for a further period of five years, as from October 1 next.

The following doctorates have been conferred: D.Sc. (*Chemistry*): Mr. R. W. West (Imperial College—Royal College of Science), for a thesis entitled "The Effect of Substituents on the Ease of Formation of, and on the Reactivity of the Bromine Atom in, Halogenated Malonyl Derivatives"; Mr. Thomas Iredale (University College), for a thesis entitled "Adsorption from the Gas Phase at a Liquid-gas Interface, with special reference to the Adsorption of Vapours on a Mercury Surface"; and Mr. W. G. Palmer, for a thesis entitled "The Catalytic Activity of Copper," and other papers, together with two subsidiary contributions. D.Sc. (*Physiology*): Mr. B. Babkin (University College), for a thesis entitled (*a*) "The Influence of the Blood Supply on the Pancreatic Secretion"; (*b*) "Note on Reflex Hyperglycæmia." D.Sc. (*Veterinary Pathology*): Mr. A. L. Sheather, for a thesis entitled "The Diagnosis of Bovine Mastitis by Milk Examination," together with eight subsidiary contributions. D.Sc. (*Geography*): Mr. C. B. Fawcett, for a thesis entitled "Provinces of England," together with nineteen subsidiary contributions.

Free public lectures on "Geodesy" will be delivered by Mr. A. R. Hinks at Bedford College for Women, on June 3 and 5, at 5.15. No tickets will be required.

MANCHESTER.—The Senate has authorised the conferment of the degree of Doctor of Science upon Mr. Maurice Copisavow, Mr. Fred Fairbrother, Mr. Edwin Leonard Gill.

OXFORD.—On May 20 the annual Romanes Lecture was delivered by Sir William Bragg. The large audience present listened with appreciation to the lecturer's lucid exposition of the crystalline state, and followed with keen attention his demonstration, by means of lantern slides and other illustrations, of the way in which the use of the X-rays enables the constitution of the atoms and molecules of which crystals are built up, to become recognisable by our ordinary senses.

---

PROF. H. WIELAND, of Freiburg-im-Baden, has been invited to succeed Prof. Willstätter in the chair of chemistry at the University of Munich.

PROF. K. FAJANS, of the University of Munich, has been invited to become professor and director of the Institute of Physical Chemistry in the University of Freiburg in succession to Prof. G. Meyer. Prof. Fajans has also been nominated a corresponding member of the Russian Academy of Science.

APPLICATIONS are invited by the Ministry of Agriculture and Fisheries for research scholarships, not exceeding seven in number, in agricultural and veterinary science. The scholarships will each be of the annual value of 200*l.* and tenable for three years. Applications must be received not later than June 30 on form 900/T.G., obtainable from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1.

THE Empire Cotton Growing Corporation proposes to award in July a number of studentships in relation to cotton growing, namely, research studentships and advanced study studentships, each of the value of 250*l.*, plus travelling expenses. Application forms may be had from the Secretary of the Corporation, Millbank House, 2 Wood Street, Millbank, S.W.1. They must be returned by, at latest, June 22.

AN award of Ramsay Memorial Fellowships for research in chemistry will be made at the end of June. One Fellowship of the value of 300*l.*, open to graduates of all British universities, and one Fellowship of the same value for Glasgow graduates are offered. Forms of application, which can be obtained from Dr. Walter Seton, secretary of the Ramsay Memorial Fellowship Trust, University College, Gower Street, London, W.C.1, must be returned not later than June 6.

THE feeling of the need for a university in the south of England was again to the fore at a meeting, held on Friday, May 22, at the Guildhall, Winchester, and addressed by Mr. Austen Chamberlain, M.P., on behalf of University College, Southampton. For the College to become of university rank a sum of 500,000*l.* is necessary, and the meeting was for the purpose of opening a campaign to raise this sum. In the opinion of Dr. C. G. Montefiore, president of the College, its present 400 full-time students could readily be made 800 so soon as its status is raised. The title suggested for the proposed new university is "The University for Wessex."

THE Society of Merchant Venturers offers for competition fifteen scholarships tenable in the day classes of the Faculty of Engineering of the University of Bristol, which is provided and maintained in the Merchant Venturers' Technical College. Candidates must be not less than 17 years of age and must have matriculated. Ten of the scholarships are restricted to the sons of officers in His Majesty's service who were killed in the War, while one is restricted to a son of a citizen of Bethune who has passed either the B.-és-L. or the B-és-Sc. examination. A War Memorial Scholarship is also offered with a preference to a candidate who is the son of a former student who lost his life while serving with the forces during the War. Further particulars can be obtained from the Registrar of the Merchant Venturers' Technical College.

## Early Science at Oxford.

**May 31, 1687.** Mr. Caswel gave in a Table shewing ye difference between Kirching his Ephemeris and ye London Latin Ephemeris for ye present year 1687. Dr. Lister's Book *de cochleis Exoticis* was presented to the Society.

**June 1, 1686.** A letter from Mr. Flavel, a Physician in Newberry, to Mr. Anderton, was read: wherein he affirms that opening a great dog, before he was quite dead, in one of his kidneys he found a *worm* 16 inches long, and an inch in girth.

**June 2, 1685.** A Letter (dated May 28th) from Mr. Aston S.R.S. brought newes, that the Councill of ye Royall Society has lately made an order, that such Persons, as are of the Oxford or Dublin Society, and likewise of ye Royall Society, in consideration of the charges they are at in ye places, where they reside, for carrying on the common work (ye discovery of Naturall Science) shall be excused half their weekly payments to the Royall Society, and be accountable to their Secretary only for £1 6*s*. per annum. Which order shews such generous and reall encouragement for the advancement of Learning, that this Society, considering that many of their Members may enjoy the Benefit of it, think themselves very much obliged by it, and accordingly order'd their Secretary to returne their humble thankes to the Royal Society for it.

A Letter from Mr. Cole, dated Bristoll May 21. tells us, that the best time to see the severall colours afforded by the Purple-fish with the help of ye Sun is by drying the ting'd cloth in a Morning Sun.

An account of a piece of Watch-work by Mr. Samuel Watson of Coventry was communicated and read, it is a *Moving Ephemeris*.

**June 3, 1684.** Mr. Bernard, and some others of ye Society, gave an account that on ye 27th of May last in ye evening, they tried to discover ye *Spot* in ye *Sun*, which Mr. Flamsteed had observed a month before, and which he conjectured would continue during a second revolution of the Sun; but they could discern nothing, tho they made use of a good telescope, 15 foot long, and ye air was clear.

A letter from Mr. Wheeler was read, concerning ye description of a *watch*, invented by him, that may be so fram'd, as to move upon a declivity without any spring, or any other weight, then what is included in ye body of ye watch; wherein he also fully, and learnedly, shewed ye reason of its motion, and ye manner how it should be pois'd.

Dr. Plott then producd a peice of *Natrôn*, or Nitre, found on ye top of a lake in Ægypt, which he observed ye last year to yeild, and melt near ye time of ye riseing of ye Nile. He said it did not grow moist in ye thaw, nor all ye winter, but it began to relent three or four dayes agoe, and ye paper it was put in, was now moistened all over; He promised to observe its increase, or decrease of weight, and to give an account of it. Afterwards Dr. Plott read a discourse concerning *Vines*, observing that after ye late great *frost* ye Vines bearing *white* grapes have suffered much more, than those that bear *red*; and consequently seem more tender, especially the white *Muscadine*, which are (some of them) quite dead, but ye *Frontinjer*, *Burlake*, and *Rhenish*, not so; these springing again fresh from ye root, though all ye old branches are dead. and yet none of these have escaped so well as ye red, whose Branches are not dead above half way down but even amongst ye red grapes too, there is a difference.

**1690.** Sir George Mackenzy observ'd that ye highest, and coldest hills in Scotland had ye greatest quantitys of Shelly Concretions.

## Societies and Academies.

LONDON.

**Royal Society**, May 21.—W. E. **Curtis** and R. G. **Long**: The structure of the band spectrum of helium. III. The doublet bands. New data extend the main series to the eighth member. Previous difficulties of interpretation are overcome by employing a non-integral quantum number $(m - \epsilon)$. For the earlier bands $\epsilon$ comes out $\pm\frac{1}{4}$ within the limits of error, but it departs from this value for the higher members of the series, except in the case of the Q branches, where it remains constant at $\frac{1}{4}$. The bands are capable of very accurate representation by the addition of a term $\beta\,(m - \epsilon)^4$ to the usual parabolic formula, and this leads to new and much more accurate values of the molecular moments of inertia and separation of the nuclei. This information, in conjunction with deductions concerning the electron orbits, affords support to Lenz's suggestion that the structure of the helium molecule may be related to that of the hydrogen molecule. The results of the analysis of the second series of doublets are closely similar to those obtained from the main series. The two series seem to originate from the same molecule, but a different radiating electron.—G. S. **Adair**: (1) A critical study of the direct method of measuring the osmotic pressure of proteins. In certain solvents the osmometric observations on hæmoglobin satisfy the three criteria—permanence, reversibility, and reproducibility; therefore they may be regarded as true osmotic pressures. Readings remained constant within 6 per cent. for nine weeks, and no products of protein breakdown could be detected in the outer liquids. With rigorous control of conditions and with adequate criteria for equilibrium, the osmometer method proved thoroughly trustworthy; and when certain corrections were applied it proved capable of giving results accurate to 0·1 mm. of mercury, which corresponds to about one hundred thousandth of a degree in depression of the freezing point. (2) The osmotic pressure of hæmoglobin and the absence of salts. In the theory of hæmoglobin solutions previously accepted, the molecular weight of pure hæmoglobin is supposed to be equal to the equivalent 16,700, and it was supposed that traces of salts caused aggregations. Pressures corresponding to the theory were obtained only in the presence of ionising impurities, and it is suggested that the so-called aggregation changes are better explained by the theory that the observed pressure is the sum of the hæmoglobin partial pressure and the partial pressure of undialysed impurities.—J. W. **Fisher**: Some further experiments on the gyromagnetic effect. It was sought to detect a gyromagnetic effect by magnetising a substance (in most cases magnetite) by a rotating magnetic field and looking for a component of magnetisation in a direction perpendicular to the plane of rotation of the field; such a component would be expected to arise if a rotation of the magnetic axes of the molecules is set up by the rotating field. Fields rotating at frequencies of 2 to $5 \times 10^4$ cycles per second gave no evidence of an effect of this kind even for rotating fields of more than 100 gauss.—G. A. **Elliott** and I. **Masson**: Thermal separation in gaseous mixtures. Equilibrium thermal separations have been measured, with nearly constant temperature difference approaching 500° C., for mixtures of hydrogen, helium, and carbon dioxide, taken two at a time and in varying proportions. The results obtained are unexpectedly high. In each case the constituent of higher molecular weight becomes more concentrated in the cold part of the mixture. The greatest separation was obtained from mixtures such that the cold side contained about 55 per cent. of

hydrogen in hydrogen-carbon dioxide, about 60 per cent. of helium in helium-carbon dioxide, and about 60-55 per cent. of helium in hydrogen-helium mixtures. The displacement seems to be specific for helium, whether it is the lighter gas of the pair or not. The separations observed may be attributed almost entirely to mutual intermolecular actions, and not appreciably to differences in the individual thermal expansibilities of the constituents of the gas mixtures.—O. W. **Richardson**: Structure in the secondary hydrogen spectrum. The paper deals with 10 lines of this spectrum previously classified by Richardson and Tanaka as $52P(m)$. These, together with 24 additional lines, are now rearranged as two new $P$ series, two new $Q$ series, two new $R$ series and a fragment each of a $P$ and $Q$ series. The $P$ and $R$ series have a superficial resemblance to a doublet band. The seven series show four sets of intercombinations. There are abnormalities which show a curious similarity throughout the different sets of term numbers.—C. N. **Hinshelwood** and C. R. **Prichard**: The catalytic decomposition of nitrous oxide on the surface of gold. At 834°-990° C. the surface reaction is unimolecular and is unretarded by oxygen. The gold provides a temporary abode for oxygen atoms, so that the reaction $2N_2O = 2N_2 + O_2$ can resolve itself into

$$N_2O = N_2 + O,$$
$$O + O = O_2.$$

Probably every molecule of nitrous oxide which strikes the gold wire with a kinetic energy greater than 30,000 calories per gram-molecule gives up its oxygen atom.—E. H. **Callow**: The velocity of ice crystallisation through supercooled gelatin gels. With "ash-free" gelatin, increase in concentration of gelatin causes decrease in velocity of crystallisation. Such decreases are considerable for concentrations above 1 per cent. (above 2 per cent. at $P_H$ 4·75), *e.g.* at $P_H$ 1·50 the velocity through a 1 per cent. gel is 960 cm./hr. (about half the velocity through distilled water), and that through a 1·5 per cent. gel is only 40 cm./hr. When the hydrogen-ion concentration is varied by means of hydrochloric acid, the velocity is a minimum near the iso-electric point of gelatin and a maximum about $P_H$ 2·6. Sodium hydroxide increases the velocity. Neutral salt causes a slight increase in velocity of crystallisation through gelatin-water gels, but when sodium chloride is added to gelatin-chloride gels there is a marked decrease in velocity.—R. C. **Johnson**: Further spectra associated with carbon. The effect of helium on carbon spectra has been investigated in the ultra-violet region. The comet-tail spectrum and a new line spectrum of carbon have been completely measured. The new lines probably constitute the true "arc" spectrum of carbon. No series relationships have, however, been identified. A new band spectrum associated with the comet-tail bands has also been measured and disposed in series. Under the conditions in which the above spectra were produced in helium, the negative band spectrum of carbon was developed with great strength.—W. **Sucksmith**: The gyromagnetic ratio for magnetite and cobalt.—Ian **Sandeman**: The secondary spectrum of hydrogen at higher pressures. With the aid of the arc spectrum a band has been selected with head at 4582·58 Å.U. and shading towards the violet. The value of the initial moment of inertia of the molecule emitting the band, when calculated by the aid of the formula of Kramers and Pauli, comes out as $19{\cdot}326 \times 10^{-41}$ gm. (cm.)$^2$, agreeing with the value predicted by a static model of triatomic hydrogen, $H_3$. The lines of the $P$, $Q$, and $R$ combination discovered by Richardson and Tanaka are also present in the same condition of the arc, and the intensity distribution found for them agrees with that found for the new band.

**Mineralogical Society**, March 17.—S. **Tomkeieff**: The structure of aragonite. A new method of etched figures which can be used for the estimation of crystal structure is described. A structure of aragonite, constructed in such a way that the transformation into calcite can be attained with a small expenditure of energy, has been tested by this method. For six of the eight faces examined the spacings are the same as those observed by Sir William Bragg, but the remaining two give only half of the spacings observed. This anomaly is explained by the hypothesis that aragonite in its natural occurrence has undergone a partial transformation into calcite. The structure proposed is unable to explain the intensities of X-ray spectra. Aragonite is considered to be pseudo-orthorhombic.—I. E. **Knaggs**: Crystalline structure of penta-erythritol tetranitrate. From X-ray examination, the dimensions of the ditetragonal bipyramidal unit cell are $a = b = 13{\cdot}2$ Å.U., $c = 6{\cdot}66$ Å.U., and it contains four molecules, each possessing fourfold symmetry. The crystals are built on the Bravais lattice $\Gamma_1$ and belong to the space-group $D_{4h}^7$. A structure is proposed in which the molecules have a digonal axis with two planes of symmetry parallel to (100) intersecting in it. There is a considerable departure from the tetrahedral angle of the bonds from the central carbon atom of the molecules. The strain caused thereby, together with the comparative proximity of eight oxygen atoms at intervals in the structure, may contribute to the explosive nature of the compound. The configuration of the nitro-group ($-NO_2$) is in favour of the oxygen atoms being equivalent.—E. D. **Mountain**: Potash-oligoclase from Mt. Erebus, South Victoria Land, and anorthoclase from Mt. Kenya, East Africa. Felspar crystals of two types, occurring in the tuffs of Mt. Erebus, have a chemical composition intermediate between anorthoclase and andesine and are referred to potash-oligoclase, being identical with certain rhomb-porphyry phenocrysts. Similar crystals from Mt. Kenya and Kilima-njaro contain less lime. A complete series of felspars exists between anorthoclase and andesine having continuously varying properties and mostly of porphyritic occurrence. This necessitates a slight modification in the definition of kenyte, but the limits of the type must depend upon the natural series rather than upon any chemical distinction.—A. **Brammall**: Further notes on the association of lime with other oxides of RO-type in minerals. Volume-relationships accentuate the differences in chemical behaviour between lime on one hand and magnesia, ferrous oxide, and manganese oxide on the other, and partly control those early molecular associations which promote differentiation in the fluid magma. Particular cases of differentiation in the Dartmoor granite furnish features analogous with those of the anorthosite-peridotite schism, and suggest also that a high concentration of ferrous oxide and magnesia promotes the early separation of orthoclase as phenocrysts, and the zoning of the ground-mass plagioclase.—G. **Greenwood**: Crystallographic data of some new organic compounds.

**Royal Anthropological Institute** and the **Prehistoric Society of East Anglia** (Joint Meeting), April 21.—Mr. Henry **Balfour**: The status of the Tasmanians among Stone Age peoples. The Tasmanians are probably the only people of whom it can be said with confidence that they remained into quite recent times (to the middle of the last century) in an arrested culture-phase which may be described as strictly palæolithic. A decided similarity can be indicated between the form and technique of many Tasmanian implements and certain characteristic implements of the Mousterian series. Many of the

types of implements which are particularly characteristic of the Aurignacian culture-horizon are well and abundantly represented in the Tasmanian series. One of the types, which is particularly associated with the Aurignacian division, *i.e.* the "grattoir à museau" of French archæologists, is by far the most abundant of the Tasmanian tools, and it is very significant that the implements within this category exhibit very commonly a flaking technique—a very delicate parallel flaking—which is identical with that which has been specially named "la retouche aurignacienne." The characteristic, more specialised implements of Tasmania, then, suggest a dual analogy—Mousterian and Aurignacian—and if we evaluate the status of this culture in accordance with the highest achievements, we must base our estimate chiefly upon the Aurignacian analogy and promote the Tasmanians to a culture level comparable with that of early late-Palæolithic man. The resemblance is only partial, since several important elements in the culture of Aurignaciar man are missing from that of the Tasmanians.—Nina F. **Layard**: Recent excavations at the neolithic site of Sainte-Gertrude, Holland. Excavations were carried out in October last at the neolithic station of Sainte-Gertrude, Holland, undertaken by the kind permission of M. le Comte René de Geloes, and under the auspices of the Trustees of the Percy Sladen Research Fund. Points of special interest which were observed were the following: Division of labour, suggested by the finding of ateliers specially devoted to the turning out of one type of implement—thus a profusion of picks on one spot, axes on another, and cores found in abundance on a third; the extraordinary number of implements argues either a long occupation or a large number of settlers; the working places were not the living places; the equipment of the miner included picks, axes and racloirs; habits of economy are very noticeable—witness the number of refashioned tools. A comparison of the various implements found at Sainte-Gertrude, with those from Cissbury, Grimes' Graves, and other neolithic mining stations, may help in the dating of these English sites.

## MANCHESTER.

**Literary and Philosophical Society**, March 31.—G. H. **Carpenter**: Collembola from southern New Zealand. There are species of the widespread genera Pseudachorutes from Mount Algidus, as well as of Paronella which had previously been known across the eastern tropics from West Africa to Queensland. But the most important discoveries are a species of Cryptopygus at Ben More, Canterbury, and two species of Lepidophorella. The former had previously been known from Graham Land and the South Orkneys; the latter from Chile and Patagonia. Their presence in New Zealand and its outlier is most suggestive for comparison with distributional facts derived from the study of other groups which indicate ancient extensions of antarctic and sub-antarctic lands.—F. E. **Weiss**: On the structure of the leaves of the graft-hybrids, *Cratægo-mespilus Asniersii* and *Cratægo-mespilus Dardari*. It has been a common practice on the continent to graft the medlar (*Mespilus germanica*) on the stem of the hawthorn (*Cratægus monogyna*). In several instances shoots have been produced from near the region of the graft which partook of the nature of both stock and scion. These have been termed graft-hybrids. In the leaves of the two forms discussed, in the former the epidermal cells of the upper surface of the leaves are in surface view small and more or less straight-walled like those of the hawthorn, and not large and sinuous as in the medlar. The resemblance to the hawthorn may be due to the fact that the leaf is in shape and size more like that of the hawthorn than the medlar. The leaves of *Cratægo-mespilus Dardari*, which are in shape more like those of the medlar though smaller in size, have epidermal cells, intermediate in shape and size between those of the medlar and hawthorn. If these graft-hybrids are periclinal chimæras, their epidermal cells have in the leaves at all events been modified to a great extent by the underlying tissues, with which they are no doubt organically connected by protoplasmic threads.

## PARIS.

**Academy of Sciences**, April 20.—Le **Prieur**: With the De Goys expedition from Paris to Gao. An account of the results obtained with the author's apparatus (which automatically records the path taken by an aeroplane), in two air voyages between Paris and Gao, a distance of 4000 kilometres.—Bertrand **Gambier**: The surfaces of translation of Sophus Lie.—A. **Lafay**: A means of modifying the wake of a cylinder moving in a fluid.—B. **Hostinsky**: The theory of magnetism in movement by Poisson.—F. **Baldet**: The influence of pressure on the band spectra of carbon in the thermo-electronic bulb. Consequences for the theory of comets. It is shown that the pressure plays an essential part in the existence of the different groups of carbon bands.—Arvid **Leide**: Researches on the *K* series of the X-rays. The table given shows the results of the measurements in the zone 29Cu-53I.—A. **Maubert**, L. **Jaloustre**, and P. **Lemay**: The influence of radium on the catalase of the liver. As with the bromide of thorium-X, radium in strong doses paralyses while in weak doses it activates the catalase. Radium emanation acts similarly, at least with small doses. The only difference observed between the effects of radium and thorium-X is that the $\beta$ and $\gamma$ rays of radium reduce the activity of catalase, an effect not observed in the earlier experiments with thorium-X.—Mlle. **Germaine Cauquil**: The thermochemical study of the sodium derivatives of cyclohexanol.—Marcel **Frèrejacque**: The structure of the phenylhydrazones of glucose.—Henry **Derville**: The facies of the carboniferous limestone in the Boulonnais.—E. F. **Gautier** and J. **Savornin**: The red layers of Ouaouizert (Central Morocco).—Pierre Le **Conte**: The regime of the waters of the Channel and the transformation into heat of a fraction of the energy of the tidal currents.—M. **Bridel** and C. **Charaux**: The products of the ferment hydrolysis of rhamnicoside: primeverose and rhamnicogenol. The hydrolysis of rhamnicoside by a ferment produces primeverose and rhamnicogenol in accordance with the equation

$$C_{26}H_{30}O_{15}+H_2O=C_{11}H_{20}O_{10}+C_{15}H_{12}O_6.$$

Rhamnicogenol is a derivative of methylanthranol.—René **Jeannel**: Apterism in insular insects. The study of Trachinæ in various localities shows only one example which might be interpreted as a case of apterism produced by isolation in an island; this is *T. quadristriatus* in the island of Elba. Other examples from Madeira, the Canaries, Corsica, and Sardinia prove, on the contrary, that the fact of living on an island has no effect in producing disappearance of the wings.—Edouard **Chatton** and Mme. **Chatton**: The action of external factors on the Infusoria. The determinism of the formation of chains in Colfidium.—F. **Diénert**: The purification of water.

## Official Publications Received.

The Institution of Civil Engineers. Engineering Abstracts prepared from the Current Periodical Literature of Engineering and Applied Science published outside the United Kingdom. Supplement to the Minutes of Proceedings of the Institution. Edited by W. F. Spear. New Series, No. 22, January. Pp. 234. (London: Institution of Civil Engineers.)

Proceedings of the Royal Society of Edinburgh, Session 1924–1925. Vol. 45, Part 1, No. 7: An Investigation of the Absorption of Superposed X-radiations. By Wm. H. Watson. Pp. 48-58. 1s. Vol. 45, Part 1, No. 8: The Stability of Suspensions. (1): The Rate of Sedimentation of Kaolin Suspensions by Salts at varying Hydrogen Ion Concentrations. By William Ogilvy Kermack and William Turner Horace Williamson. Pp. 59-70. 1s. Vol. 45, Part 1, No. 9: The Influence of Gelatin on the Stability of a Colloidal Solution of Cholesterol, and on the Charge on the Particles. By William Ogilvy Kermack and Peter MacCallum. Pp. 71-89. 1s. 6d. Vol. 45, Part 1, No. 10: The Action of Salts with Multivalent Cations on Colloidal Solutions of Gold and Gum Benzoin. By William Ogilvy Kermack and Cecil Innes Bothwell Voge. Pp. 90-101. 1s. (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.)

Ministry of Health: Advisory Committee on Water. Report on Measures for the Protection of Underground Water. Pp. 19. (London: H.M. Stationery Office.) 2d. net.

The Physical Society of London. Proceedings, Vol. 37, Part 3, April 15. Pp. 101-194. (London: Fleetway Press, Ltd.) 6s. net.

Proceedings of the Cambridge Philosophical Society. Biological Sciences. Vol. 1, No. 4, April. Pp. 219-277. (Cambridge: At the University Press.) 12s. 6d. net.

Aeronautical Research Committee. Reports and Memoranda. No. 934 (Ae. 155): Wind Channel Tests on Radiators. By R. G. Harris and W. K. Alford. Pp. 16+5 plates. 1s. net. No. 942 (Ae. 162): The Royal Aircraft Establishment Control Movement Recorder, Mark III. By D. A. Jones and H. L. Stevens. Pp. 3+3 plates. 6d. net. No. 943 (Ae. 163): Tests of three Aerofoils suitable for High Speed; A.D. 1, Sloane, and R.A.F. 26. By F. B. Bradfield and A. S. Hartshorn. Pp. 6+6 plates. 6d. net. No. 944 (Ae. 164): Measurement of Pitching Moments due to Roll on Wings of Avro 504.K. By F. B. Bradfield. Pp. 6+2 plates. 4d. net. No. 945 (Ae. 165): Lift and Drag of Junker Monoplane; Comparison of Model with full scale Results. By B. D. Clark, L. P. Coombes, H. Glauert and A. S. Hartshorn. Pp. 10+10 plates. 9d. net. No. 946 (Ae. 166): The Theory of the Design of Aerofoils, with an Analysis of the Experimental Results for the Aerofoils R.A.F. 25, 26, 30 to 33. By H. Glauert. Pp. 7+3 plates. 6d. net. No. 948 (Ae. 168): An Experimental Investigation into the Properties of certain Framed Structures having Redundant Bracing Members. By Prof. A. J. Sutton Pippard. Pp. 25+6 plates. 1s. 3d. net. (London: H.M. Stationery Office.)

The Volcanic Activity and Hot Springs of Lassen Peak. By Arthur L. Day and E. T. Allen. (Publication No. 360.) Pp. viii+190+14 plates. (Washington: Carnegie Institution.)

Rhodesia Museum, Bulawayo. Twenty-third Annual Report, 1924. Pp. 12. (Bulawayo.)

Field Museum of Natural History. Report Series, Vol. 6, No. 4: Annual Report of the Director to the Board of Trustees for the Year 1924. (Publication 227.) Pp. 265-383+plates 47-62. (Chicago.)

Ministry of Agriculture, Egypt: Technical and Scientific Service (Botanical Section). Bulletin No. 55: Ratoon Cotton in Egypt; a Preliminary Note. By James Templeton. Pp. iii + 14+1 plate. (Cairo: Government Publications Office.) 5 P.T.

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 17: American School Buildings. By Fletcher B. Dresslar. Pp. ix+100 +45 plates. (Washington: Government Printing Office.) 45 cents.

Experimental Researches and Reports published by the Department of Glass Technology, the University, Sheffield. Vol. 7, 1924. Pp. iii+175. (Sheffield.)

The Institute of Physics. Report of the Board for the Year 1924. Pp. 15. (London.)

Bergens Museum, 1925: en historisk fremstilling redigert av professorkollegiet. Pp. 528. (Bergen.)

Nauka Polska: jej Potrzeby, Organizacja i Rozwój. Tom 5. Pp. vi+553. (Warszawa: Im. Mianowskiego.)

La science polonaise: ses besoins, son organisation et ses progrès. Résumé français des articles parus dans le volume 5. Pp. 36. (Varsovie: J. Mianowski.)

Proceedings of the Royal Irish Academy. Vol. 37, Section A, No. 1: The Equilibrium of Ionisation in the Atmosphere. By Prof. J. J. Nolan, R. K. Boylan and G. P. de Sachy. Pp. 12. 1s. Vol. 37, Section B, Nos. 4, 5: The $\alpha\alpha$ and $\alpha\gamma$ Isomerides of 2·4·6·3′·4′-Pentamethoxy Diphenyl Propane, by J. J. Drumm, Norah G. J. O'Reilly and Prof. Hugh Ryan; The Condensation of Aldehydes with Methylethylketone, by Prof. Hugh Ryan and John J. Lennon. Pp. 19-36. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Bulletin of the American Museum of Natural History. Vol. 51, Art. 9: A Revision of the Mesozoic Crocodilia of North America. By Charles C. Mook. Pp. 319-432+plates 4-5. (New York.)

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 6, Memoir No. 4: Upper Carboniferous Fossils from Chitral and the Pamirs. By Dr. F. R. Cowper Reed. Pp. viii+134+10 plates. 9.13 rupees; 15s. 3d. New Series, Vol. 8, Memoir No. 2: The Anthracotheriidæ of the Dera Bugti Deposits in Baluchistan. By C. Forster Cooper. Pp. iv+60+7 plates. 4 rupees; 6s. 4d. (Calcutta: Government of India Central Publication Branch.)

Memoirs of the Geological Survey of India. Vol. 48, Part 2: The Geology of parts of the Persian Provinces of Fars, Kirman and Laristan. By Dr. Guy E. Pilgrim. Pp. vi+116+plates 11-16. (Calcutta: Government of India Central Publication Branch.) 3.12 rupees; 6s. 3d.

Survey of India. General Report for 1923–24, from 1st October 1923 to 30th September 1924. Prepared under the Direction of Col. E. A. Tandy. Pp. vii+66+ii+7 maps. (Calcutta.) 2 rupees; 3s. 6d.

Canada. The Dominion Fuel Board in co-operation with the Geological Survey, Department of Mines. Smoky River Coal Field: Examination and Comparison with the Kananaskis Area. By James McEvoy. Pp. x+19+5 plates. (Ottawa: F. A. Acland.)

Canada. Department of Mines: Geological Survey. Bulletin No. 39: Colour Printing of Geological Maps. By C.-O. Senécal. (Geological Series No. 44.) Pp. iv+4 plates. (Ottawa: F. A. Acland.)

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending 31st December 1924. Pp. 23. (Kirstenbosch.)

## Diary of Societies.

*SATURDAY*, MAY 30.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at King's College), at 10 A.M.—R. Chambers and P. Reznikoff: Studies on the Plasma Membrane and Physical State of Protoplasm by Micro-dissection and Micro-injection. —C. Shearer: Child's Hypothesis.—J. S. Huxley: Some Problems of Differential Growth.—Dr. W. H. Pearsall: Rates of Growth and Plant Form.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. Dr. E. M. Walker: Democracy in the Ancient World (II.).

*MONDAY*, JUNE 1.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.

*WEDNESDAY*, JUNE 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. R. Whiddington: The Passage of Electricity through Vacuum Tubes (Tyndall Lectures) (III.).

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30. — Dr. C. H. Mayo: A Consideration of Gastric and Duodenal Ulcer.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Dr. R. L. Smith-Rose: The Effect of Wave Damping in Radio Direction-finding.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Annual Congress) (at Folkestone) (*continued on June 4, 5, 6*).—Sir John Russell: The Place of Science in Rural Life (Presidential Address).—A. G. Tansley: The Vegetation of the English Chalk.—A. L. Leach: New Road Sections in North Kent.—E. C. S. Baker: Field Naturalists and Evolution.—G. L. Pepler: Regional Survey in East Kent.—D. W. Cutler: Life in a Garden Soil (Evening Lecture).—Sir Arthur Smith Woodward: The Evolution of Fishes (Evening Lecture).—Capt. J. J. Eckersley: Broadcasting (Evening Lecture).

*THURSDAY*, JUNE 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. F. O. Bower: The Natural Classification of Ferns as a Study in Evolution (III.).

CHEMICAL SOCIETY, at 8.—W. A. Wightman: The Spatial Structure of Cycloparaffins. Part I. A New Aspect of Mohr's Theory and the Isomerism of Decahydronaphthalene.—Dr. T. A. Henry and H. Paget: Chenopodium Oil. Part II. The Hydrocarbon Fraction. — J. A. Goodson and Dr. T. A. Henry: Echitamine.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (Annual General Meeting), at 8. — Dr. A. Willett: Placenta Prævia treated by Traction on the Fore-coming Head.—D. C. L. Fitzwilliams: Curiosities in Connexion with the Secretion of Milk.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Annual Congress) (at Folkestone). (*See June 3 for programme.*)

*FRIDAY*, JUNE 5.

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting), at 10 A.M.—Dr. Tapia: The Big Pharyngostomes as an Accident in Laryngectomy: How they can be Avoided and the way of Closing them.—Dr. C. Mayo: Methods of Caring for Diseases of the Pharynx, Larynx, and Mouth.—Dr. R. Rodger: Tracheotomy in Tuberculous Laryngitis.—Dr. A. L. Turner and Dr. F. E. Reynolds: Furuncle of the Nasal Vestibule and Cavernous Sinus; Thrombosis the Pathway of Infection.—Dr. J. S. Fraser: Intra-nasal Dacryocystotomy.—At 3.— Clinical Meeting. — Prof. Burger: Pharyngeal Voice in a Case of Complete Laryngectomy.

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 5.30.— Extraordinary General Meeting.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—W. Worrall: Dictionary Evening.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—A. J. Brill and H. B. Milner: The Geology of the Eastbourne–Hastings Coastline.—G. S. Sweeting: The Geology of the Country around Crowhurst.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Howard Carter: The Tomb of Tut-Ankh-Amen from the Ante-Room to the Burial Chamber.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Annual Congress) (at (Folkestone). (*See June 3 for programme.*)

*SATURDAY*, JUNE 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. Dr. E. M. Walker: Democracy in the Ancient World (III.).

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Annual Congress) (at Folkestone). (*See June 3 for programme.*)

### FREE PUBLIC LECTURES.

*WEDNESDAY*, JUNE 3.

BEDFORD COLLEGE FOR WOMEN, at 5.15. — A. R. Hinks: Geodesy. (Succeeding Lecture on June 5.)

*THURSDAY*, JUNE 4.

ST. MARY'S HOSPITAL (Institute of Pathology and Research), at 5.— Sir Arthur Keith: The Structural and Functional Disorders of the Great Bowel.