



SATURDAY, OCTOBER 15, 1932

CONTENTS

	PAGE
Post Office Reform	557
Anthropology in Nigeria. By P. Amaury Talbot	561
Poesy in Combustion. By Dr. E. J. Holmyard	562
Researches in Aerodynamics	563
Short Reviews	564
Chemistry in Space. By S. S.	566
Food Preservation	568
International Astronomical Union	569
Recent Researches on Cosmic Rays	570
Obituary :	
Mr. William G. Collingwood	571
Mr. H. C. Chadwick	572
News and Views	572
Letters to the Editor :	
The Oldoway Human Skeleton.—Dr. L. S. B. Leakey ; E. J. Wayland	578
Lubricating Oils and Cancer.—Dr. J. B. Speakman and N. H. Chamberlain	578
Inheritance of Acquired Characters.—Dr. R. A. Fisher, F.R.S.	579
Diamagnetism of Molecules.—D. P. Ray-Chandhuri	579
Nuclear Structure.—E. Gwynne Jones	580
Absorption of Sound by Porous Materials.—Viktor Kühl and Dr. Erwin Meyer	580
Efficiency of Geiger Counter and Absorption of Cosmic Rays.—Dr. J. C. Jacobsen	581
Spectrum of Cosmic Radiation.—Prof. Arthur W. Conway, F.R.S.	581
The Contribution of Science to the Future.—W. E. Lishman	582
A Biological Conversion of Glucose to Glucosone.—Dr. T. Kennedy Walker	582
Research Items	583
Astronomical Topics	585
Conference of the Association of Special Libraries and Information Bureaux	586
A Census of Summer Thunderstorms	587
Mathematical and Experimental Evidence for the Existence of a Central Intellectual Factor. By Dr. William Brown	588
University and Educational Intelligence	589
Calendar of Geographical Exploration	590
Societies and Academies	590
Forthcoming Events	592
Official Publications Received	592

Post Office Reform

WE do not know whether it was mere coincidence or good stage-management that Lord Wolmer's book on "Post Office Reform" (Ivor Nicholson and Watson, Ltd., 6s. net) was published a week before the report of the Committee of Enquiry on the Post Office (Cmd. 4149. H.M. Stationery Office, 9d. net). However this may be, no study of the findings of that Committee can avoid reference to Lord Wolmer's campaign since he ceased to hold office as Assistant Postmaster General, for it was his persistence, supported ultimately by more than three hundred members of Parliament of all parties, which led directly to the appointment, by the present Government, of Lord Bridgeman and his colleagues, Sir John Cadman and Lord Plender, as a Committee "to enquire and report as to whether any changes in the constitution, status or system of organisation of the Post Office would be in the public interest".

Criticism of governmental administration is no modern diversion, and the Post Office, like other great departments of State, has not escaped the baiting to which 'bureaucracy' is always liable to be subject from those who as a matter of principle abhor State intervention, particularly in the sphere of commerce. Nevertheless, as a result of the reforms associated with the name of Rowland Hill, the attitude of the public towards the Post Office, personified in that popular character the postman, has been not unfriendly. The speed and accuracy of its letter-carrying activities and the extent of at any rate the pre-War facilities as regards deliveries and collections indeed left little to be desired.

Serious criticism of the Post Office only began to arise after the Office, in 1912, became solely responsible for the administration of telephone services, and it is the relative backwardness of telephone development in Great Britain in comparison with other countries, coupled with a certain administrative inelasticity, that has supplied the real driving force of Lord Wolmer's campaign. On one hand, as Lord Wolmer insists, it is a fact that the number of telephones per thousand of population is lower in Great Britain than in most other countries; that this feature is also apparent if large cities at home and abroad are compared; and that such telephones as are installed are less used than those in other countries. On the other hand, it is equally an undoubted fact, to which the Bridgeman Committee pays handsome

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testimony, that the Post Office engineers have led the way in technical development in telephony and, we may add, in electrical communications generally. Yet with this tremendous advantage of an able and alert, if underpaid, technical staff, foremost in promoting the development of this highly technical industry, there has been, rightly or wrongly, widespread public dissatisfaction with the telephone service. If such dissatisfaction had not existed, it would have been impossible for Lord Wolmer's campaign to gather the necessary momentum to lead the Government to appoint the Bridgeman Committee of Enquiry.

The report of the Committee summarises as follows "the rather generalised charges" that have been made :—

- (1) An absence of the spirit of public service, among certain sections of the staff—an attitude of indifference instead of a desire to help the public.
- (2) A lack of initiative and an absence of elasticity and imagination in adjusting service to meet the reasonable variations in the public demand; prompt action is thought to be hampered by 'red tape' and dilatory procedure.
- (3) In general an absence of the commercial outlook necessary for the efficient conduct of what is, at any rate to a large extent, a business concern.
- (4) A failure in regard to the telephone and telegraph services which are of a highly technical character, to give proper scope to the engineer, whereby technical progress is impeded.

This summary may to some extent be taken as reflective of the criticisms of Lord Wolmer, who argues that the telephone and telegraph services have not been administered on commercial lines because they have been administered by a Government department organised on the traditional Whitehall basis, with all that such organisation necessarily involves in rigidity of administration, owing to day-to-day accountability to Parliament in regard to the minutest details; inability to take normal commercial risks as a result of financial control by the Treasury; and above all in the arrangement, copied from Whitehall, under which all sub-departments come to a narrow bottleneck at the Secretary of the Post Office, so rendering promptness of decision impossible.

In the controversies generated by Lord Wolmer's campaign, the serious questions of organisation involved have tended to become obscured by political factors. The fundamental issue has been

represented to the public as being primarily one of the respective merits of public and private enterprise; and to overcome the weaknesses of Post Office administration, reformers have offered us a choice between the transfer of the Post Office communications services either to a public board on the model of, say, the Port of London Authority, or to a public utility company analogous to the Imperial and International Communications Company Limited, which is now responsible for all international wireless telegraph services originating in Great Britain. Unfortunately, the form which the public controversy has taken has caused certain essential elements of the problem to be overlooked, especially the obvious but all-important fact that, although for historical reasons the postal, telegraph and telephone services have become closely interlocked, the industrial structure of the Post Office, as regards electrical communications, is very largely, indeed almost entirely, the fashioning of scientific discovery and invention. The telegraph and telephone services are dependent, to a much greater degree than are the mail-carrying services, upon research and technical progress. No change of ownership or control which fails to take account of this fundamental fact is likely to achieve the desired results.

These considerations are by no means novel, for they were in the minds of that somewhat unpromising body the Select Committee on the Telephone Service, appointed so long ago as 1922 "to inquire into the organisation and administration of the telephone service and the method of making charges". That Committee emphasised that telephone business is essentially commercial and must be *administered on commercial lines*. It pointed out that the carriage of letters has always been upheld as the main foundation on which Post Office management rests, and when the telephone and telegraph undertakings were in turn transferred to the Post Office, "it seems to have been decided to patch them into the existing organisation rather than to alter the organisation to suit the extended conditions". The Committee recommended, therefore, the separation of the telephone and telegraph services from the mails. It also pointed out that "the Secretary's Department at the General Post Office, which really controls it, has neither special business training other than that of the ordinary Civil Service, nor special expert and technical qualifications", and it hinted at the desirability of the establishment of an administrative board

for the control of the segregated telephone and telegraph services. Finally, the Committee insisted that greater weight should be given to technical knowledge both in settling policy and in ordinary routine.

The Bridgeman Committee again and again throughout its report pays tribute to the zeal and ability with which the Post Office staffs carry out their duties. Yet the Committee is constrained to state that the criticisms of the telephone service "are not devoid of some substance", and that it believes that "there is room for improvement", but that "such improvement can only come from a removal of certain fundamental impediments to efficiency". These fundamental impediments are considered to be the relationship in which the Post Office stands as a revenue department to the Exchequer, and the internal organisation of the Post Office. The Committee, however, rejects the transference of all Post Office communication services to an independent authority of the public utility company or statutory corporation type, for it considers that "the public have a right to the influence which Parliamentary discussion and control alone can give". The proposal for the transference of electrical communications to an independent authority is also rejected. It is admitted that there might be advantages in this course if it were a question of inaugurating for the first time in Great Britain a new system of communications, but the Committee makes a point of considerable importance which, it must be admitted, has the force of expediency. Under present conditions, in all but the largest offices, the counter staff now deal indiscriminately with all kinds of business, and in all the smaller towns the sorting and telegraph operating staffs are combined to good effect, since the 'peak' hours of postal work are usually outside those of telegraph business. Separation, in the view of the Committee, "would entail large additional expense and would result in two separate organisations, neither of which would be carrying a full load."

Limitations of space prevent us from dealing with the first of the above-mentioned impediments to efficiency. We need only say that, in the view of the Committee, "In the present state of the National finances it would be impracticable to suggest any other principle than that the Exchequer should retain out of the net revenue collected by the Post Office a sum approximating to the amount which it is at present receiving."

As regards the second fundamental "impediment to efficiency", namely, the system of administrative control at the Post Office itself, the Committee is more drastic. It considers, in the first place, that there is far too much centralisation of staff management at headquarters and too little freedom left to the local officer in the provinces. It believes that much of the dissatisfaction with the telephone system is due to the general diffusion of responsibility and absence of co-ordination between those concerned with the various elements involved in the provision and conduct of the service. There is, the Committee says, "no one authority who can deal with complaints or ensure that orders are promptly and satisfactorily executed". The District Manager, who is, broadly speaking, responsible for the telephone service in his area, has no jurisdiction over the engineering and little disciplinary control over the operating staff. The Committee states that the District Manager is also handicapped by the restriction of his executive authority and is subjected in such matters as publicity, canvassing, etc., to rigid control by headquarters on matters of outlay and method, which tends to repress zeal and initiative as well as to waste time and money.

The Committee proceeds to remark that the Post Office Secretariat "has come to acquire a status out of proportion to that of other Post Office departments"; no executive department of the Post Office can give an instruction to another department, nor can it through its own officers do anything for which it has not Secretariat authority. The present position of the Secretariat, it is stated, "contravenes the fundamental principle of organisation, namely, the distinction between policy and practice, between the administrative and the executive functions". The Committee considers that the neglect of this important distinction is one of the main weaknesses of the existing Post Office organisation, and it arrives at the same conclusion as the Select Committee of 1922 that the Secretariat, as at present constituted, is unsuited by training and experience for the duty of conducting the daily business of the Post Office services, which function it undertakes in addition to the framing and formulation of policy. It is noted too that, owing to the "autocratic isolation of the Secretariat", the Engineering and Accountant General's Departments are prevented from taking an adequate part in the general scheme of control, and although the Committee considers there is no evidence that the engineer is unduly

hampered, it believes that engineering experience is insufficiently brought into the consideration and formulation of general policy.

Such serious defects demand radical treatment, and the Committee recommends that the control of all Post Office business shall be taken out of the hands of the Secretariat and effected through the medium of a functional Board, presided over by the Postmaster General. In addition to the Assistant Postmaster General the Board should, it is suggested, comprise four or five members of the Post Office staff representing such functions as general operating and supply, engineering and research, finance, and personnel. In the absence of the Postmaster General the Board would be presided over by the senior permanent member, who would carry some such title as 'Director General', and whose duty it would be to ensure that Board decisions were made effective, that continuity and unity of policy were maintained, and that the general machine of administration worked smoothly and effectively. The duties of the Board would, so far as possible, be restricted to the consideration and formulation of policy, leaving to the heads of the district organisation the duty of translating into effect the policy prescribed by the headquarters board. In the provinces it is recommended that the local administration should be controlled by regional directors who would constitute the co-ordinating authority for their respective regions and whose organisation would in effect be a reproduction in miniature of the headquarters board. It is in the application of this recommendation that controversy is not unlikely to arise, for the engineers in each district, hitherto autonomous, would thus come under the local control of a regional director, who might or might not be a 'telephone' man.

Other vital recommendations are that the existing division between the Secretariat and the rest of the staff should be removed and fluidity of interchange of staff between headquarters and the provinces secured. The Committee proceeds to make the long-awaited recommendation from a public inquiry: "As regards access to administrative posts, we consider that there should be no bar to a technical officer holding such posts, provided he has shown himself to possess administrative ability." With regard to the problem of the technical expert, the Committee considers it essential in an organisation such as the Post Office, which depends so much upon scientific discoveries and developments and

their practical applications, to bring engineering and research into more intimate touch with the general problems of administration.

In its appreciation of the fundamental weakness of present-day Civil Service administration the Committee has rendered an important public service. That the higher administrative posts in Government departments are commonly held by individuals of exceptional ability cannot be challenged, but a system under which almost autocratic powers of control and the monopoly of the formulation of policy are solely vested in individuals who may have no knowledge of or sympathy with scientific and technical developments can only be described as a national menace; for what the Bridgeman Committee has discovered in the Post Office can equally be said *mutatis mutandis* of most of the larger departments of State. The remedy proposed—the introduction of the Board system, under which departmental chiefs, both technical and non-technical, would be given a full opportunity of taking their proper share in the formation of policy—is one we have consistently advocated. The Committee's recognition of the importance of the expert and of the folly of debarring him irrespective of his administrative capacity from positions of control is of first importance. The divorce between the administrator and the technologist, the failure to achieve anything like a complete synthesis of the administrative and technical sides, is not peculiar to the Post Office in particular or to government departments in general. It characterises far too many business and industrial organisations.

In a paper read last year during the centenary meeting in London of the British Association for the Advancement of Science, Major L. Urwick, the director of the International Management Institute, Geneva, pointed out that throughout the century of the life of the British Association, despite the immense services which the inductive sciences are rendering to industry, it apparently has never occurred either to industrialists or to men of science that these services are other than contributory or ancillary. The Bridgeman Committee is the first public inquiry committee to give full recognition to the scientific expert in the Civil Service scheme of things. What it proposes amounts in sum to this, that the scientific expert is to be brought into the industrial family on level terms with the administrative expert and the financial expert and to have his due say as well in the formulation of policy as in the control

and execution of the routine operations. There is no suggestion that the business of the Post Office should be turned over entirely to the technologists. Viscount Bridgeman and his colleagues say sensibly: "Generally speaking we think it to be true that the specialist in any walk of life tends to remain a specialist; but there are, of course, well-known exceptions to the contrary, and we consider that where a member of the technical staff has shown that he possesses administrative talent he should be eligible for other appointments." No champion of the scientific worker in industry need ask for more than this or should be satisfied with less. The recommendation of the Bridgeman Committee, "to bring engineering and research into more intimate touch with the general problems of administration" is to be welcomed, not only for the beneficial effects which, if it is adopted, it is likely to have on the development of the Post Office, but also, and perhaps especially, for the stimulus it may give to the wider movement to bring about a closer fusion of science and industry and to get the scientific worker fully adopted into the industrial family.

Anthropology in Nigeria

Tribal Studies in Northern Nigeria. By C. K. Meek. Vol. 2. Pp. viii + 633 + 48 plates. (London: Kegan Paul and Co., Ltd., 1931.) 25s. net.

IN this work Mr. Meek apparently concludes his valuable notes on some of the smaller and lesser known peoples of Northern Nigeria—more than a score in all. As in the first volume (see NATURE, vol. 128, p. 285; 1931) chief attention has been paid to linguistics and social organisation and little to religion, which in the main consists of animism and ancestor worship. Each tribe is dealt with separately, and no attempt is made to give a general description of any particular custom or belief—doubtless the wisest course to pursue until more information has been collected.

One of the immediate practical advantages to be gained from these studies is that it should now be possible to group these peoples more scientifically; at present the Katab, for example, are not only divided by provincial boundaries, but also some of them are directly administered by British officers, while others are under Fulani emirs. One of the chief defects of indirect rule, as practised in Northern Nigeria, lies in the fact that so many pagan tribes have no native courts of their own

but are subject to the judicial administration of Mohammedan alkalis.

Most of the peoples under consideration are of ancient semi-Bantu origin and possess interesting features in the way of totemism, exogamy and mother-right organisation. As is usual in Nigeria, totemism is mixed up with metamorphosis and is now fast breaking down. There is a certain amount of evidence for the belief that clan exogamy—at any rate in this region—arose from a desire to avoid local conflicts, and has nothing to do with consanguinity or the hypothetical unattractiveness of the woman whom you see every day; among the Piti, for example, intermarriage is most usual between those 'wards' which are nearest to one another. Fundamentally, no man may marry a woman of his own clan but, as the sense of kinship with the parent community dwindles, the exogamic taboos become confined to the new group.

There are examples of all stages of development, from the mother-right Longuda to the Kanakuru, who are mainly patrilineal though matrilineal in totemistic affairs, and the wholly patrilineal Bornuese tribes. Marriage is often matrilineal, and the children may be handed over to the mother's relatives, though occasionally to those of the father.

Until lately, marriage by capture was quite usual and traces of the custom are found in most tribes. One of the commonest methods of obtaining a wife is that of elopement with a married woman from another group or clan—a transaction previously regularised by payments to her family. This practice is apparently recommended, since it gives each party the opportunity of finding the one who suits him, or her, best; the original marriage is generally arranged at a very early age, sometimes even before the girl's birth. Children begotten of the second husband, as a rule, belong to him, but he cannot claim the return of his dowry should the woman leave him in turn, while the first husband practically never does so, as he always lives in the hope of her coming back to him.

Indeed, the position of women here, as in so large a part of West Africa, is highly enviable. The man is always anxious to gain, or keep, the services of at least one wife to cook for him; among the Gabin, where the women make the beer, they do not hesitate to dictate as to the friends who are allowed to partake of this, and even to forbid their husbands to attend a neighbouring celebration, if they consider that these would be better employed at home. The husband must continue to pay court not only to his wife,

but also to her maternal relatives, else they may transfer her to another suitor. The more attractive she is—and it is of interest to note that among the Kanakuru slimness is considered a beauty—the greater efforts must be made by him to counter-balance those of his would-be rivals. In fact, many husbands may be said to spend most of their time in endeavouring to retain their wives or in working out plans to obtain the wife of some one else.

The birth of a child before the mother's cicatrization ceremonies have been carried out among the Yungur and Kona Jukun—or, with the Hona and Gabin, before the ordained time—is a serious offence; the consequences are usually avoided by abortion. A Katab woman marks each month of pregnancy by putting a circular dot of red earth on her thigh, while the husband keeps his own private tally in case his wife runs off before giving birth to the child.

Mr. Meek's volume is profusely illustrated, but the index would be of much more use if it were fuller; at present, if it is desired to look up, say, a certain fact about the Fulani, it may be necessary to go through the whole fifty-three references under this heading.

P. AMAURY TALBOT.

Poesy in Combustion

A History of Fire and Flame. By Oliver C. de C. Ellis. Published for the Poetry Lovers' Fellowship with the International Fellowship of Literature. Pp. xxiv + 440 + 20 plates. (London: Simpkin Marshall, Ltd., 1932.) 15s. net.

A PROBLEM that the alchemists found extremely difficult to solve was the preparation of an amalgam of iron. Dr. Ellis has attempted an analogous task, namely, the fusion into a homogeneous unity of the cold and hard scientific facts of the history of fire with the æsthetic appeal of fire and flame to his poetical emotions. The result is a book *sui generis*, which will be variously estimated according to the point of view from which it is surveyed. It is scarcely within the province of the present reviewer, and still less within his capacity, to appraise its merits as a work of art, though Dr. Ellis's mellifluous prose and well-developed sense of style must afford pleasure even to the most Philistine of his readers. The book is, however, by no means easy to understand, partly because the author's fancy leads him to stray down every attractive by-path, and partly because his wealth of quotation and allusion is apt to prove

bewildering to anyone less familiar than himself with the original literature.

While every topic relevant to fire and flame—from the unicorn and the phoenix to the history of lucifer matches—is fitted neatly into the pattern, the pattern still remains somewhat kaleidoscopic, and the main arguments consequently have to be discovered by a process of induction. It is only just to add that the process is well worth undertaking, for Dr. Ellis's ideas are often highly original and frankly opposed to many opinions now generally accepted. Indeed, judged as a scientific history of certain fundamental chemical discoveries, the book demands serious attention.

One of the principal theses is that "the prime secret of the alchemists was oxygen". It is, of course, undeniable that oxygen must have been liberated on innumerable occasions during the progress of alchemical operations; but the same statement is equally true of hydrogen, hydrogen sulphide, hydrogen chloride, carbon dioxide, carbon monoxide, ammonia, and nitrogen peroxide, so that one turns with interest to see how the thesis is supported and what value is to be assigned to the evidence adduced. Such an examination makes it only too clear that Dr. Ellis is rather easily satisfied. He first assumes that the alchemists were able to collect oxygen by heating 'nitre'. It is possible—indeed, it is practically certain—that the early alchemists used potassium nitrate, but for the most part 'nitre' or 'nitrum' was applied to naturally occurring sodium carbonate, and a sharp distinction between the latter and the substance we now call nitre was not drawn earlier than the thirteenth century.

When Dr. Ellis says that "the earliest historians, geographers, and technicians speak of vast alluvial deposits" of nitre, that is, potassium nitrate, he is misinterpreting the sense of the Latin *nitrum*, which here signifies *natron*. Again, he quotes Virgil: "I have seen many sowers artificially prepare their seeds and steep them first in saltpetre and black lees of oil". He does not give the reference, but presumably the passage is that in the "Georgics", i. 193-196:

semina vidi equidem multos medicare serentes,
et nitro prius et nigra perfundere amurga,
grandior ut fetus siliquis fallacibus esset,
et, quamvis igni exiguo, properata maderent.

There is nothing in this description to suggest that by *nitrum* Virgil meant saltpetre; on the other hand, *natron* would fit the context, since it appears to have been believed by the Romans that plants

grown from seeds treated in this way would be softer and greener on cooking. Pliny ("Historia Naturalis", xxxi. 115) says that *nitrum* was used in cooking vegetables to give them a greener colour: such *nitrum* could scarcely have been anything but soda. Further, Dr. Ellis says that "nitre was a familiar weapon of the medieval chemist, in whose mind it was associated with fire as naturally as air was". What limits he sets to the Middle Ages he does not say, but in any event such a sweeping generalisation needs a good deal more documentary evidence than he is able to bring forward.

There are several other points in which Dr. Ellis's accuracy is far from unimpeachable. Thus he complains that there is no English translation of Mayow's "Five Treatises" (which he describes as "an amazing pack of nonsense"), though an excellent translation was published in the Alembic Club Reprints (No. 17) in 1907; he attributes the celebrated generator to Kipps instead of to P. J. Kipp (1808-64); he equates the alchemical 'tinctures' to 'slags'; and he says that the phlogistians conceived phlogiston as a palpable, substantial chemical 'sulphur'. Moreover, the passage from Paracelsus that Dr. Ellis takes to be a description of the preparation of phosphorus from urine is capable of interpretation in many other and much more probable ways; while the quotation from the "Demonolatry" of Nicholas Rémy does not carry conviction—at least to the reviewer—that phosphorus was known in 1588. Finally, Dr. Ellis's tentative identification of Eirenaeus Philalethes (properly Philaletha) with Boyle has little to recommend it, in view of the fact that the only definite knowledge we have of this alchemical writer is that he was twenty-three years of age in 1645, when Boyle was eighteen.

In spite, however, of the too frequent carelessness shown in verifying references, and in spite of Dr. Ellis's tendency to credit the alchemists with more knowledge than they can be proved to have had, the "History of Fire and Flame" is a fascinating, informative, and beautiful book. No one who turns its pages will fail to catch some of Dr. Ellis's enthusiasm for his subject, or to experience (even if vicariously) some of his æsthetic emotion. There are passages of great poetic charm, and, equally, passages of keen historical insight, while flashes of dry humour sparkle in unexpected places and add a lively flavour to the whole. Nor, though his facts are not always above suspicion, is Dr. Ellis's critical judgment lacking. As Watson once wrote of a book of Nollet's, "he has traced the

origin of several happy inventions, and has exhibited the real authors of them. He has given, as he imagines, additional value to several experiments which appear to have been too much neglected; and brought others which have been over-rated to their proper standard." Zoroaster would have no cause to be ashamed of this latest offering to the flame of his altar.

E. J. HOLMYARD.

Researches in Aerodynamics

- (1) *Hydro- und Aeromechanik nach vorlesungen von L. Prandtl*. Von Dr. O. Tietjens. Band 2: *Bewegung reibender Flüssigkeiten und technische Anwendungen*. Pp. viii + 299 + 28 Tafeln. (Berlin: Julius Springer, 1931.) 23 gold marks.
- (2) *Handbuch der Experimentalphysik*. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4: *Hydro- und Aerodynamik*. Teil 2: *Widerstand und Auftrieb*. Herausgegeben von Ludwig Schiller. Pp. viii + 443. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 41 gold marks.

(1) DR. TIETJENS has performed a very valuable service in writing his two books, based on the lectures of Prof. Prandtl at Göttingen. This second volume deals mainly with the motion of viscous fluids, and the treatment of the subject follows the lines of Prandtl's lectures, but Dr. Tietjens has amplified certain sections, particularly those dealing with the flow in pipes and with the drag of symmetrical bodies, and has added a final chapter describing experimental apparatus and technique. The book contains perhaps little that is new to the student of the subject, and for the greater part it gives a critical descriptive account of the observed phenomena and the corresponding theory rather than the details of the theoretical analysis. The great merit of the book, however, is the excellent account of the physical basis of the boundary layer theory, of the significance of evanescent viscosity in determining the nature of the flow even when the surface friction itself is negligible, and of the fundamental principles underlying the theory of the lift of an aerofoil.

The chapters dealing with the flow in pipes, with boundary layers, and with the drag of symmetrical bodies are perhaps the most interesting and comprehensive; but exception must be taken to the statement that there is a laminar boundary layer below the turbulent flow over the surface of a body, since it rests solely on an attempt to apply rigidly the semi-empirical power law for the velocity

distribution of turbulent flow and is not in accordance with the actual physical conditions. The final chapter on experimental methods contains a brief historical account of the development of wind tunnels and a description of the various modern types. Particular attention is also devoted to the methods of making the flow visible, and there is an interesting series of photographs showing the development of turbulence behind a bluff body and of circulation round an aerofoil.

(2) This volume of the "Handbuch der Experimentalphysik" is devoted to the subject of the lift and drag of a body moving through a fluid, and more particularly to the experimental methods of measuring these forces. All the articles attain a high standard, being comprehensive in character and clear in expression, but it is perhaps to be regretted that experiments in flight, apart from deceleration tests of airships, receive only the briefest attention.

Flachsbart contributes an interesting historical account of the development of hydrodynamics, confined mainly to the determination of drag and the necessary experimental apparatus, and this is followed by an article by Prandtl on the design and operation of modern wind tunnels, in which he expresses a preference for the open jet type in spite of its poorer economy of power. Seiferth and Betz discuss the method of testing aeroplane models in a wind tunnel, describe the principal types of balance used in these tests, and give a few typical experimental results. The problem of wind tunnel interference is discussed in detail, but unfortunately there appears to be some misapprehension on the subject. The authors seem to assume incorrectly that the corrections in open and closed tunnels of any shape are of the same magnitude but opposite sign, and in discussing the interference on the downwash behind an aerofoil they fail to realise that the method of images remains valid for a rectangular tunnel, though it breaks down for a circular tunnel.

Muttray contributes an excellent account of the measurement of the drag of symmetrical bodies, both directly and by measurement of the flow in the wake, and he gives a critical account of the experimental results available. Dropping tests of spheres and discs are discussed very ably by Schiller, who concentrates on the lower range of Reynolds's number, whereas Muttray deals mainly with wind tunnel tests on a larger scale. Schiller also gives a critical discussion of the problem of the sphere, including a summary of the theoretical work on the subject, and shows that the most

reliable experiments confirm the accuracy of Goldstein's extension of Oseen's solution with Faxen's correction for wall interference. The final article is devoted to the problem of lubricated bearings, and Kiesskalt gives a clear account of the subject, including a brief summary of the theory initiated by Reynolds and developed by Duffing.

Short Reviews

Introduction des théories de Newton en France au XVIII^e siècle avant 1738. Par Prof. Pierre Brunet. Pp. vii + 355. (Paris: Albert Blanchard, 1931.) 55 francs.

The eighteenth century witnessed the bitter controversies between the Cartesian and the Newtonian conception of the physical world. For decades, the Cartesians tried all the subtleties of logic and science to defend the vortex theory against the views based on universal attraction. But in the end, they had to give way; and the popular defence of Newton's philosophy by Voltaire marked the turning of the tide. It is the epic of these controversies which Prof. Brunet describes for us with a wealth of details giving a scholarly interest to his exposition. The opposition of the Cartesians can be explained by the fact that their master's theory was the first universal explanation of the world, independent of the occult forces which were in favour during previous centuries. The scientific atmosphere of the time was quite at ease with the mechanist conception of Descartes, and loathed any system which had even a vague resemblance to occult qualities. No doubt these controversies help to clear the implications of Newton's system of the dogmatic blemishes which had to be ultimately recognised in Descartes' cosmology. In bringing to light such and other important points, Prof. Brunet has rendered a great service to the history of science.

T. G.

More Essays of Love and Virtue. By Havelock Ellis. Pp. xiii + 218. (London: Constable and Co., Ltd., 1931.) 7s. 6d. net.

MR. HAVELOCK ELLIS began writing books more than thirty years ago, and some of his books might be described as milestones on the way to a more scientific and therefore a saner outlook upon certain aspects of human life. He tells us that his earliest book, having first been received with howls of execration, is now called sane and reasonable. Here he writes again, as indeed he has always written, of love and virtue—meaning by these not crude sex and namby-pamby goodness, but something heroic. He writes of the new mother, the renovation of the family, the function of taboos, the "revaluation of obscenity", the control of population, and the future of eugenics. Whether the reader agrees with Mr. Ellis or not, he feels himself in the hands of one who is master of his theme, and master also of a felicitous literary style. Few people, we imagine, could read the preface to these chapters without reading on to the end.

A World of Epitomizations: a Study in the Philosophy of the Sciences. By Prof. G. P. Conger. Pp. xiv + 605. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1931.) 22s. 6d. net.

THE progress of scientific philosophy seems to be based on rather peculiar assumptions. Run away from substance but hang on to structures, is the slogan that would characterise them best. Yet, in turning its back on Plato and Aristotle, scientific philosophy runs the risk of becoming finally a meaningless logomachy. This tendency seems to us to be interestingly illustrated in the book under review, in which the author, in order to explain structures by other structures, finds himself compelled to adopt a language of his own, to which one may easily take exception for the sake of clarity if not of value and truth.

It is a matter of convenience to divide the cosmos into the three realms of matter, life, and mind, and to discover in them parallel configurations ranging from simpler to more complex ones. But it seems to us misleading to call 'monads' the structures characteristic of each of these configurations. What the author calls "epitomization by monads or by analogy" is the classification of the various 'monads' according to their significant resemblances. This general methodological frame enables him to marshal an amazing wealth of details and philosophical or scientific pronouncements into a convenient place in the development of our knowledge. In this he has perhaps performed a useful work, in so far as it enables us to see, almost at a glance, the possible connexion between sometimes widely different theories. But such an epitome of science scarcely explains science itself, which should be the object of philosophy. The hypothesis of epitomisation, if considered as a metaphysics, could not help us to advance one inch towards any philosophical results. "Synoptic naturalism", by which the author defines his position, is merely a term, and the few remarks made about it at the end of the volume are apt to kindle one's curiosity rather than to satisfy it. But perhaps the author does not mean to expound any metaphysics at all—at least, as it is understood in the Greco-Roman tradition.

Recent Advances in Botany. By E. C. Barton-Wright. Pp. viii + 287. (London: J. and A. Churchill, 1932.) 12s. 6d.

THE "Recent Advances" series of books published by Messrs. Churchill have made for themselves a definite niche in modern scientific literature. Such volumes, written by active scientific workers, must prove invaluable especially to advanced university students of the subjects concerned.

Botanical literature, even that in English, from the point of view of the keen student, has developed into such a maze that it is almost impossible to keep into close touch with all recent important discoveries.

This volume will help such students considerably. The subject matter, controversial though

it may be, is presented fairly and references for further study are given at the end of each chapter. The recent theories of form and size are given a prominent position and modern views on palæobotany, species, Fungi, Algæ and virus diseases are considered. Coming from this author, one cannot restrain a feeling of disappointment at the meagre space allotted to plant physiology.

Despite several defects, especially with regard to choice of material (and even this is purely a matter of individual opinion) one can say that the book should be available to all advanced students of the subject.

Glastechnische Tabellen: Physikalische und chemische Konstanten der Gläser. Unter Mitwirkung von H. Alterthum, Chr. Andresen-Kraft, D. Badt, E. Berger, W. E. Fleisch, M. Fritz-Schmidt, H. G. Frühling, B. Lange, G. Liebmann, T. Liepus, J. Löffler, M. Reger, A. Russ, R. Schmidt, J. Völker, W. Weyl. Mit besonderer Unterstützung der Deutschen Glastechnischen Gesellschaft E. V. Herausgegeben von Prof. Dr. Wilhelm Eitel, Prof. Dr. Marcello Pirani, Prof. Dr. Karl Scheel. Pp. xii + 714. (Berlin: Julius Springer, 1932.) 149/80 gold marks.

THIS volume of more than seven-hundred pages of summarised information must be admitted as a super-production. The very names of the three co-editors are sufficient to guarantee a book of eminence, and their long list of collaborators of standing is proof of the thoroughness with which the quickly growing literature on glass technology has been combed for data.

The book was planned in 1928, in which year it received the blessing of the Deutschen Glastechnischen Gesellschaft, since which time the editors and their colleagues must have been exceptionally industrious, for information has been collected from about 2500 original papers. It has been examined and sifted, only that which appeared sufficiently precise and reliable being included. Not a single paper containing information capable of being expressed by numbers or diagrams appears to have been overlooked.

The first section of three into which the book is divided, deals with the constitution of glass from the point of view of the 'phase' theory. Temperature-concentration equilibrium diagrams are given for all the systems that have been worked out. Though such diagrams cannot of course refer to true glasses, but only to devitrified glasses, they do help towards an understanding of the constitution of glass. In the second section, the whole range of physical properties—together with the chemical durability—are treated systematically. Where the compositions of the glasses, referred to in Section 2, are known with a sufficient degree of accuracy, they are included in and compose the third section. The usefulness of the book is increased by the inclusion at the end of each subsection of detailed references to the literature on the subject. S. E.

Chemistry in Space

THE chief impression left by the first meeting of Section B (Chemistry) of the British Association at York on Sept. 1, was the soundness of the foundations on which stereochemistry has been built. After thirty years of revolution in our ideas of the nature of the physical world, the basic conceptions of chemistry need little modification and their assimilation into the body of the new atomic physics only gives them a clearer meaning and a wider usefulness.

This is well exemplified by the first of the two main themes to which Dr. W. H. Mills devoted his presidential address, namely, the value of the tetrahedral atom model when expressed in terms of the electronic theory of valency. The three dimensional extension of the octet theory can be simply represented in a diagrammatic manner by placing the four pairs of electrons at the corners of a tetrahedron concentric with the atom under consideration. Another atom, linked by a pair of electrons, will be situated on the axis through the corresponding axis of the tetrahedron. This tetrahedral octet can only be expected to give a general indication of configuration; since atoms are deformable and valencies can be deflected, it cannot be used, for example, to predict accurate values of intervalency angles. Qualitatively, however, it is able to represent the stereochemistry of all compounds formed in accordance with the octet rule.

When such compounds contain only links composed of two electrons, then it is invariably found that a four co-ordinate atom has a tetrahedral configuration, a three co-ordinate atom a pyramidal configuration, and a two co-ordinate atom an angular configuration. This is illustrated by the configurations of methane, ammonia and water in the Fig. 1.

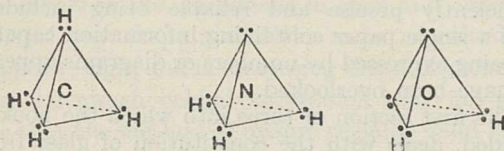


FIG. 1.

The tetrahedral type covers not only the familiar carbon compounds but also accounts for the optical activity of substituted ammonium ions of the type $[Nabcd]^+$, of amine oxides, and of four co-ordinate complexes of beryllium, copper and zinc. The pyramidal formula is, of course, in harmony with the structure of ammonia deduced from its dipole moment and infra-red spectrum; it also accounts naturally for the isomerism of the oximes, the optical activity of sulphoxides and sulphinic esters observed by Kenyon and Phillips, and for the recent resolutions of the *aci*-forms of secondary nitroparaffins. The latter are of particular interest since they probably contain a

tri-covalent carbon atom with a pyramidal configuration. (Fig. 2.)

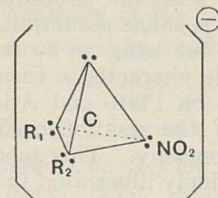


FIG. 2.

The outstanding difficulty in this group of compounds is the persistent failure to resolve amines of the type *Nabc*. Prof. J. Meisenheimer's contribution to the discussion was concerned mainly with this point; he showed that no resolution is obtained with compounds in which one of the nitrogen valencies is attached to oxygen, namely, in hydroxylamines and in quinoline oxide. Negative evidence of this kind may, as Sir William Pope remarked, have little or no significance and must be very cautiously interpreted; on the other hand, there is some spectroscopic evidence for the view that the nitrogen atom oscillates through the plane containing the attached groups and so makes it impossible to isolate an optically active product.

The idea of the movement of a critical atom to a new permanent position in the molecule was shown by Dr. Mills to give a simple and natural interpretation of three important stereochemical problems, namely, the Walden inversion, the *trans* elimination of water from aldoximes, and the *trans* Beckmann change. The mechanism by which the first of these changes is brought about can be represented very simply by the formulæ in Fig. 3.

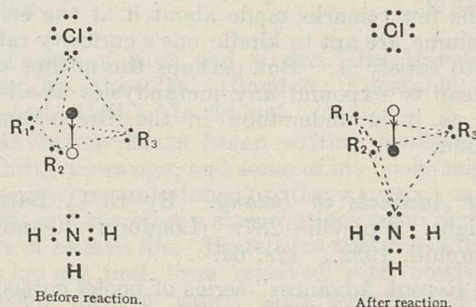


FIG. 3.

The reaction considered here is the action of ammonia on a compound containing chlorine, which results in the liberation of chlorine as an anion and the formation of a substituted ammonium ion with an inverted configuration. This result is naturally and simply represented by the movement of the asymmetric carbon atom through a distance equal to half the height of the tetrahedron. The critical point in this explanation is, of course, the attack of the ammonia molecule on

the correct face of the tetrahedron, since attack at any other face would not give the inverted-configuration. The electrostatic fields due to the dipole moments of the C—Cl link and the N—H link will give a directing effect and the movement of the carbon atom in this direction will most readily facilitate the escape of the chlorine ion. Thus the velocity of reaction at the proper face will be favoured and inversion will be almost complete.

The formation of benzonitrile from the β -form of benzaldoxime acetate is represented in Fig. 4. The essential reaction is the removal of the elements of acetic acid; this is brought about readily by the action of alkalis on the β -form in

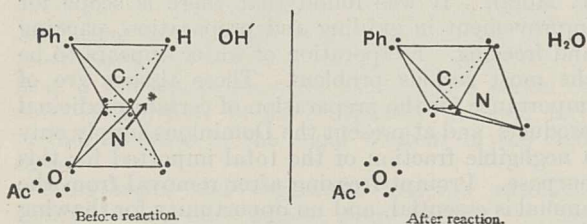


FIG. 4.

which the acetyl group and the hydrogen are on opposite sides of the molecule. The first step is the removal of a proton by union with a hydroxyl ion. The second is the movement of the nitrogen atom into line with the carbon atom to form the linear grouping of benzonitrile. This movement is directly away from the acetate group, which is, therefore, liberated as an ion. The movement of the nitrogen atom in the acetate of the isomeric α -oxime would not be in a direction away from the acetate group; hence the isomeride which reacts most readily must have the *trans* configuration in accordance with the modern view.

This conception of the movement of critical atoms gives a particularly neat explanation of the *trans* Beckmann change. It is usual to think of the migration of groups. If, however, we consider the change occurring in an isolated molecule and remember that moment of momentum must be conserved, it is clear that most of the movement by which the relative displacement is brought about would be executed by the nitrogen atom. Fig. 5 indicates the alternative movements of the nitrogen atoms corresponding with *cis*- and *trans*-migration, and show that the latter is much more probable. The driving force which brings about the change is probably the affinity of the oxygen for the central carbon atom. The first step would therefore be the attachment of the oxygen atom to this carbon atom, followed, or accompanied by the migration of the nitrogen atom. As the diagram shows, this could readily occur to give *trans*-migration, whilst *cis*-migration would involve the passage of the nitrogen atom across the line of closest approach of the oxygen atom to the central carbon atom. The *cis*-interchange of groups, instead of being an assumption which could be taken for granted, is a highly improbable hypothesis and the

natural course of the reaction is that leading to *trans*-interchange.

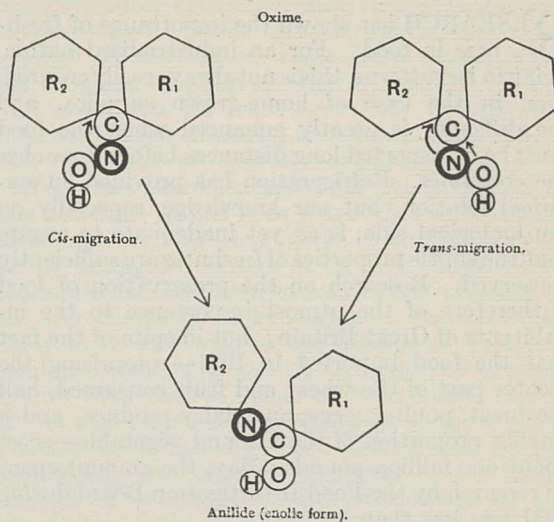


FIG. 5.

The second part of Dr. Mills's address was concerned with the problem of the optical activity of living matter. Pasteur was inclined to ascribe this to cosmical causes and later workers have invoked the influence of circularly polarised light. Dr. Mills suggested, however, that the production of dissymmetric products by living tissue is intimately connected with the characteristic property of growth which differentiates living matter from dead.

The synthesis of dissymmetric products in living tissue involves, at least in its later stages, reactions between dissymmetric substances. Such reactions are known to be stereo-specific and the velocity of the reaction is much greater with one of the optical forms than with the other. This stereospecificity is observed in comparatively simple compounds and can readily be accounted for by the shape and disposition of the parts of the molecule; in the favoured reaction the groups which react can more readily be brought into juxtaposition. With enzyme reactions a high degree of specificity is found and these reactions undoubtedly play an important part in the growth of living tissue.

From a detailed analysis of simplified models of growing tissue, Dr. Mills concludes that the optical activity of living matter is an inevitable consequence of its property of growth. Owing to the stereospecificity of the later changes, any small lack of balance between the *d* and *l* forms of the first dissymmetric product in the chain of reactions would rapidly increase and the dissymmetric tissue would grow more rapidly and soon be present in the growing organism in overwhelming amount. "The mystery of living matter seems to lie in its power of growth. Given this, the optical activity of its components appears to follow as a necessary consequence of the law of mass action and the stereospecificity of interactions between dissymmetric compounds." S. S.

Food Preservation*

RESEARCH has shown the importance of freshness in food. For an industrialised nation, living in large towns, this is not always easily ensured, even in the case of home-grown supplies, and the difficulty is greatly enhanced when the food must be transported long distances before it reaches the consumer. Refrigeration has provided an empirical solution, but our knowledge, especially on the biological side, is as yet inadequate to ensure that the subtle properties of freshness are sufficiently conserved. Research on the preservation of food is therefore of the utmost importance to the inhabitants of Great Britain; but in spite of the fact that the food imported in 1931—comprising the greater part of the wheat and fruit consumed, half the meat, poultry, eggs, and dairy produce, and a smaller proportion of the fish and vegetables—cost about one million pounds a day, the amount spent on research by the Food Investigation Board during 1931 was less than £50,000.

The necessity for economy has led to a reduction in the Board's expenditure, but the staff has not been reduced. Owing to the specialised nature of the work, losses of personnel cannot immediately be made good when circumstances warrant an expansion of the Board's activities, so that reduction of staff would delay the resumption of normal progress to an extent out of all proportion to the economy effected.

Food investigation is of value, not only to the consumer, but also to the producer both at home and in the Empire overseas. The Board has received financial assistance from the Empire Marketing Board, and co-operation with other parts of the Empire is ensured by the presence of representatives of the Dominions, India, and the Colonial Office, sitting as assessors, at the Board's meetings. The experimental work on the cold storage of food has now reached a stage when the results obtained can be transferred to the full commercial scale. The co-operative survey of the New Zealand frozen lamb industry, which was mentioned in last year's Report and full details of which are about to be published, was so successful that the Board felt that this collaboration should be continued. A Consultative Group has therefore been formed, comprising the Director of Food Investigation (Sir William B. Hardy) and members of his staff, the assessors mentioned above, and representatives of the shipping lines nominated by the Chamber of Shipping of the United Kingdom and the Liverpool Steamship Owners' Association.

The Report is this year arranged in four parts, describing respectively the researches carried out at the Low Temperature Research Station, at the Torry Research Station, and at the Ditton Laboratory, the three research stations of the Board; the fourth part deals with extramural researches carried out at the National Physical Laboratory and the Imperial College of Science and Technology. The different sections deal with meat, bacon, fish, fruit,

and vegetables, as well as problems of biological engineering and canning. Each is written by the investigator who has carried out the research described, and presents the results obtained in a form which is best described as that of a detailed summary. References are given to the original papers from which fuller information may be obtained. It is not possible here to do more than refer to one or two of the more important points raised by the Report; but it is hoped to consider certain other aspects at a later date.

A preliminary survey of the problems associated with imported edible offal has been carried out by T. Moran. It was found that there is scope for improvement in grading and preparation, packing and freezing. Evaporation of water appears to be the most serious problem. These tissues are of importance for the preparation of certain medicinal products, and at present the Dominions supply only a negligible fraction of the total imported for this purpose. Prompt freezing after removal from the animal is essential, and no opportunity for thawing during storage and transport must be permitted. In New Zealand, a further difficulty has to be overcome, since the demand is almost exclusively for ox's glands at present, mainly on account of their size.

It has been shown by E. H. Callow that the transport of unsmoked mild-cured bacon from Australia and New Zealand is impracticable under existing commercial conditions, since the fat becomes rancid after less than two months' storage even if a temperature so low as -10° C. is used. Gas storage may be the solution of this problem, since the rancidity is due to the fact that the fat takes up oxygen even at this low temperature. On the other hand, carcasses of frozen pork can be transported successfully and used as pork or for the manufacture of bacon. It has also been found that smoking retards the subsequent development of rancidity, whatever the temperature of storage, within the range 15° C. to -20° C., but cannot prevent it entirely.

In the case of fish, it has been found that after freezing in brine, it is necessary to store at temperatures so low as -20° to -25° C. instead of the usual -4° to -12° C., if alteration in the fish is to be prevented. Fish stored at the lower temperature can be smoke-cured: hitherto one of the objections to frozen fish has been that it is quite unsuitable for smoking. The conditions required for properly smoking haddocks and herrings have been examined by A. Lumley. To give a 'finnan' finish to the former, seven hours' smoking was necessary, the temperature being gradually raised from 80° to 90° F., and the relative humidity being less than fifty per cent at 80° F. To produce a 'kipper' it was necessary to extend the time of curing to twelve hours and to raise the temperature to 95° F. for one hour and to 100° F. for the final hour. Most of the smoking in commercial practice is carried out by rule-of-thumb methods. It is suggested that the incomplete control and the length of the process

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the year 1931. Pp. x+293. (London: H.M. Stationery Office, 1932.) 5s. net.

is the reason why so many dyed kippers are on the market: dyed herrings can be smoked in 5-6 hours.

Work has been continued on the gas-storage of apples in the experimental stores at the Ditton Laboratory. At present, control over the composition of the atmosphere is obtained by regulated ventilation with fresh air, but there is now some evidence that a closer control over the percentages of oxygen and carbon dioxide in the store may be required in the case of certain varieties. Experiments have also been carried out on the gas storage of pears and bananas and the cold storage of potatoes. J. Barker has found that between $+3^{\circ}$ and -1° C. there is a great increase in the amount of sugar found in the potato after sixty days' storage, the concentration being inversely proportional to the temperature. The sweetening is attributed to a change in the organisation of the protoplasm. It was also found that transference from a low temperature to 15° C. for a period of only twenty-four hours completely arrested any further increase in the sugar content in the cold store.

Most fruits and vegetables undergo autolytic changes when hard frozen, even at -20° C., the only exception so far observed being raspberries. On thawing such frozen raspberries, colour and

flavour were perfect and the texture was scarcely altered. Blanching will permanently inhibit these changes: after blanching, peas, runner beans, and potatoes can be frozen, and on thawing again are superior to the canned vegetables. Strawberries can be frozen in syrup at -20° C., and the thawed fruit is suitable for fruit salads, etc. Plums and cherries, treated similarly, turn brown on thawing; they can, however, be frozen after blanching.

Work has been continued on the corrosion of iron and tin. It has been found that ferrous salts accelerate the corrosion of tin in the presence of air by acting as carriers of oxygen. Ferric salts accelerate the corrosion of iron in the presence of air over the range of hydrogen ion concentration likely to be met with in the canning of fruit, the combined effect of air and the ferric iron being much greater than that of either of them alone, especially at a hydrogen ion concentration of about pH 4. Further work has also been carried out on the engineering and physical problems of the maintenance of temperature and composition of the atmosphere in stores such as ships' holds. In the storage of fruit, the metabolism of the fruit itself affects both the temperature and atmosphere of the store, and complicates the problem of maintaining a constant environment.

International Astronomical Union

THE fourth general meeting of the International Astronomical Union, attended by representatives of twenty-four countries, was held at Cambridge, Massachusetts, on Sept. 2-9, under the presidency of Sir Frank Dyson. At the opening session the Union was welcomed by the Hon. C. F. Adams, Secretary for the Navy in the United States cabinet, and by Dean Bernice Brown, head of Radcliffe College. The members of the Union were for the most part accommodated in the dormitories of the College, a very convenient arrangement giving every opportunity for the informal discussions in small groups which add so much to the real value of the meeting. The full meetings were held in the Alice Longfellow Hall of Radcliffe College, and the commissions met in the various lecture rooms. All the arrangements for the meeting were made with a thoroughness and completeness, which it would be difficult to equal, by a local committee with Prof. Harlow Shapley as chairman and Mr. L. B. Andrewes, following the late Miss Adelaide Ames, as secretary.

The formal work of the Union lay in the sessions, reports and resolutions of twenty-seven committees: these dealt with such subjects as meridian astronomy, planetary observations, *Bureau International de l'Heure*, variation of latitude, *Carte du Ciel*, stellar parallaxes, variable stars, stellar spectra—to mention only a few of them. The volume of draft reports is nearly two hundred pages long and can scarcely be summarised here, but reference may be made to the reports on solar physics, by Dr. St. John, on standard wave-lengths by Prof. A. Fowler, on stellar photometry by Dr. Seares,

on radial velocities by Dr. J. S. Plaskett, and on the observations of Eros for solar parallax, by Dr. Spencer Jones.

Among resolutions passed by the General Assembly were the following: The equinox of 1900.0 was adopted for catalogues other than catalogues of precision, by agreement among the various groups of astronomers interested in the question. A proposal to fill a gap existing in astronomical bibliography between 1880 and 1899 was approved. A proposal to establish the vertical circle of the Pulkovo Observatory in as nearly equal a southern latitude as possible in the hope of improving fundamental declinations, met with much sympathy and full approval. A number of recommendations adopting fresh standard wave-lengths and urging further work on the subject was adopted. The printing of a list of designations for lunar formations was approved. Further exploration of the meteor craters in North Africa and Siberia was urged, also an extension of the meteor work now being carried on in Arizona. A resolution from the commission on radial velocities earnestly commending any project for obtaining urgently needed data in the southern sky, and welcoming the possibility of establishing a large reflector in South Africa in the event of the transfer of the Radcliffe Observatory, was passed unanimously by the General Assembly. Financial help was granted towards the printing of further volumes of the *Carte du Ciel*. Other grants were continued mostly at a reduced figure, and a new grant was made toward the reduction of the Eros observations.

On the proposal of the finance committee the unit of subscription from the adhering countries was lowered. It was hoped that this might check any further secessions of countries on financial grounds, Australia and South Africa having resigned on that score. Two new countries—India and the Vatican State—were reported as adhering since the last General Assembly, while Roumania had become a fully subscribing member of the Union. As in the number of countries adhering, so also in the numbers of commissions there were changes. The commission on dynamical astronomy was abolished at its own request, while new commissions on 'Selected Areas' and spectrophotometry were formed. The solar commission broke up once more into its earlier constituent parts in the form of commissions on sunspots, chromospheric phenomena, solar spectroscopy and radiation and eclipses.

In addition to the technical discussions and the international organisation in the commissions there was an interesting visit to the Harvard College Observatory and to its new station at Oak Ridge for a 61-inch reflector; later a demonstration was given of eclipse results so far as they could

be announced. Good results may be expected apparently from chromospheric spectra obtained by the falling plate method by the Lick observers, and a very nice flash was secured by the Greenwich observers—the only British expedition in Canada which had any luck at all. Nice pictures of the corona were secured by a number of expeditions, notably the Lick party which also at last obtained some interference fringes from the coronal line. Good polarisation results are hoped for from the French and the Harvard expeditions. Amongst other interesting slides shown at the meeting were the coronal spectrograms and photographs secured by M. Lyot, of the Paris-Meudon Observatory, without the aid of an eclipse.

The next meeting of the General Assembly was fixed for 1935 (probably early July) in Paris on the invitation of the French astronomers. The newly elected executive committee to serve until then consists of Prof. F. Schlesinger (United States), *President*; Prof. T. Banachiewicz (Poland), Prof. E. Bianchi (Italy), Prof. C. Fabry (France), Prof. N. E. Norlund (Denmark), Prof. F. Nušl (Czechoslovakia), *Vice-Presidents*; Prof. F. J. M. Stratton (Great Britain), *General Secretary*.

Recent Researches on Cosmic Rays

IN the *Times* of October 8, Prof. A. Piccard gives an account of his experiments on the cosmic rays during his balloon ascent on August 10, in which he was accompanied by Max Cosyns, and reached a maximum height of 53,672 feet. Two distinct types of observations on the cosmic rays were made on this occasion, one to determine the variation of intensity of the rays with height, and the other to determine the distribution of the radiation in different directions.

The observations on the change of intensity were apparently made in the usual way by measuring the ionisation produced in a sealed vessel. Prof. Piccard states that his results over the same range of height are in good agreement with those found by Prof. Regener, of which an account was given in a letter published in *NATURE* of September 3. It will be recalled that in Regener's experiments, self-registering apparatus was attached to a free balloon which reached a much greater height than Piccard's balloon. He found that the intensity of the radiation increased rapidly at first with altitude, then more slowly, and finally reached what appeared to be a constant maximum at the greatest heights. The free balloon of Regener rose to a point where the barometric pressure was about 25 mm., while the lowest pressure reached by Piccard was 73 mm. The concordant results obtained by the two observers thus give us new and valuable information of the apparent variation of intensity of the rays up to the highest altitudes that are likely to be reached for some time to come.

The second type of experiment made by Piccard was to determine the direction of the cosmic rays by using a tubular Geiger counter. This device

has the property of distinguishing to some extent between rays coming from different directions. At the earth's surface it can be shown with this apparatus that the rays come predominantly downwards. In striking contrast to this, Piccard finds no such directional effect at high altitudes, and thus concludes that the radiation at such great heights is uniform in all directions. He provisionally suggests that the cosmic rays have their origin in the stratosphere. He is, however, careful to point out that this is not the only possible explanation. For example, little if any directional effect would be expected if the rays were actually cosmic in origin and fell on the earth uniformly in all directions. Whatever may be the ultimate interpretation of these observations, they constitute an important contribution to our knowledge.

A vigorous attack on the problem of the nature of the cosmic rays is now being made by several new and powerful methods. The experiments of Regener and Piccard afford trustworthy information of the variation of intensity of the rays with altitude, while the work of many experimenters has given us accurate data of the absorption of the radiation for great depths of water and for other absorbing material. The earlier observations of Millikan had indicated that the intensity varied little if at all on the earth's surface. This important question has been again examined by Prof. A. H. Compton during the past year in the course of his travels in the northern and southern hemispheres. He made observations of the relative intensity of the cosmic rays by the ordinary ionisation method. He concludes that there is a marked change of intensity at different parts of the earth, especially

for the softer components of the radiation. In a recent communication to the *Physical Review* (Sept. 1, 1932) he concludes that there is a definite correlation between the intensity of the cosmic rays and the direction and magnitude of the earth's magnetic field. The intensity in general is higher the greater the angle of magnetic dip. The dependence of the intensity of the cosmic rays on magnetic latitude has also been convincingly shown by Clay and Berlage from continuous observations on a voyage from Amsterdam to Batavia.

Such a relation between intensity of the rays and the earth's magnetic field is to be expected on general grounds if the radiation consists of a stream of swift charged particles. It will be remembered that Prof. C. T. R. Wilson long ago suggested that the cosmic radiation may originate from thunderstorms in our atmosphere. In the intense electrical fields that precede a lightning flash, it is probable that electrons and other charged particles may acquire a very high velocity. If some of these pass out into space, their paths will be bent by the earth's magnetic field and a few may eventually re-enter our atmosphere. In the light of the new observations, such a possible origin of the cosmic radiations should not be overlooked. In this connexion, it should be noted that Schonland in South Africa has found that the intensity of the rays is suddenly altered by the occurrence of distant lightning flashes, but no such effect is observed immediately beneath the thundercloud.

The question of the nature of the cosmic rays is still a matter of much discussion—whether, for example, the primary radiation is of the γ -ray type or consists of a stream of fast electrons or protons—but there seems to be a growing belief that the main part of the radiation is corpuscular in character. This question is now being actively investigated by photographing the tracks of the ionising particles in an expansion chamber and observing the curvature of these tracks due to a

strong magnetic field. By this method Millikan and Anderson have found that not only are swift electrons present, but also positively charged particles believed to be swift protons. Many of these particles undoubtedly have energies corresponding to several hundred million electron volts. Blackett and Occhialini (*NATURE*, Sept. 3, 1932) have made experiments of a similar kind using an ingenious device whereby the passage of an ionising particle through two Geiger counters in line is made to actuate an expansion chamber, placed between the counters, within a hundredth of a second of the passage of the radiation. By this device the accumulation of data should be much more rapid. By the full use of these powerful methods, we may hope soon to obtain definite information as to the nature and energy of these ionising particles, and of the effects produced by them in their passage through matter.

Reference should also be made to another strange type of occurrence observed with the cosmic rays. Hoffmann and Steinke and Schindler have observed sudden bursts of ionisation in a measuring vessel, of a magnitude far exceeding that produced by the swiftest α -particle known. It has been suggested that these bursts of ionisation arise from some type of disintegration process brought about by the cosmic rays: whatever may be the explanation, there can be no doubt these observations suggest a fascinating if difficult field for further research. It should be mentioned that Compton, in his recent experiments already referred to, noted that these bursts of ionisation are much more frequent at high altitudes, and suggested that they may be due mainly to an effect of the softer components of the radiation.

The problem of the origin and the nature and properties of the cosmic rays is one of the most interesting in the domain of physics. It is to be hoped that the concentrated attack from so many different directions will soon bring more definiteness to our knowledge of this obscure type of radiation.

Obituary

MR. WILLIAM G. COLLINGWOOD

THE death of William Gershom Collingwood, artist, archæologist and author, at the age of seventy-eight years, took place at Coniston on Oct. 1. The son of a well-known landscape painter, W. Collingwood, he was born at Liverpool on Aug. 6, 1854, and matriculated at University College, Oxford, in 1872. While at Oxford, where he took first class honours in *Literæ Humaniores*, he formed a close friendship with Ruskin, then Slade professor, and when the health of the latter broke down, accompanied him abroad to France and Italy, later settling near him at Windermere. Here he occupied himself in landscape painting, editing Ruskin's works and lecturing on the theory and history of art. After Ruskin's death he was for some time professor of art at the University of Reading.

In Cumberland Collingwood had come into contact with members of the Cumberland and Westmoreland Antiquarian Society and had been attracted to the study of Icelandic literature and the archæology of the Norse settlements in the north of England. The first fruits of his studies, however, took the form of fiction, his first novel appearing after a visit to Iceland in 1897. Ill-directed criticism of his second venture "The Bondwoman", notwithstanding its high literary merit, diverted him to a more intensive study of the Norse and Anglian archæology of northern England, especially on its artistic side, upon which he became widely recognised as the first authority. A long series of papers in the *Proceedings of the Antiquarian Society*, of which he became editor, culminated in the publication of an exhaustive and

standard work on "Northumbrian Crosses" (1927), in which a knowledge both wide and profound was combined with keen insight and artistic feeling. Although to the general public "The Life and Work of John Ruskin" among Collingwood's writings will be his strongest claim to remembrance, "Northumberland Crosses" is his most enduring achievement. Under his editorship the *Proceedings of the Cumberland and Westmoreland Antiquarian Society* attained a standard of technical and artistic excellence unusual among the publications of local scientific societies; and he was the inspiration and the organiser of much of the excellent work in archaeological research which has been accomplished by the Society in the present century. In 1920 his work was recognised by election to the presidential chair.

MR. H. C. CHADWICK

WE regret to announce the death of Mr. Herbert Clifton Chadwick on Sept. 16 at the age of seventy-three years. He was the last survivor of a group of scientific men who, in the 'eighties of the last century, began the biological investigation of the Irish Sea region. For this purpose the late Sir William Herdman founded the Biological Station at Port Erin, in the Isle of Man, and Mr. H. C. Chadwick, then a business man in Manchester and an amateur naturalist, was made curator of the laboratories. He was a recognised authority on the morphology and systematics of the Echinodermata and was the author of many papers on

these subjects. But his general zoological knowledge was very wide and in his capacity of curator of the Port Erin Station he was able to assist very many investigators and students who worked there during the last forty years.

WE regret to announce the following deaths:

Prof. Karl E. Ritter von Goebel, For. Mem. R.S., professor of botany in the University and Director of the Botanical Gardens, Munich, an authority on cryptogamic botany, especially Bryophyta and ferns, on October 10, aged seventy-seven years.

Dr. T. H. C. Stevenson, formerly superintendent of statistics at the General Register Office, who rendered great service in the field of vital statistics, on September 12, aged sixty-two years.

Prof. William Stirling, formerly Brackenbury professor of physiology in the University of Manchester and in 1906-9 Fullerian professor of physiology at the Royal Institution, on October 1, aged eighty-one years.

Dr. Florence A. Stoney, formerly demonstrator in anatomy at the London School of Medicine for Women, who was a pioneer in X-ray and ultra-violet light treatment, on October 7, aged sixty-two years.

Sir Everard Im Thurn, K.B.E., formerly curator of the British Guiana Museum, and in 1919-20 president of the Royal Anthropological Institute, on October 8, aged eighty years.

News and Views

Antony van Leeuwenhoek, 1632-1723

ON October 24, 1632, four days after the birth of Sir Christopher Wren at East Knoyle, Wiltshire, the tercentenary of which has just been celebrated, Antony van Leeuwenhoek, the eminent Dutch naturalist who has been called the "Father of Protozoology and Bacteriology" was born at Delft. Both Wren and Leeuwenhoek were long associated with the Royal Society in its early days, and both lived to extreme old age; Leeuwenhoek outliving Wren by six months and dying at Delft on August 26, 1723, being then aged—as his epitaph says—"90 years, 10 months, and 2 days". But the careers of these two distinguished men followed very different lines; for while Wren was first a professor of astronomy and then a great architect, Leeuwenhoek began his life as a draper and haberdasher with few advantages of education, and his fame came through his lifelong devotion to microscopical studies. The son of a basket maker, he was sent to a school at Warmond, near Leyden, and at sixteen was an apprentice in Amsterdam. At the age of twenty-two years he married and set up in business for himself in his native town, and for thirty-nine years was "Chamberlain of the Council-Chamber of the Worshipful Sheriffs of Delft". He was also a surveyor and wine gauger. When he began his work with his simple microscopes

is not known, but at the age of forty-one years he addressed the first of his many letters to the Royal Society, then eager to get into touch with all men working for "the promotion of natural knowledge", and it was through these letters he became famous. He was made a fellow of the Royal Society in 1679 (1680 N.S.), a *correspondant* of the Paris Academy of Sciences in 1699, and in 1716 the University of Louvain presented him with a medal. At his death at Delft in 1723 he was buried in the Old Church, in which his daughter Maria, in 1739, erected a monument to his memory.

Leeuwenhoek and the Royal Society

THE connexion of Leeuwenhoek with the Royal Society was unique, since, although for fifty years he was a constant correspondent and for forty-three years a fellow, he never attended a single meeting. His letters were all written in old-fashioned Dutch and before publication in the *Transactions* were translated into English or Latin. They were none the less highly appreciated and many distinguished men visited Delft in order to see the writer of them. He, indeed, became one of the 'sights' of the pleasant town. In spite of his wonderful discoveries and his communications to the Royal Society, hitherto there has been no good account of his career in English.

But the three-hundredth anniversary of his birth is happily marked by the publication by Prof. Clifford Dobell of a handsome volume entitled "Antony van Leeuwenhoek and his 'Little Animals' being some Account of the Father of Protozoology and Bacteriology and his Multifarious Discoveries in these Disciplines". Prof. Dobell has been called Leeuwenhoek's "greatest living admirer" and his book is worthy of his hero. How he was led to the study of Leeuwenhoek's letters in the original Dutch, what difficulties he met with and how these were gradually overcome are set forth in an entertaining prefatory epistle, while after this come chapters dealing with the life of Leeuwenhoek, his observations on protozoa and bacteria, his microscopes and methods of work, his language, his writings and other matters. Leeuwenhoek appears to have been singularly free from prejudice and in one of his letters wrote: "As I aim at nothing but Truth, and so far as in me lieth, to point out Mistakes that may have crept into certain Matters; I hope that in so doing those I chance to censure will not take it ill; and if they would expose any Errors in my own Discoveries, I'd esteem it a Service; all the more, because 'twould thereby give me Encouragement towards Attaining of a nicer Accuracy."

Australian National Research Council

AT the annual meeting of the Australian National Research Council held in Sydney in August, it was determined to make a special effort to secure further financial support for the chair of anthropology which was established in the University of Sydney some time ago through the activity of the Council. The existence of the chair is threatened by recent reductions in government grants. In recognition of the work of its first two presidents, Sir T. W. Edgeworth David and Sir David Orme Masson, the Council has established two lectureships to be awarded alternately at two year intervals, the David lectureship, commencing in 1933, to be devoted to geology or biology, the Masson lectureship, commencing in 1935, to physics or chemistry. A bronze medal in honour of Sir Thomas Ranken Lyle, the retiring president, is to be struck and it will be awarded not more frequently than every second year to such Australian worker in mathematics and physics as may appear to the Council to be worthy of the honour. The incoming officers are: *President*, Sir George A. Julius; *Vice-Presidents*, Sir William Mitchell, Dr. A. C. D. Rivett, Prof. N. T. M. Wilsmore, Prof. H. C. Richards; *Secretary*, Mr. A. J. Gibson; *Treasurer*, Dr. H. G. Chapman; *Executive Committee*, Sir Douglas Mawson, Profs. Agar, Watt, Osborn and Goddard, Drs. Waterhouse and Dickson, and Messrs. Andrews, Gepp and Wainwright.

A LONG discussion as to the future policy of the Australian National Research Council and its relationship to the International Research Council took place at the annual meeting. The standing of the Council as a national academy of sciences for the Commonwealth was reaffirmed and, with the object

of stimulating its working in certain respects, the executive committee was requested to introduce such changes in constitution and by-laws as might be necessary to give effect to the following objects:— (1) the institution of a very limited fellowship; (2) the appointment of distinguished overseas scientific workers who have been associated with science in Australia as honorary overseas fellows; (3) migration of headquarters between capital cities; (4) alteration in rules of appointment to the executive committee to ensure more frequent changes in personnel and to effect closer contact with Royal Societies and other scientific bodies; (5) the display of greater initiative and leadership in the attack upon major problems associated with science in Australia, the Mandated Territories and the Australian quadrant of the antarctic continent; (6) the devising of practical means for bringing members in all centres into more intimate touch with the handling of these problems; and (7) the formation of a committee to explore the possibilities of a federation of Royal Societies and certain other scientific organisations in Australia.

Exhibition of Inventions

THE eighth International Exhibition of Inventions organised by the Institute of Patentees (Incorporated) was opened at the Central Hall, Westminster, on October 5 by Sir Maurice Jenks, the Lord Mayor of London. The opening was followed by a luncheon at St. Ermin's Restaurant, when Lord Askwith, president of the Institute, remarked that it is not the old men, but the young, who are bringing marvellous things into the world. As in former years, the exhibition is divided into two main sections, a trade section which includes many things already on the market, and a section of new inventions, the latter being sub-divided into groups of exhibits relating to domestic and labour-saving appliances, electrical and radio apparatus, building and housing details and mechanical apparatus. As might be expected, the last of these groups contains many new devices for motor vehicles such as brakes, lights, signalling signs and means for preventing cars being stolen. One interesting exhibit is a small electrically driven model boat in a tank demonstrating the increase in efficiency of the propeller obtained by surrounding it with a ring of approximately cone section. Other exhibits relate to internal combustion engines and to variable speed gear and transmission gear.

A Reversing Centrifugal Gear

AMONG the last group of exhibits in the Inventions Exhibition is the new epicyclic gearing invented by Prof. F. Soddy, the main object of which is to provide for the transmission of large powers at high speed, and for reversing without declutching. The gear in one form or another is therefore suitable for use with steam turbines or high-speed marine engines. Unlike most epicyclic gears, there are in it no toothed wheels. The driving and driven shafts are co-axial. On the end of the driving shaft are

two cranks at 180° apart and these drive two heavy 'planets', which have a slight freedom of movement in a radial direction relative to the crank pins. When the shaft is revolved at high speed, the planets are thrown outwards by centrifugal force and their outer surfaces come into contact with the inner surface of a fixed annular casing around which they begin to roll. The disc of each planet is pierced with circular holes and in these fit loosely a corresponding number of rollers and studs carried by discs on the driven shaft. It is through these that the power is transmitted. The gear can be arranged so that if necessary the second shaft is fixed while the casing revolves, while by using planets of a different design the gear can be made reversible. The exhibit attracted considerable attention and it is to be hoped will soon be tried on a large scale.

A Dinosaur from Montana

DURING the past summer, a party from the American Museum of Natural History, under the leadership of Mr. Barnum Brown, has explored the Cretaceous rocks of Montana in which remains of fossil reptiles occur. According to a message from the New York correspondent of the *Times* which appears in the issue of Oct. 1, it has found a nearly complete skeleton of the armadillo-shaped dinosaur *Nodosaurus*, which has hitherto been known only from fragments. The reptile is remarkably broad, for although it is only 14 ft. long, it is 7 ft. wide at the hips. It is heavily armoured with bony plates, which are arranged to give flexibility to the trunk and tail. It has feeble teeth adapted for feeding on either vegetables or insects. *Nodosaurus* was first recognised and named in 1889 by the late Prof. O. C. Marsh, who received characteristic pieces of it from his collectors in the Cretaceous rocks of Wyoming. A somewhat similar fossil skeleton, without head, was discovered in 1913 by the late Mr. W. E. Cutler in corresponding deposits in Alberta, Canada, and it is now exhibited in the British Museum (Natural History). It was named *Scolosaurus cutleri* by Baron Nopcsa, who published a restored drawing of it by Miss Alice B. Woodward in the *Illustrated London News* of Sept. 11, 1926. *Scolosaurus* must have been about 12 ft. long, and would be only about 3 ft. high when walking. A smaller reptile of the same group was found long ago by the late Rev. William Fox in the Wealden formation in the cliffs on the south coast of the Isle of Wight, but he was able to recover it only in a rather fragmentary state. It was named *Polacanthus foxi* by Hulke, and is now also exhibited in the British Museum (Natural History).

Memorial to the Late Sir Andrew Balfour

ON October 6 the Earl of Athlone, Chancellor of the University of London, unveiled a memorial tablet to the late Sir Andrew Balfour, first director of the London School of Hygiene and Tropical Medicine, in the entrance hall of the School. The tablet, which is of polished Roman stone with a bas-relief head in bronze, is the visible part of a twofold memorial,

the other purpose being a scheme to enable students, preferably those from overseas, to pursue courses of study at the School. At the ceremony the Chancellor paid a well-deserved tribute to Sir Andrew and his world-wide work in the cause of tropical medicine and public health. Referring to the organisation of the London School of Hygiene and Tropical Medicine he said: "To that work which was, alas, to prove the last of his labours—the building, the equipment, the organisation of this great School—Andrew Balfour brought the same passionate zeal, the same untiring energy which were characteristic of his whole career, and his inspiring personality is so very fresh in the minds of all of you that of his last great piece of work there is hardly any need to speak. The appointment of Andrew Balfour to be the first Director of this School gave to the School from its very inception a splendid introduction throughout the whole world and contributed perhaps more than anything else to the reputation which it has already established. Finally, and in a word, Balfour was a great Empire builder; and when I say this I am thinking not so much of his devotion to work, of his vast knowledge and contributions to the subject of Empire health, not of his academic distinctions, not of his contributions to sport and literature, but of his fine character. He was without guile, honest to the core, a man who evoked in his colleagues a spirit of love and sacrifice." It is fitting that the memorial tablet bears the quotation from Walt Whitman which Balfour himself loved:

"Through the battle, through defeat, moving
yet and never stopping,
Pioneers! O pioneers!"

Excavations in Westmeath, Ireland

EXCEPTIONAL interest is attached to the finds which have been made by the Harvard University Archaeological Expedition in excavating a crannog at Ballinderry, near Moate, Co. Westmeath, Ireland, and an early bronze age cairn at Knockast nearby. The excavations are in charge of Dr. H. O'Neill Hencken, whose recent book on Cornwall in the "County Archaeologies" series, has given him an assured place among authorities on British archaeology. The crannog was first identified by Dr. Adolf Mahr, of the National Museum of Ireland, some four years ago, when a Viking sword was found in the course of cutting a drain across the bog. The island constituting the crannog is built up of layers of brushwood and peat contained by timber piles, on which lay a substructure of massive timbers supporting further layers of peat and brushwood and the floor of a circular dwelling. Above this, and built some time later, were two smaller rectangular houses. Judging from the animal remains, the inhabitants were both hunters and herdsman, while the coulter of a plough and querns indicate their practice of agriculture. In place of pottery they used well-turned wooden vessels, made on a lathe, and barrels made of staves and hoops. Among the tools and weapons of iron was a Viking battle-axe. The remains are dated at about A.D. 1000. The

most remarkable finds were a hanging lamp and a gaming board. The former is described by a correspondent of the *Times*, who gives an account of the discovery in the issue of Oct. 7, as "the finest bronze which has yet come to light in excavation in Ireland". It is a pointed oval, with three hanging chains attached to animal heads, and is decorated with rosettes and an acanthus scroll. It will be interesting to hear Mr. Kendrick's analysis of its relation to the British hanging bowls, from which descent is claimed for it. The wooden gaming board has forty-nine holes and is bordered with carved Celtic patterns, said to be the finest Viking object known from Ireland.

Television Broadcasting

THE transmissions from Broadcasting House, London, of television by the Baird process have fulfilled the expectations of the radio engineers. Some think that this may lead to the revival of the 'puppet' show which was very popular about two hundred years ago. The London transmissions have been seen well in Scotland, a distance of more than 400 miles. At present two bands of radio frequencies are required in the overcrowded ether, one for the visual and another for the sound signals. In *Television* for September A. P. Peck describes a new system of broadcasting developed by the Columbia Broadcasting Company of New York which uses only one wave for both sight and sound signals and thus makes a smaller demand on the available channels in the ether. A low-powered 45 kc. (kilocycle) oscillator is used in the first instance for the sound signals, the wave being modulated by the sound programme coming from the television studio. The sound modulated current includes frequencies up to 5 kc. on each side of the carrier wave. The wave with the television signals occupies the band on the frequency spectrum ranging from 2750 to 2850 kc. The sound signal is actually radiated on two sub-carrier waves with frequencies of 2755 and 2845 respectively. With this arrangement the Columbia engineers have got satisfactory results. Not only does the method save space in the ether but it also saves equipment at each end. It is a great advantage to the average 'looker in' to have a receiver for both sight and sound which is compact, not easily damaged and simple to operate.

Revised Standard Frequency Radio Transmissions

THE modern extensive use of radio communication of all types demands for its success that each transmitting station shall keep very exactly to its allotted wave-length or frequency, so that interference with transmissions on neighbouring wave-lengths may be reduced to a minimum. At the present time the majority of commercial radio transmitting stations on land, including those employed for broadcasting purposes, use in their installation a source of oscillations the frequency of which is accurately controlled by means of a tuning fork or piezo-electric crystal. In order that the administrations to which these stations belong may be able to measure and adjust

their wave-lengths very accurately, it is necessary that their controlling apparatus may be frequently checked against some national or international standard. It was to meet this need that on behalf of the Radio Research Board of the Department of Scientific and Industrial Research, waves of accurately known frequency have been transmitted for some years past from the wireless station at the National Physical Laboratory for checking the calibration of wavemeters and other apparatus.

THE programme of transmissions has recently been revised and the main standard now employed consists of a single frequency of 1,000 cycles a second. This frequency is derived from an installation which is maintained in continuous operation, day and night, at the National Physical Laboratory and serves as the national standard of Great Britain. This low frequency standard is emitted in the form of a modulation on a carrier wave the nominal frequency of which is 360 kc./s. (wave-length 830 m.). A regular monthly programme of such transmissions is now maintained by the National Physical Laboratory to enable all those desirous of doing so, to receive the transmission and to make a comparison between their own frequency standard and that of the Laboratory. In addition, a second quarterly programme of standard frequency transmissions consisting of a controlled carrier wave of frequency 1785 kc./s., is still maintained by the Laboratory, largely for the benefit of amateur experimenters. Those interested in this work can obtain a copy of the programmes of transmissions on application to the Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, London, S.W.1.

Pharmacy and Recent Advances in Science

THE opportunities which the present rapid advances in science offer to the student formed the text of the address delivered by Dr. C. W. Kimmins at the opening of the School of Pharmacy of the Pharmaceutical Society of Great Britain on Oct. 5. For the scientific research worker there are all sorts of important problems awaiting solution. A student of organic chemistry frequently encounters puzzles such as this: a substance is known as a natural product of great medicinal value; the chemist works upon it and finds that a substance can be produced synthetically apparently exactly similar, yet the physiological properties may differ in a marked degree. Many of these problems of the different action of synthetic and natural substances have been solved, but delightful fields for research remain. Even in a limited field, to have extended the bounds of human knowledge must ever be a source of intense gratification to the worker. To take another example, in physical analysis, scientific workers at one time concentrated exclusively on the elements of the visual spectrum; but of late years a great transformation has taken place. Men of science are concentrating on the larger wave-lengths on one side and the smaller wave-lengths on the other, with the relative neglect of the intermediate wave-lengths. When the ultra-violet part is successfully

charted and carefully studied it will cast a wonderful flood of light on physiological processes, especially upon the growth of plants, so many of which are materially affected by stimuli associated with minute wave-lengths. With such advances in science and the solution of previously apparently insolvable problems, it is not to be wondered that the enthusiastic student of to-day has developed a spirit of adventure unknown in former days.

The Giant Horntail Borer

A SHORT time ago a cinema picture of the giant horntail borer (*Sirex noctilio*) and its parasite (*Rhyssa persuasoria*) was shown in the theatres of New Zealand. This picture was of especial interest to the Dominion, since it was upon the researches into the biology of these insects in England on behalf of the Cawthron Institute, Nelson, that the picture was based. Owing to the widespread establishment of *Sirex* in the exotic coniferous forests, particularly of *Pinus radiata*, in New Zealand, Sir Guy Marshall, of the Imperial Institute of Entomology, was approached by Dr. D. Miller, and as a result, the former arranged with Dr. Thomson, of the Empire Marketing Board's Parasite Laboratory at Farnham Royal, for a study to be made of the parasite *Rhyssa* in order that supplies might be secured and sent to New Zealand. This has been done and the parasite liberated in its new environment. The actual life-history studies on *Rhyssa* were undertaken by Dr. Chrystal, of the School of Forestry at Oxford, where the picture was made. It is work of this nature, especially when presented to the public in picture form, that forcibly demonstrates how dependent the overseas Empire States are upon the assistance of such institutions as the Imperial Institute of Entomology and the Farnham Royal Parasite Laboratory.

Antiquities from the Thames

A QUESTION of considerable interest to archaeologists was raised at a meeting of the Thames Conservancy Board on October 10 in connexion with a report by Prof. Elliot Smith on a human skull and bones of late bronze age which had been dredged from the bed of the Thames below Hampton Court Bridge. A letter was presented from the Council of the London and Middlesex Archaeological Society asking that articles of archaeological interest from the bed of the Thames should be deposited with the museums of the county in which they were found, and suggesting that objects found in Middlesex should be deposited at the Brentford Museum. The decision of the Board was to refuse the request on the ground that it was felt that all relics from the Thames should be together in the possession of the Board. The opinion of a majority of archaeologists would probably be in favour of the claims of local museums in this matter; but there is much to be said for the single collection, in view of the character of the Thames as a highway of culture from very early times. This argument, however, loses force when it is remembered how many antiquities from the Thames already lie scattered in various museums and collections. The most cogent consideration is the

accessibility of the material for purposes of study. Apart from the suggestion of loans to museums from time to time, Lord Desborough, as chairman, could only hold out the vague hope that the Conservancy might be able to display its collections at some indefinite future time when space might become available. It is very desirable that the collection now in the possession of the Thames Conservancy should be accessible to students. A statement from the Board as to how far this is possible, and if at all, in what conditions and under what regulations, would be welcome.

Industrial Organisation

ARRANGEMENTS have been made by the Governing Body of the Imperial College of Science and Technology for the delivery during the present session of a series of special lectures on various of the productive industries by lecturers whose experience will enable them to speak with authority. The lectures will be given in the Huxley Building of the Royal College of Science, Exhibition Road, S.W.7 on certain Thursdays at 4 p.m., and will be open to all members of the College staff and students. The lectures during the autumn term will be by Dr. Herbert Levinstein, on the chemical manufacturing industry (Oct. 27); Mr. Austin Hopkinson, on the advantages of the small industrial organisation (Nov. 17); Mr. Maurice Solomon, on the electrical industry with special reference to the advantages of the large industrial organisation (Dec. 1); and Mr. G. M. Burt on the building industry (Dec. 15). Particulars of the lectures during the spring term will be announced later; but they are expected to treat of (a) the heavy engineering industry, (b) the textile industry, and (c) the steel industry. It is intended to publish the seven lectures in a volume.

THE immediate object of the lectures is to give Imperial College students, many of whom enter manufacturing industries after graduation, an idea of some of the bigger problems, of whatever nature, which confront manufacturers at present, and to suggest what the future may have in store, either in the way of technical improvements, or as a result of national and international developments. In taking this step the Governing Body has been prompted by the feeling that, in this time of world depression, the considered views of the manufacturer have not been sufficiently heard. The lecturers have accordingly been chosen from distinguished men in control of particular branches of the productive industries, and able therefore to speak with authority upon the subjects with which they will deal.

Training in Industrial Management

THE increasing complexity of industrial management, together with the intensification of world competition, seems to call for the more effective training of managers and industrial executives than has been usual in the past. To meet the special requirements of 'industrial scientists', a course of training in industrial management is to be started by Mr. W. R. Dunlop at 57 Gordon Square, London. The aim is to supplement the basic scientific training

of the physicist, chemist, biologist or engineer with a training in the methods, functions and problems of industrial and business management. The course extends over a period of three months and covers "The Function and Problems of Industrial Management", "Sciences underlying Industrial Management" and "The Mental Activity of Industrial Management."

"Current Science"

WE have often commented on the increased interest which is being shown in science in India and further evidence of this is afforded by the issue of a new scientific monthly, *Current Science*, the first two parts of which have now been received. The journal, which is published at the Indian Institute of Science, Bangalore, under the direction of a strong editorial board, is modelled on NATURE both in its format and in the arrangement of its contents. The first two numbers contain editorials on "Retrenchment and Education" and "Unemployment among the Educated Classes". The former is of general interest, the latter, however, deals with a problem peculiar to India and one which has arisen mainly from the adoption of a university degree as a means of entry to Government service. The problem is now acute and without doubt steps will have to be taken to raise the degree standard in Indian universities and simultaneously to institute Civil Service examinations. Other articles of interest are "The Study of Nutrition in India" by Col. R. McCarrison and "Chemistry and Currency" by Dr. Gilbert J. Fowler. Numerous short scientific communications appear in the form of letters to the editor and there are short abstracts of recent publications in other journals. We welcome the appearance of this new monthly; if the standard of the first two issues is maintained it will be a valuable addition to scientific literature.

Automatic Temperature Control

WHEN the temperature during an industrial process must be kept constant it is more economical to do it automatically than by hand, and in a thirty-page pamphlet issued by Messrs. Negretti and Zambra methods of control are described. They depend on mercury in steel thermometers in which the capillary tube ends in a Bourdon tube which uncoils as the temperature of the bulb of the thermometer rises. This actuates a mercury switch if the heat supply to the furnace or chamber is electrical, or a compressed valve in a two-atmosphere air supply leak if the heat supply is gas or liquid. The change of pressure of the air supply operates a valve in the gas or liquid supply pipe.

Announcements

THE Secretary of State for the Colonies has appointed Mr. P. C. Chambers to be agricultural officer, Kenya.

THE Thomas Hawksley Lecture of the Institution of Mechanical Engineers will be delivered by the Right Hon. Lord Rutherford on Nov. 4, at 6 P.M. Lord Rutherford has chosen as his subject "Atomic Projectiles and their Applications".

MR. H. J. PAGE has been appointed controller of the Agricultural Research Station of Imperial Chemical Industries, Ltd., at Jealott's Hill, Bracknell, Berks, following the release of Sir Frederick Keeble from his executive and routine duties at that Research Station. Mr. Page was until 1927 head of the Chemical Department and chief chemist at the Rothamsted Experimental Station, and since that time has held the position of head of the Research Laboratories and chief chemist at the Research Station of which he has now taken charge.

AT the annual meeting of the Yorkshire Naturalists' Union to be held on Dec. 10, it is proposed to present to Mr. Thomas Sheppard, director of the Hull Municipal Museums and editor of the *Naturalist*, the official organ of the Union, his portrait in oils by Mr. Vincent Galloway. The presentation is to mark the retirement of Mr. Sheppard from the editorship of the *Naturalist* and as an appreciation of his work in that capacity for the last thirty years. Subscriptions may be sent to the Hon. Treasurer, The Yorkshire Naturalists' Union, Sackville Street, Leeds.

AN award of the Harrison Prize will be made next December by a committee consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society. The Prize is of the value of about £150 and is awarded to the chemist who, in the opinion of the Selection Committee, during the last five years has conducted the most meritorious original investigations in any branch of pure and applied chemistry and has published his results. Further information can be obtained from the President, The Chemical Society, Burlington House, Piccadilly, London, W.1.

A MOVEMENT is on foot among the engineering profession to mark in an appropriate manner the centenary, in April next year, of the death of Richard Trevithick, one of the greatest of British engineers. A meeting of representatives of engineering institutions will be held on October 20, at 5.30 P.M. at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1. Engineers generally who are interested in the proposal are cordially invited to attend. The movement was started by the Newcomen Society for the Study of the History of Engineering and Technology, the honorary secretary of which is Mr. H. W. Dickinson, Barn Field, Riddlesdown Road, Purley, who will be pleased to answer inquiries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in biology at the Bishop Otter College (Church of England) for Women Teachers, Chichester—The Principal (Oct. 24). A director (professor) of the Research Laboratory in Zoology and a director (professor) of the Research Laboratory in Biochemistry at the University of Madras.—The Registrar, University of Madras, Triplicane, P.O., Madras (Dec. 1).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Oldoway Human Skeleton

IN NATURE of June 18, 1932, page 903, Prof. D. M. S. Watson and C. Förster Cooper discuss further the question of the Oldoway human skeleton. I should be grateful for space to reply to certain points raised by them.

They state: "Dr. Leakey now claims that the skeleton was buried in Bed 2 before Bed 3 was deposited over it. This involves the supposition that the deposition of the materials of Bed 2 took place in water so shallow that a bedding plane was at one time exposed to air and sufficiently dried to allow men to walk over it and dig a grave in it." I simply cannot agree that any such supposition is necessarily involved. Bed 2 is a shallow water deposit and its surface may have dried up as they suggest; but there is another explanation equally possible: that the body of Oldoway man was deposited into the deposits of Bed 2 *under water*. Even to-day in certain circumstances, some native tribes dispose of the bodies of undesirables, such as suicides, in just such a way, "so as to prevent the spirit from escaping". Possibly the idea of a burial under water had not occurred to my critics.

Concerning the rate of erosion, my own estimate is that at a time less than fifty years before Prof. Reck came to Oldoway, the site where he found the skeleton was covered by a deposit consisting of a very small relic of Bed 3 overlain by Bed 5 and the steppe lime. The rate of erosion can be estimated fairly accurately from certain facts, and if anything, I believe my estimate is on the conservative side. Moreover, I do not remember ever having mentioned "survey pegs inserted by Prof. Reck in 1913"; for they do not exist. What we did find were the stumps of the corner posts of the hut erected by Prof. Reck over the skeleton while he was working on it. Experiment shows that these posts, if they were to hold the weight of the hut, must have been inserted at least eight inches into the ground, and the hut was erected on the flat. When we found them, erosion *on the flat* had been such that one of the post stumps had fallen and the others were sticking a bare two inches into the ground. In other words, erosion on the flat had been about six inches between 1913 and 1931.

Actually, of course, erosion does not go on at a constant rate, but the cliff face has receded between 1 ft. 6 in. and 2 ft. since Reck was there in 1913. If Prof. Watson and Mr. Förster Cooper had seen the site, I cannot believe that they would still contend that the skeleton represents a relatively recent burial.

I agree that the mere fact that the bones of the Oldoway skeleton are as much mineralised as others from Bed 2 (though less so than bones from Beds 3 and 4) is of itself evidence of no great value, but I would like to point out that Messrs. Mollison and Giesler, after a very careful study of the amount of organic matter remaining in the bones, formed the conclusion that the skeleton was not younger

than Magdalenian. I would further point out that, so far as I understand them, Messrs. Mollison and Giesler do not dwell on the resemblances to the Masai. Their argument is rather that "as we find certain Oldoway characters among Hamites it is quite possible that these characters are of old standing in Africa and form one element (perhaps mixed with negro) among the Hamites". This is very different from a statement that Oldoway man resembles the Masai who still inhabit the district.

My criticisms and replies to other points raised in the letter must be reserved for our detailed report. I must, however, add that I do regard the discovery of the Kanam mandible and the Kanjira skulls as relevant to the Oldoway problem, in that they at least show that *Homo sapiens* was in existence at the time when Bed 2 at Oldoway was being formed.

L. S. B. LEAKEY.

(Written in camp at Oldoway. Aug. 14, 1932.)

P.O. Box 40,

Limuru,

Kenya Colony.

HAVING recently visited Oldoway, and having studied the geological sections there displayed, especially with the view of evaluating evidence for or against the Bed 2 age of Oldoway man, I am deeply interested in Prof. Boswell's letter in NATURE of Aug. 13, under the above title, and I should like to offer the following remarks.

Average samples of the beds were taken and these were studied in the laboratory by Mr. W. C. Simmons, senior assistant geologist on my staff, who has considerable experience of such work, and from my own investigations and the work of Mr. Simmons I personally have no objection to the post-Bed 4 age of the human remains. Indeed, field studies have inclined me to the view that Oldoway man is probably of Kenya Aurignacian date, and from personal knowledge of the site I am persuaded that he is pre-steppe limestone. Prof. Boswell and Dr. Solomon have, I consider, shown the human fossil to be younger than Bed 4, but I contend they have not done more than that; at any rate, it would so appear from the former's letter. The fact that the matrix from between the ribs contains bits of concretionary limestone containing a mineral characteristic of Bed 4 does not prove the burial to be post-Bed 5, for Bed 4 contains concretionary limestone, and for that matter so do the other beds, not excluding Bed 2, a fact to which I particularly directed Dr. Leakey's attention.

E. J. WAYLAND.

In Camp,

Nsongezi,

Kagera River, Uganda.

Sept. 17.

Lubricating Oils and Cancer

IN connexion with a recent note on emulsification,¹ Mr. W. T. Astbury has directed our attention to the latest report of the Manchester Committee on Cancer. According to the *Times* abstract from this report, "the addition of a small quantity of saponifiable oil to the lubricating oil reduces markedly the number of tumours induced. No oil surpasses lanolin in this respect. The substitution of lanolin for castor oil as a protection for oil workers has markedly lessened dermatitis among them, particularly if the workers

are young". A striking parallel exists between these results and the data obtained for the removal of mixed oils from wool. It has been shown that mineral oil is extremely difficult to remove from wool by emulsification, owing to high oil-water interfacial tension and high adhesion. The difficulty can be overcome by the addition to mineral oil of polar compounds which reduce the oil-water interfacial tension without increasing adhesion so far as to make emulsification difficult. Fatty acids, and glycerides such as olive oil, were found to be ineffective compared with oleyl alcohol, which causes ready emulsification in 6 per cent concentration. Similarly, certain alcohols from lanolin may be used to confer emulsifiability on mineral oil, a mixture containing 15 per cent being emulsified with as much ease as olive oil.

The parallel between these two sets of results suggests that the incidence of dermatitis and tumours may be caused by the difficulty of removing mineral oil from skin by means of soap solution, and that lanolin is effective only in so far as it affects emulsifiability. Working on this hypothesis, Prof. R. D. Passey, director of cancer research of this University, has commenced experiments with mixtures of mineral oil and polar compounds possessing the necessary critical oil-water interfacial tensions. The inherent probability of the view that ease of removal of mineral oil from skin must lessen the risk of cancer formation, impels us to say that, on the basis of the work on emulsification, mixtures of mineral oil and derivatives of wool fat were prepared for use on textile machinery, but simply on account of their improved lubricating properties and ready emulsifiability. The possibility of such mixtures being non-carcinogenic was in no way foreseen.

J. B. SPEAKMAN.
N. H. CHAMBERLAIN.

Textile Chemistry Laboratory,
The University, Leeds.
Sept. 16.

¹ Speakman and Chamberlain, *NATURE*, 130, 274; 1932.

Inheritance of Acquired Characters

THE interesting letter from A. F. Dufton in *NATURE* of Oct. 1, p. 508, suggests a statistical method of study of the possible transmission to the offspring of mental characteristics acquired during their life by their parents, the possibilities and limitations of which seem to have been little explored or discussed. Mr. Dufton takes the age distribution of the fathers at the birth of 1000 eminent persons from the fourteenth edition of the "Encyclopædia Britannica", and shows that these ages are distinctly higher than the ages of the fathers of 100,000 children less than one year of age at the Census of Scotland in 1921. At first sight the inference might be drawn from this fact that the superior ability of the children was due to the increased wisdom acquired by their parents during their experience of life; but, before drawing this conclusion, there are one or two preliminary points to be considered.

(1) It is certain that during the relevant period the upper and middle classes married on the average some few years later than the general population. Presumably, the ages of fatherhood in these classes were also somewhat retarded. If, as one might suppose, the 1000 eminent persons chosen by Mr. Dufton came disproportionately from these classes, this alone

would explain the greater age of paternity. A more satisfactory comparison would be between the ages of paternity for the eminent persons, and those of their less eminent brothers and sisters. This reduces itself to a comparison between eminent and non-eminent persons from the same families according to order of birth.

(2) In comparisons between selected and unselected children according to order of birth, great care is unfortunately necessary to eliminate the effects of death in childhood. It is a mistake to assume, for example, that corresponding to every sixth child, there is one child of each preceding birth order, who might equally have become eminent. In families of six or more, some of the first five children will have died before attaining an age at which their talents might have raised them to eminence. Again, among families terminated voluntarily, the sex ratio of the last child must be much disturbed in favour of males, and more than half of the 1000 eminent persons are doubtless of this sex. A just comparison will require the proportion of eminent to all the surviving non-eminent, according to birth rank and size of family, for the two sexes separately. Such a tabulation would be full of interest.

(3) Supposing the sociological and statistical difficulties of the comparison were overcome, it would be a matter for further inquiry whether the differences observed (supposing them to be in the same direction as those found by Mr. Dufton) were due to the inheritance of environmental modifications, or to environmental modifications themselves. There is little doubt that children brought up in close contact with others slightly older than themselves are somewhat more precocious (in reading and writing for example, and in acquiring a vocabulary) than others without this advantage. Again, if parents increase in wisdom with years, should not this wisdom be partly applied in improving the upbringing of the later children? I mention these points, not to discourage inquiry into the effects of birth rank, but to show that the specific question of a Lamarckian factor is not more easily disentangled in this than in other modes of inquiry.

(4) Some doubt might be felt whether all forms of capacity do increase greatly with increasing age, say from 30 to 43, to take the quartiles of Mr. Dufton's distribution for the fathers of the eminent. Should we not expect that the fathers of athletes, aeronauts and possibly artists and poets, and any occupations showing enterprise, receptivity and a capacity to learn, should be younger than the average, while those of misers and politicians should be conspicuously older? Opinions will doubtless differ widely as to the position of men of science.

R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, Herts.
Oct. 3.

Diamagnetism of Molecules

For diatomic homopolar molecules the bond-forming electrons are imagined to be concentrated within the region of the two nuclei and to experience the attractions of the different centres. The resulting torque causes a continual transference of angular momentum between the electron and the nuclei, and, as has been shown by Van Vleck, the average square of the electronic angular momentum, and

hence of the magnetic moment, does not vanish even for 1S state of the molecule. This causes a loss in diamagnetism the magnitude of which is proportional to the degree of concentration of charge within the region between the nuclei; this concentration is also responsible for the more essential part of the binding energy of a homopolar molecule. Hence for diatomic homopolar molecules we should expect that the loss in diamagnetism on molecule formation will be proportional to the binding energy.

The table given below attempts to test this conclusion. The atomic χ values have been computed by Slater's method. As these values are for isolated atoms, comparison would have been justified if the molecular χ 's referred to the gases. Unfortunately, observations are available mostly for solids and liquids. There is also an uncertainty in the spectroscopic determination of the dissociation energy. Considering all these factors, it would seem from a study of the table that the relation holds to a first approximation.

Table I.

	Calc. (atom+atom)	Obs. (molecule)	Percentage loss	Dissociation energy (spectroscopic) (thermal)	
H ₂	4.86	3.99	18	4.42	4.2
C ₂	18.82	11.76	37.5	7.0	
		(diamond)			
N ₂	16.20	11.8	27	9.0*	
CN	17.51	11.25	36	9.5	
S ₂	44.02	30.72	30	4.9	
		(rhombic sulphur)			
Cl ₂	40.78	40.47	1	2.54	2.47
Br ₂	67.56	62.4	7.7	1.96	2.0
I ₂	102.86	91.5	11	1.53	1.6

The susceptibility and energy data are taken from the International Critical Tables except * which is from NATURE, vol. 129, 870; 1932). It appears roughly that there is a loss of about four per cent per volt of dissociation energy. Cl₂ does not fall into the scheme. There are reasons for believing that the computed value for I₂ is too high, which if true will improve the agreement. A detailed paper appears elsewhere.

D. P. RAY-CHANDHURI.

University College of Science,
Calcutta. Aug. 18.

Nuclear Structure

In a recent note in NATURE,¹ Bartlett has shown that the nuclei of the light elements may be represented by a model built up of appropriate numbers of neutrons and protons arranged in independent groups about an α -particle. It seems very significant that the numbers of protons and neutrons thus assigned to the p - and d -shells are the same as those required by the Pauli Exclusion Principle for electrons. This at once suggests that quantised spins and orbital momenta are also associated with the neutrons and protons in the nucleus. From quite another point of view, Heisenberg² has found it necessary to assign a spin, $\frac{1}{2} \cdot \frac{h}{2\pi}$, to the neutron.

Considerable support can be found for such an extension of the model by consideration of the nuclear moments of the lightest elements. To obtain complete agreement with experiment, the following assumptions are necessary:—

(1) The protons and neutrons are independently coupled to the central α -particle; as the α -particle has no spin, the nuclear moment is the difference of the resultant momenta of these two systems.

(2) The protons—attracted to the α -particle owing to the nature of the potential curve for small separ-

ations—form a quantised system the state of least energy ('ground term') of which may be predicted by analogy with the similar electronic system, the terms of which are inverted with respect to those of the proton system.

(3) For each neutron, the spin vector is parallel to, and coupled with, the orbital momentum vector. The neutrons form groups of two, with opposed total momentum vectors. In the p -shell, the contribution of each neutron to the resultant moment is $\frac{3}{2} \cdot \frac{h}{2\pi}$.

TABLE.

Nucleus.	Structure.	Component Momenta.		Nuclear Moment (I).
		Neutrons.	Protons.	
H1	π	—	$\frac{1}{2}$	$\frac{1}{2}$
He4	α	—	—	0
Li6	$\alpha + \nu + \pi$	$\frac{3}{2}$	$\frac{3}{2} ({}^2P_{\frac{3}{2}})$	0
Li7	$\alpha + 2\nu + \pi$	0	$\frac{3}{2} ({}^2P_{\frac{3}{2}})$	$\frac{3}{2}$
Cl2	$\alpha + 4\nu + 4\pi$	0	0 (3P_0)	0
N14	$\alpha + 5\nu + 5\pi$	$\frac{3}{2}$	$\frac{1}{2} ({}^2P_{\frac{3}{2}})$	1
O16	$\alpha + 6\nu + 6\pi$	0	0 (1S_0)	0

 π = proton; ν = neutron.

As the table shows, this model accounts for all the observed moments of the nuclei up to O¹⁶—where the p -shell is completed. It is very striking that the nuclear moments of Li⁷ ($I = \frac{3}{2}$) and N¹⁴ ($I = 1$) are no longer exceptional.

It is at present not possible to predict the behaviour of the protons in the d -shell, as the screening effect of the six protons of the p -shell is greater than the attraction of the central charge (+2 units).

E. GWYNNE JONES.

University College,
Nottingham.
Sept. 15.¹ J. H. Bartlett, Jr., NATURE, 130, 165; 1932.² W. Heisenberg, Z. Phys., 77, 1; 1932.

Absorption of Sound by Porous Materials

SOME time ago, there was a discussion¹ between E. T. Paris and Heyl concerning the dependence of the absorption of sound upon the angle of incidence, which, however, produced no solution to the problem. Since for many practical purposes dependence of absorption upon angle and frequency is very important, investigations have been undertaken in this direction, which confirm qualitatively the angle theory of Rayleigh and Paris and a frequency theory proposed by us.

The relation of absorption to angle of incidence was measured in the open air on the flat roof of the institute. Loudspeaker and microphone were placed directly upon the floor. The sound reflected from the specimen under test was measured and compared with that from a completely reflecting plate (for example, a thick glass plate).

The frequencies used lay between 1,000 and 10,000 Hz., the angle of incidence lay between 10° and 75°. The following materials were tested: Tentest, Celotex B and BB, cotton wool and acoustic board. These materials were generally mounted upon plates of absorbing materials (Insulite). Particularly interesting is a material which functions according to the assumptions of Rayleigh, that is, which consists of a series of parallel lying channels constructed from corrugated paper. By closing a varied amount of surface, for example, changing the number of

channels, the porosity was altered from 0.2 to 0.99. The curves measured for the frequency 5,000 Hz. are reproduced in Fig. 1. These curves correspond in the measured range to the theory of Rayleigh and Paris. For the above mentioned materials, curves were obtained in the specified frequency range, which have the form of the theoretical curves for small and intermediate porosities; cotton wool has curves corresponding to a large porosity.

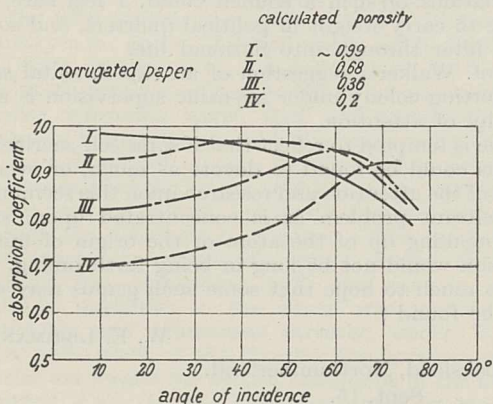


FIG. 1.

Secondly, the dependence of absorption upon frequency was tested. The acoustical impedance was measured for normal incidence in a tube with the help of an electrostatic vibrometer. Theory and experiment show, that the real part of the characteristic acoustical impedance (for infinite thickness) decreases with increasing frequency from a large value to a limit, while the imaginary part decreases to zero. The limit is given theoretically by the expression $\frac{Z_0}{P}$; where Z_0 = acoustical impedance of air and P = porosity. The characteristic limiting impedance of porous materials is always larger than that of air; it follows that a maximum must exist in the above mentioned curves showing the dependence of absorption on the angle of incidence, which is given by the relation $\cos \theta_{\max} = \frac{Z_0}{Z}$ (Z = impedance of the material). The absorption coefficient increases continuously to a limit and has, therefore, on account of porosity alone no maximum. Selective absorption is explained by interference due to limited thickness. This effect has also been investigated.

Details of this work will be published towards the end of this year in the *Elektrische Nachrichten-Technik*.

Heinrich-Hertz-Institut
für Schwingungsforschung,
Berlin NW 87.
Aug. 10.

VIKTOR KÜHL.
ERWIN MEYER.

¹ NATURE, 126, 9, 350, 880; 1930.

Efficiency of Geiger Counter and Absorption of Cosmic Rays

The efficiency of a Geiger counter may be defined as the probability of excitation when the counter is traversed by a high speed electrified particle. A determination of the efficiency for cosmic rays may be obtained in the following way. Imagine three counters 1, 2, and 3, which are placed with their axes in the same plane and their centres in the same (vertical) line. Let n_{12} be the number of coincidences between 1 and 2 and n_{123} the number of triple coincidences. The

efficiency of the counter 2 is then determined by $n_{123} : n_{12}$.

In the experimental arrangement the dimensions of the counters were 5 cm. x 20 cm.; the counters were filled with air at a pressure of 4-9 cm. of mercury. The central electrode was a steel wire treated with nitric acid. The counters were placed in a vertical plane with a distance of 15 cm. between their axes; lead blocks 7 cm. x 10 cm. x 20 cm. could be placed between the counters. Below and on the sides the whole arrangement was screened by 10 cm. of lead in most of the experiments. The method used for recording coincidences has been described previously.¹ It consists essentially in imparting the impulse delivered by the counter to the mirror of an oscillograph. When coincidences between two counters are recorded, the deflections of the two mirrors are crossed, so that when a coincidence occurs the actual deflection makes an angle of 45° with each of the single deflections. In the present experiment it was necessary to use four oscillographs in order to record coincidences between three counters. The deflections of the four mirrors were crossed in such a way that the three possible kinds of coincidences, namely, 1-2, 1-3, and 2-3, were all recorded on the same film.

The smallest time difference which can be detected by this method is 2×10^{-4} sec., corresponding to one-tenth of the duration of the impulse. The number of single impulses from each of the counters was about eighty per minute, the number varying somewhat with the experimental conditions. This gives for the number of accidental coincidences between two counters 0.05 per minute, and for the number of accidental triple coincidences 2.4×10^{-5} per minute. The number of coincidences actually observed was for neighbouring counters about five per minute and for triple coincidences one per minute. The corrections for accidental coincidences are thus very small.

When the counters were operated at a potential a few volts above the lower limit of the sensitive range of voltage, about half of the coincidences 1-3 were triple coincidences, or, what is the same, the efficiency of the counter 2 was 50 per cent. At a potential 30 volts higher the efficiency was 85 per cent. The statistical material was too small for giving accurate numerical values, but in all experiments the same general result was found, the efficiency approaching unity at the upper limit of the sensitive range of voltage.

The justification for considering the efficiency as a property of the counter and not of the exciting radiation lies in the fact that the results were only determined by the voltage of the counters, and not by the presence or absence of the lead absorbers between and on the sides of the counters. This result has some bearing on the problem of the nature of the cosmic rays. If the cosmic rays were of electromagnetic nature, it seems very difficult to account for the values of efficiency actually observed.

J. C. JACOBSEN.

University Institute for Theoretical Physics,
Copenhagen.
Sept. 5.

¹ NATURE, 128, 185; 1931.

Spectrum of Cosmic Radiation

WITH respect to the formula suggested by Dr. A. St. Skapski in NATURE of Sept. 24, p. 472, it is of interest to note that such a formula can be deduced from the classical equations of Maxwell without reference to wave mechanics (*Proc. Roy. Irish Acad.*, vol. 41, A, No. 2).

ARTHUR W. CONWAY.

University College, Dublin,
Sept. 27.

The Contribution of Science to the Future

THE leading article under the above title in NATURE of Sept. 3 is a timely reminder of the outstanding problem of the present age. When science begins to question what is being done with its lavish gifts to humanity, it is a healthy sign, and gives grounds for hope that something may be done towards solving the greatest anomaly of our time—that of scarcity in the midst of abundance, and its attendant evil, unemployment. It is, too, a sign of awakening to the realities of the situation that there were echoes of this question at the recent meeting of the British Association—notably in the president's address and in the suggestive address by Prof. Miles Walker on "The Call to the Engineer and Scientist". Moreover, there are not lacking other signs in various directions that this question is becoming a live issue, and one that must be grappled with, and that quickly.

The question arises, What is the best way of following up these finger-points, and translating them into action?

It may I suppose be laid down as a general proposition that the fruits of science—and they are many—ought to be made available to the community, free of any exacting toll, and in such a way that the benefits are distributed as evenly as possible to every member of the community. Efforts should be directed towards seeing that there is no loss of efficiency between the findings of science on one hand, and their application to human life on the other. Here, if anywhere, should be evidence of the 'conservation of energy' on its highest plane.

Thanks to science, the problem of production has been solved, and by means of a policy of rationalisation, costs have been reduced to a minimum. On the *distributive* side, however, there has been no corresponding advance or change. In the midst of an otherwise changed world, we continue to pursue the same outworn methods of our forefathers of 150 years ago, relying upon the inertia of the past to carry us through.

This disequilibrium between the productive and distributive side of industry, which is the root of the problem, must be righted if civilisation is to reap the benefits of scientific progress. Here more than anywhere else is abundant scope for rationalisation in the proper sense of that rather hackneyed term. Nothing indeed could be more irrational than the existing state of affairs.

The fact is, there has been a sad lagging behind the advance of science on the part of what may be termed the non-scientific world, that is, the ethical and spiritual, and we might add, the political. There has been no preparing of the ground for the coming of the gifts of science, and the result is that much that should otherwise have been a benefit to mankind has simply led to social chaos.

As to what is to be done, a humble suggestion may be hazarded. In these days of over-specialisation, when the general is apt to be lost in the particular, should not an attempt be made to co-ordinate all the leading forces of to-day—scientific, ethical, industrial, political, etc.—by forming some sort of general council, the object of which would be to concentrate upon this special problem of how Nature's gifts, as revealed by science, can best be applied to the welfare of mankind; to plan definitely, and if need be to create, a new order of society, fitted to receive, and make adequate use of, our newly found

powers; and further, to tackle the correlative problem of providing for the proper use of that leisure which may be expected to be the outcome of a proper use of Nature's bounties? The one essential qualification for members of such a council would be the possession of those qualities of mind referred to in the article: it may, perhaps, be summed up in freedom from the inertia and prejudices of the past, and an open mind towards the future. The recommendations of such a council could, I feel sure, be made to carry weight in political quarters, and so in time filter through into national life.

Prof. Walker's suggestion of an experimental self-supporting colony under scientific supervision is also worthy of attention.

One is tempted to reflect that if some self-sacrificing genius could be found to devote as much, or even a tithe of the attention and research upon this seemingly recalcitrant problem as is concentrated upon, say, the breaking up of the atom or the origin of life, a solution would not be long in being forthcoming. Is it too much to hope that some such genius may one day be found?

W. E. LISHMAN.

Stocksfield, Northumberland,
Sept. 15.

A Biological Conversion of Glucose to Glucosone

WHEN the fully developed mycelium of a certain mould belonging to the flavus section of the *flavus-oryzae* group of Aspergilli, is allowed to act upon a 5 per cent solution of glucose in the presence of a small quantity of toluene, I have observed that glucosone is produced. This may be detected in the medium when the experiment has been allowed to proceed at a temperature of about 27°–28° for several days, the presence of the glucosone being demonstrated by the fact that addition of phenylhydrazine acetate in the cold gives rise immediately to a precipitate of glucosazone. A 5 per cent solution of glucose on treatment with phenylhydrazine acetate in the cold does not yield immediately a precipitate of glucosazone.

The glucosone was also characterised as an azine, which was formed when *o*-phenylenediamine was added to the medium from the culture flask. The derivative melted at 194°–195° and proved to be identical in appearance, composition and behaviour, with the azine obtained by treatment of a solution of authentic glucosone with *o*-phenylenediamine. A mixture of the two specimens also melted at 194°–195°.

This formation of glucosone from glucose under the influence of an enzyme or system of enzymes present in a mould is not without interest in view of the suggestion made by Hynd¹ that the first step in the utilisation of glucose in the animal body is oxidation to glucosone, insulin being presumed to act as an oxidase catalysing the conversion.

Further study is being made of the conditions under which this transformation can be effected by biological agency.

T. KENNEDY WALKER.

College of Technology,
University of Manchester.

¹ *Proc. Roy. Soc.*, B101, 244; 1927.

Research Items

Celtic Art in Britain.—A counter theory on Celtic art to that developed by Mr. T. D. Kendrick in his recent advocacy of a Romano-British source for the hanging bowl (see NATURE of July 2, p. 27) is put forward by Dr. R. E. Mortimer Wheeler in *Antiquity* for September. Two main phases of Celtic art in Britain are recognised, a pagan Celtic art beginning in the fifth century B.C., and ending in the second century A.D., and a Christian Celtic art beginning in the sixth century A.D., and lingering on until about the ninth century. Though linked by an essentially similar informing spirit, they are separated by a hiatus of three centuries, a feature rare in the history of a single school of art. Further, when Celtic art reappears after the hiatus, it is not in the dominantly Celtic parts of Britain, but in the pagan Saxon area. Taking the distribution of pagan Celtic art in time and space, it reaches its zenith during the first century B.C., coinciding with the area in which political authority in the island was consolidated, indirectly and afterwards directly, under Roman rule, while north of the Humber the northern school of this art awaits the settled conditions of the second century A.D. In the Christian phase, it was the Saxon settlement and the Saxon peace which afforded the Celtic craftsman the security and leisure he needed for the development of his art, while he was free from the competition of Roman mass production. On this line of thought the sequence of Celtic art becomes logical. On four occasions the Celtic artist was in a sympathetic environment. First in the Belgic and earliest Roman occupation; secondly during the earlier Roman occupation of northern Britain; thirdly during the Saxon settlement of central and southern Britain; and fourthly during the regime of a strong and wealthy church in Ireland; that is, four periods when political and economic security were forced upon the Celts.

Gods of the Acoma.—The Acoma Indians of New Mexico were first visited by whites when Capt. Alvarado was sent on an exploring expedition from Zuñi (Cibola) by Coronado in 1540. They then earned a reputation for unfriendliness which they have maintained until the present day. A study of their culture has recently been published by Mr. Leslie A. White (Forty-seventh Ann. Rep. Bur. Amer. Ethnology). At the head of their pantheon stands Ocato, the sun, the chief of supernaturals. With him are his two sons, Masewi and Oyeyewi, the twin war gods, symbolising courage, strength, and virtue. They are rainmakers and were the leaders of the Acoma people when they lived in the north. Anthropomorphic spirit rainmakers live in the west and are of the greatest importance in ceremonial. Mysterious spirits who dwell in the sunrise strengthen the weak and the sick. Most important of all, however, is Iatik, the great mother, the symbol of human life, but remote from the daily activities of her children. After death the individual goes back to her; but she is never pictured as human in form. The moon and stars are said by some to be spirits; while the clouds, especially the rain clouds, are important and prayers are said to them. Lightning is a symbol of power, and flints are called 'lightning stones'. Four rainmakers live at the cardinal points, each bringing a different type of wet weather. There are also hunting and medicine gods, and with them are San Estevan, Yoshti, Dios (or God), and Christo. These are a survival of the

Spanish conversion of the Acoma to Christianity. Dios is not considered well-disposed towards the Acoma, because he punishes after death, which the other gods never do. Prayer sticks are sometimes offered to him, but always accompanied by prayer sticks for the great mother, Iatik.

Insects attacking Hardwood Timbers in Great Britain.—The Department of Scientific and Industrial Research has recently issued a practical brochure entitled "A Survey of the Damage caused by Insects to Hardwood Timbers in Great Britain", by Dr. R. C. Fisher and Messrs. F. R. Cann and E. A. Parkin (Forest Products Res. Bull. No. 16. London: H.M.S.O. 2s. 6d. net). The losses incurred through attacks of beetles, mainly *Lyctus* powder-post beetles, by all branches of the hardwood timber trade, are increasing. The spread of native and imported species of *Lyctus* in timber stores is such that they now occur in almost every yard and workshop in which susceptible timbers such as oak, ash, walnut, and elm are used. The most reliable method of eliminating *Lyctus* infestation is by kiln sterilisation, in which the timber is heated up to a definite temperature in a moist atmosphere. The Forest Products Research Laboratory, which is responsible for this publication, considers that immediate steps should be taken to control the spread of *Lyctus* beetles in Great Britain. Co-operative action by all trades concerned would result in a widespread demand for kiln-sterilised wood, or wood otherwise free from attack. The bulletin contains the latest information on the *Lyctus* problem and recommendations to trades anxious to diminish losses from this source. It also gives information of the types of injury caused by other insects, and methods of distinguishing them. Unlike *Lyctus*, however, these do not survive the seasoning of the timbers.

Chromosome Numbers of the Genus *Crocus*.—The study of chromosome numbers is becoming of increasing interest. Mr. K. Mather (*Genetics*, vol. 26, No. 1) has made a comparison of the somatic chromosomes in many species of *Crocus* and finds every haploid number between 3 and 15 in this genus, which reproduces annually by forming corms. There is considerable differentiation between the chromosomes of a group, satellites and constrictions being present. There is also evidence of chromosome fragmentation in certain species. Although the haploid numbers form a continuous series, as in *Cyperus*, yet there is also evidence of polyploidy in certain species of *Crocus*, and some species and varieties are clones with an odd number of somatic chromosomes. Fusion of chromosomes may have been concerned in producing such low haploid numbers as 3 or 4. The genus also differs from *Crepis* in that no chromosome number is common to a large number of species. Measurements show that the total bulk of chromatin in the chromosomes may be from five to seven times as great in some species as in certain others with a higher chromosome number. In general, as the number of chromosomes increases there is a decrease in their length and an increase in their size differentiation. This work furnishes the beginning of an important study in chromosome phylogeny.

Maturity of Fruit.—An intensive investigation of the factors affecting the maturation of fruit is being

prosecuted by several members of the Long Ashton Fruit and Cider Institute. Dr. J. C. Hinton reviews the literature on the subject (Ann. Rep. of the Institute, 1931, pp. 40-53), and gives some interesting results of measurements made by a hardness tester. He finds that the rate of softening of later-picked fruit is greater than with earlier-picked produce. Apples from ringed trees and from grass orchards soften more slowly than fruit from cultivated fields, most probably because they have larger quantities of solids, and particularly carbohydrates. The same author reviews the problem from another angle in a later paper (pp. 54-67) of the same report. Extensive data as to the relative amounts of sucroses and hexoses are coupled with the results of starch tests at picking time, and lead to the general conclusion that fruits with a relatively favourable food supply ripen slower than those with a less favourable nutrition. This is, however, complicated by the special cases when potassium is deficient or when the tree is ringed or thinned, for the generalisation does not then hold. Messrs. J. C. Hinton, J. O. Jones, and F. C. Lewis have investigated the influence of position in the cluster on the quality of apples, pp. 68-76). Lateral fruits had more sucrose and lost weight quicker during storage than terminal fruits. Thinning to one fruit per cluster produced an increase in sucrose content of all fruits. Ash constituents were apparently not affected by thinning treatments.

Oxygen Intake of Living Tissues.—Dr. T. A. Bennett-Clarke (*Sci. Proc. Roy. Dublin Soc.*, vol. 20 (N.S.), No. 23, pp. 281-291) has described a method for recording automatically the oxygen intake of living tissues. The suggested method, based on that of Fernandes, embodies certain novel technical features which render it insensitive to changes in atmospheric pressure and include an automatic device for replacing the oxygen utilised by the tissue with oxygen electrolytically produced and introduced into the otherwise closed gas circuit. A specially constructed gas circulating pump which ensures a flow free from pulsations is described in some detail. Details of the methods used for carbon dioxide estimation are given. The methods have been applied (*loc. cit.* No. 23, pp. 293-299) to a study of the respiratory quotients of succulent plants. The changes with time of the oxygen absorption and carbon dioxide production of excised leaves of *Sedum praealtum* were determined and their theoretical significance discussed.

Thunderstorms and Penetrating Radiations.—Whereas C. T. R. Wilson has suggested that very penetrating radiations may be produced during thunderstorms, B. F. J. Schonland in 1930 reported that he had observed a screening effect due to thunderstorms on the ordinary fine weather penetrating radiation. As mentioned in a letter in NATURE of Sept. 10, p. 399, he has since confirmed this by further observations. Prof. G. B. Rizzo, of the Geophysical Institute, the University, Naples, writes to report a similar observation made on August 27, 1932, on Rocciamelone Mount, 3537 metres above sea level. During a very powerful thunderstorm, from 14^h 40^m until 18^h 20^m (M.E. mean time), there was a distinct diminution in the number of ion pairs formed per sec. per cm.³ inside an iron shield 5 cm. thick, placed in an alpine refuge, wooden roofed and covered with 1 mm. galvanised iron plate. The measurements, made with a Kolhörster electrometer (by Günther and Tegetmeyer) showed a reduction from 7.70 pairs

before the storm, and values oscillating about 7.60 after the storm, to values of 7.05 during the storm.

The Velocities of the Ions Striking the Cathode of a Discharge Tube.—In the glow discharge an important part is played by the bombardment of the cathode by positive ions. This bombardment is an important mechanism in maintaining the supply of electrons for the discharge. The velocity distribution of the ions passing through a hole in the cathode has been roughly examined by the Doppler effect in spectral lines emitted by the canal rays, and by the intensity distribution in the J. J. Thomson parabolas, and some particles were found having velocities corresponding to nearly the full cathode fall of potential. Chaudri and Oliphant (*Proc. Roy. Soc.*, Sept.) describe experiments in which the beam of ions passes through a hole in the cathode into a space which is kept free from gas by a fast diffusion pump. The velocity analysis is then carried out by the electrostatic focusing method of Hughes and Rojanski. The velocity distribution curves show a maximum for a rather low energy (of the order of a quarter of the total cathode fall of potential)—with a sharp decrease at lower energies and a more gradual fall towards higher energies. Some ions were found with energies corresponding nearly to the full cathode fall, and it seems that these ions must go through the cathode dark space—about 20-100 mean free paths for molecules—without losing energy by collisions. The authors give a partial explanation of their results in terms of the ionisation efficiency of electrons and the consequent distribution of ionisation in the dark space. The peak in the velocity distribution they explain tentatively by invoking the exchange of charge (Kallmann and Rosen) between the fast ions and slowly moving gas atoms.

The Accommodation Coefficient for Helium on Tungsten.—In a paper in the September *Proceedings of the Royal Society* Jackson and Mott apply quantum mechanics to the problem of the collision between gas atoms and a solid surface. The latter is treated as an assembly of independent atoms which vibrate about a position of equilibrium. The energy of interaction of a gas and a solid atom is supposed to vary exponentially with the separation. The probabilities of energy transfers are calculated, and from these the thermal accommodation coefficient is deduced. The formula derived contains the 'characteristic temperature' of specific heat theory and a parameter characterising the law of interaction between gas and solid atoms. The formula fits well to Roberts's experimental curve connecting temperature and accommodation coefficient for helium on clean tungsten, when the one arbitrary parameter is adjusted for one temperature. The value of this parameter fits in with ordinary ideas of atomic dimensions.

Testing Strings of High-tension Insulators.—The high-voltage transmission cables used for the transmission of electric power are supported by 'strings' of insulators to the lattice towers. These strings have always to withstand very high electric pressures and sometimes owing to atmospheric and other disturbances a 'flash over' occurs and the string may be left in a damaged condition, one or more of the

insulators being punctured. To avoid interruption to the supply it is advisable to test the insulators at periods varying from six months to two years depending on special conditions. To the *Electrical Times* for Sept. 22 Mr. G. A. Robertson contributes a useful article on the new methods which are coming into use for detecting these faulty insulators. Some of the methods seem crude but are none the less effective. The 'buzz-stick' method, for example, consists of a long stick made of bakelite, an excellent insulator, with a pointed metallic object on the top shaped like a hay fork with an extra metallic prong at right angles to the two other prongs. If when holding the eight-foot stick at the insulated end the extra prong is made to touch the 'live' cable and then drawn slowly away, a buzzing noise is heard the loudness of which depends on the rate the fork is moved away and on the voltage of supply. The prong is then applied to the caps of the various insulators in turn and drawn away at the same rate. The sounds heard should vary according to the normal distribution of potential along the string. The next test is to bridge each insulator in turn by the two prongs of the fork. When they are sound, short

snappy sparks are produced, the intensities varying with the potential distribution. When an insulator has been perforated no spark occurs and so it is detected.

North American Game Birds.—The ninth of the valuable series of bulletins on the life-histories of North American birds, published by the United States National Museum, concerns the gallinaceous birds (orders, Galliformes and Columbiformes), and on that account is of more than usual interest to the general reader (*U.S. Nat. Mus. Bull.*, 162). It is the first of the series in which any considerable number of subspecies had to be dealt with, but technical descriptions are reduced to a minimum, and the author, Arthur Cleveland Bent, has made full use of historical data and of the observations of habits made by correspondents. Some notion of the scale upon which the volume is written will be gathered from the fact that 24 pages are devoted to the extinct passenger pigeon, and almost 16 to the heath hen, one among the first of the American birds to be mentioned in the writings of the early colonists, and now apparently represented only by a single aged male individual living in Martha's Vineyard Island, Mass.

Astronomical Topics

Theories of the Evolution of Binary Stars.—*Revue Scientifique* for July 23 contains a discussion on this subject by Dr. P. Baize. He first discusses the capture theory, which imagines the chance approach of the two stars, constrained either by collision with each other or with secondary bodies of their systems to remain in company; it is easily shown that such collisions or appulses would be too rare to explain the immense number of binaries. The theory of neighbouring nuclei in a nebula, favoured by Sir James Jeans to explain the binaries of long period, does not meet with much favour from Dr. Baize. He suggests as an alternative an explosive expulsion from the primary, and refers in support of this view to the companion bodies of Nova Pictoris. But the products of such explosions would either recede indefinitely or would intersect the parent star on their return. Perturbations might prevent actual impact, but it would be a long step from such perilous near approaches to the safe and stable orbits of most of the known binaries. The theory of fission of the primary through rapid rotation, favoured by many cosmogonists to explain the spectroscopic binaries and other close pairs, is taken by Dr. Baize as the general mode of origin of most binaries. He is aware of the immense gap that intervenes between the initial small circular orbits and the large elongated ones, with periods of centuries, of many visual binaries; but he conjectures that loss of mass through radiation, and possible disturbances by passing stars, might bring this about in the billions of years (he says trillions, but he means British billions) which he postulates for the life of the stars.

Exception must be taken to a sentence of the article: "Les étoiles du type 61 Cygni dont le mouvement relatif s'exécute en ligne droite. . . ." It was shown first by Peters, then by T. Lewis, lastly by A. Fletcher (*Mon. Not. Roy. Astro. Soc.*, Dec. 1931), that the motion of 61 Cygni is not rectilinear, but in an ellipse with a period in the neighbourhood of seven centuries.

Report of the Cape Observatory for 1931.—This report contains an account of much important work; that relating to the observations of Eros is of special interest. The unexpectedly large deviation of Eros

from its predicted place necessitated the selection of some new stars of reference; stars from both the old and new lists have been well observed at the Cape. Stars in the zone -30° to -35° are being observed as reference stars for the photographs taken of this zone; a new list has been prepared of stars down to mag. 7.5 between the equator and -30° . 475 plates of Eros were obtained with the Victoria telescope and 678 plates with the astrographic one; the latter are fairly equally divided between large easterly hour-angles, small hour-angles, and large westerly ones. Plates were also taken with a wire grating, to detect stars of outstanding colour-index, and others for obtaining positions of the reference stars. Eros was photographed until May 1931, to provide material for Prof. Gustav Witt, who is revising the orbit.

Observations of the outer planets with the heliometer were continued; the results will be published when revised positions of the comparison stars are available.

The report contains a note on changes in the spectrum of Nova Pictoris, of which a spectrogram was taken at the Union Observatory, Johannesburg, in February 1931. Two lines of unknown origin, at 6088 and 5722, were the strongest; then followed the line $H\alpha$, and that at 4686, due to ionised helium; there was no trace of the nebular emissions, N_1 and N_2 , which were present, but weak, in 1928. The year 1931 was a dry one at the Cape, the rainfall being 19.09 inches, which is 5.28 inches below normal; the mean temperature was 63.8° F., which is 1.4° above normal.

Minor Planets.—Circular No. 653 of the Berlin Rechen Institut assigns permanent numbers to fifteen new planets discovered between 1927 and 1932; three of these proved to be identical with planets observed, but not numbered, in earlier years. The new numbers run from 1209 to 1223. The interesting planet discovered by M. Delporte at Uccle last March, which comes nearer to the earth than Eros, receives the number 1221 and the name *Amor*; this was doubtless chosen as suitable for a companion of Eros.

Conference of the Association of Special Libraries and Information Bureaux

THE ninth annual Conference of the Association of Special Libraries and Information Bureaux, which was held at Somerville College, Oxford, on Sept. 23-26, opened and closed on a note echoed from the British Association meetings at York. In an opening address to the Conference on Sept. 23, on "Science and the Humanities", Prof. J. L. Myres directed attention to three characteristics of our own age, in the abundance of information and of working tools or instruments as well as of those who use them, linked up with increasing opportunities of use and the growing complexities of organisation directed to make both more accessible, and suggested that the depression which accompanies this superabundance of means is possibly no temporary depression. The leisure state may well be upon us and it is difficult to predict what the new order will be. All that can be said is that the situation must be met with new ideas and new projects, and Prof. Miles Walker's address at the British Association meeting was essentially a challenge to the present order and to the general outlook. With this the Association of Special Libraries and Information Bureaux is concerned in the provision of information relating both to accurate knowledge of the world and to the training necessary to make people competent to live. Sir Alfred Ewing's presidential address at the York meeting of the British Association likewise issued a challenge to modern politics, economics and systems of education and raised the whole question of the relative value of science and the humanities both in society and in the preparation of people for its privileges.

Prof. Myres pointed out that while the scientific method makes its chief contribution to human welfare in the assistance it gives in the observation and interpretation of experience, scientific achievement is at once impeded by the absence of moral qualities and aesthetic or artistic taste, and the humanities or human sciences such as human biology, psychology, statistical economics, make an equally important contribution in training human qualities, and the activities of the individual. The development of self-consciousness and self-control is an important aspect in social relations, and full use of information presumes the discernment of individuality in ourselves as in others. Accordingly moral, political, economic and social methods have a geographical or distributional aspect as well as a historical aspect. This, together with the distributional aspects of the systematic sciences, which only become directly applied to life when local or temporal conditions are involved, cuts right across the traditional view of the humanities and even raises doubts as to whether any real distinction is possible between the human and the pure sciences. Prof. Myres suggested that the teaching of a systematic science should be humanised by paying more attention to its historical growth and regional application, and also that the teaching of the humanities might be clarified and intensified by a firmer distinction between their systematic aspect and those historical and regional reconstructions which alone can set the civilisations of the present in an intelligible perspective.

The same vigorous and refreshing outlook characterised the closing address to the Conference, in which, pointing out that the present depression is

sapping moral as well as material resources, Mr. F. W. Pethick-Lawrence emphasised the importance of rational thinking on the situation and of discarding the old method of trial and error. Financial muddling is directly responsible for the crisis, and the way out of our difficulties lies in the intelligent use of accurate information, in treating finance not as an end in itself but as the handmaid of politics.

Comparing the present with previous Conferences, it is evident that the industrial representation is gaining strength and that despite its financial difficulties, the Association is steadily proving its worth and demonstrating the value of the co-operation which it has already established between special libraries and information bureaux. It is clear from discussions like that opened by Dr. S. C. Bradford on "Systematic Subject Indexes to Periodical Volumes" that there is still plenty of room for further co-operation. The intensely individualistic point of view of some special librarians or heads of information bureaux which was evidenced in this discussion probably deserves some of the strictures recently uttered against the expert and the specialist, and has sometimes led them to overlook practical advantages in the decimal classification. On the other hand, those most interested in securing the adoption of the universal decimal classification have sometimes failed to realise the practical and even financial difficulties which at present beset the application of the classification in certain sections of industry. It is perhaps a little unfortunate that the Association devoted so much time at its conferences to a subject on which there is a strong cleavage of opinion, particularly as, with the growth of co-operation, the practical advantages of the decimal classification for many purposes may be more fully appreciated.

The discussion centring round the decimal classification was somewhat marred by the absence of an impartial chairman, but if any criticism is offered of the following discussion on the establishment and operation of an information service, it is that the joint paper circulated in advance to the Conference was treated at such length by the four joint authors that little time was left for discussion. This was evidently felt by the meeting, for a resolution was passed and adopted at the final session of the Conference, asking for a similar discussion on particular aspects of information services, especially in regard to co-operation, to be arranged at future conferences.

The discussion was opened by Mr. A. F. Ridley, of the British Non-Ferrous Metals Research Association, who stressed the advantages of an efficient information service in handling a far greater body of knowledge than could possibly be handled haphazard by individuals. Such a service, while not relieving individual members of the organisation from the duty of reading and digesting all information of importance to their work, assists them by selecting for them to read the information bearing on their special work. This work is educative as well as informative, inducing members of the organisation to make better use of the facilities offered. Special emphasis was placed on the selection of staff, as although much of the work is routine, it must never be allowed to become too much so. A very real part of the business of an information service is to safeguard the organisation for which it works from

becoming hidebound with tradition. Initiative is of high importance, and the shortness of the time-lag between publication of information and its being brought to the notice of the individual needing it is largely a matter of adequate library, technical and clerical staff.

Miss E. W. Parker, of the Mond Nickel Co. Ltd., stressed the value of external literature surveys conducted outside the library as a means of supplementing information received in the library. Much valuable advance information can be obtained by co-operation and by contact with technical and scientific personnel all over the world. As regards bibliographical work, Miss Parker suggested that it is important to produce bibliographies in advance of the demand, and stressed the importance of attention to detail in such matters as well as in dealing with inquiries. It is doubtful whether any inaccuracies in such work can be described as minor. Mr. E. J. Carter emphasised aspects of the information service maintained by the Royal Institute of British Architects, stressing particularly the importance of maintaining a full service of journals and books inside the library and the value of propaganda regarding the services offered. Mr. T. M. Herbert described the information service recently developed as part of the research organisation of the London Midland and Scottish Railway.

An animated discussion, opened by Mr. J. P. Lamb, chief librarian to the City of Sheffield, with a paper entitled "The Public Library as an Aid to Industry and Research" and by Mr. B. M. Headicar with a paper, "Research: Where the Library and Librarian come in", focused attention on the general neglect of the municipal library by industry. Mr. Lamb referred to the possibilities of co-operation between the public libraries and special libraries in regard to co-ordination of purchases of books and the pooling of periodicals and storage space. In the course of discussion, Mr. Lamb directed attention to the changed conditions under which the reference library now operates and the necessity for some elasticity in adapting its former rigid procedure regarding the loan and exchange of books. Where local conditions permit rapid and easy book exchange a very useful field of co-operation between industrial and municipal libraries exists and a promising tendency is that towards the development of a pool of technical and specialised works between the strictly reference library and the general library.

Prof. M. Greenwood delivered a delightful paper on the "History and Sources of Official Vital Statistics" in which a keen sense of humour enabled him to make an apparently uninteresting theme eloquent and to convey to others something of the fascination the subject has for the expert as well as of the difficulties and pitfalls which beset those attempting to compare vital statistics or to base conclusions on them.

One of the most important discussions, to which very little time was allotted, however, was that

initiated by Mr. A. A. Eldridge's report on the A.S.L.I.B. inquiry into technical and scientific abstracting. This inquiry was conducted by a small committee of which Mr. A. A. Eldridge was chairman and was the direct outcome of the informal conference convened by Mr. H. T. Tizard last year at the Imperial College of Science and Technology. The report presented by Mr. A. A. Eldridge was purely preliminary and outlined the general trend of the replies received to the questionnaire. Some fifty replies had been received covering nearly all the important abstracting agencies in Great Britain, including research associations and imperial bureaux, the Department of Scientific and Industrial Research, the Royal Photographic Society, the Textile Institute, *British Medical Journal*, Bureau of Chemical Abstracts, Institution of Civil Engineers and various industrial firms like the British Aluminium Co. Ltd., J. Lyons and Co. Ltd., Imperial Chemical Industries Ltd., Metropolitan-Vickers Electrical Co., Ltd.

The report directs attention to the opportunity for co-operation in the purchase or examination of journals of secondary interest and distinguishes between overlap in preparation and unavoidable overlap in publication. The replies received in answer to the questions regarding the qualifications for abstractors and their selection should provide the Association with a valuable analysis of experience as a basis for useful suggestions in response to definite requests for help. Divergent opinions were expressed as to the value of authors' summaries where provided, and opinion was expressed in the discussion on the report that abstracts must be written from the point of view of the user for whom they are intended. This is particularly true of the industrial abstracting services, but such services are frequently run deliberately to supplement and not to replace the work of agencies like the Bureau of Chemical Abstracts and the view that abstracts are best contributed by specialists in a particular field finds little support in industry. The discussion suggested that full time abstractors who are generally familiar with the subject and its principal complexities are regarded as most satisfactory for the special libraries or information bureaux. Attention was also directed to the desirability of uniform practice in regard to the abbreviations used for journal references, etc., and the transliteration of names in non-Latin scripts, as well as to the difficulties in the way of co-operation presented by the introduction of abbreviations into the text of abstracts.

At the annual meeting, discussion on the report and on what members want of A.S.L.I.B., initiated by Mr. H. Robinson of the Textile Institute indicated a very lively appreciation of the valuable work which the Association is carrying out and the wide and useful field of co-operation open to it. Sir Charles Sherrington was elected president of the Association in succession to Mr. H. T. Tizard.

A Census of Summer Thunderstorms

THE first annual report of the Thunderstorm Census Organisation, Langley Terrace, Huddersfield, deals statistically with the records obtained, largely with the aid of private observers, during the six summer months April-September of 1931. It is an amateur enterprise conducted by Mr. S. Morris Bower as a sequel to a similar investigation carried on during a long period by Mr. C. J. P. Cave into

the occurrence of thunderstorms in winter. The British Rainfall Organization, which is now part of the organisation of the Meteorological Office, Air Ministry, no doubt began in much the same way to supply information about one meteorological element with a greater degree of detail than could possibly be done without the aid of voluntary observers. The demand for such detailed information about

rainfall on the part of engineers occupied with water supply is considerable and fully justifies a permanent organisation of that kind; whether the same will be found in the case of thunderstorms as a result of electrical developments, wireless transmission, and aviation, remains to be seen.

The response to this enterprise has been very good for it is stated in the foreword to this report that 966 voluntary observers and organisations have contributed to it. The only criticism that suggests itself is that the working up of the statistical material does not appear to promise any notable advance in our knowledge of the conditions favourable for the development of thunderstorms, or of their life history. Great accumulations of statistical information of this kind abound in meteorology, but it only too often happens that nobody comes forward to extract new knowledge from them.

Nothing in the way of a generalisation is suggested by this report except that the regions of maximum frequency of winter thunderstorms—the western coasts of Scotland and Ireland—are roughly those of minimum frequency of summer storms. This is not new knowledge; it has been recognised with the aid of a comparatively moderate number of regular official observing stations, and the explanation is furnished by ordinary synoptic meteorology, when due attention is paid to the possible ways in which atmospheric instability can arise at the two seasons. It seems reasonable to suppose that real advance will necessitate a study of selected portions of this detailed statistical information on correspondingly detailed synoptic lines in the endeavour to trace the physical processes that accompany the development and decay of individual storms or systems of storms.

Mathematical and Experimental Evidence for the Existence of a Central Intellectual Factor*

By DR. WILLIAM BROWN

IF a number of sufficiently dissimilar mental tests of intellectual ability be applied to a group of individuals and correlation coefficients calculated, it is found that these correlation coefficients are related to one another in such a way that for any four (or *tetrad*) of them the following relation holds good within the limits of random sampling:

$$r_{ap} r_{bq} - r_{aq} r_{bp} = 0;$$

and similarly with other arrangements of these four

The method of applying the tetrad criterion is to draw up a frequency distribution of all the possible tetrad differences derivable from the table of correlation coefficients ($6 \times {}^nC_4$ in number, where n is the number of mental tests correlated with one another), and to compare its standard deviation with the 'theoretical' standard deviation of a purely chance distribution of such tetrad differences. A formula for the latter has been calculated by Spearman and Holzinger.

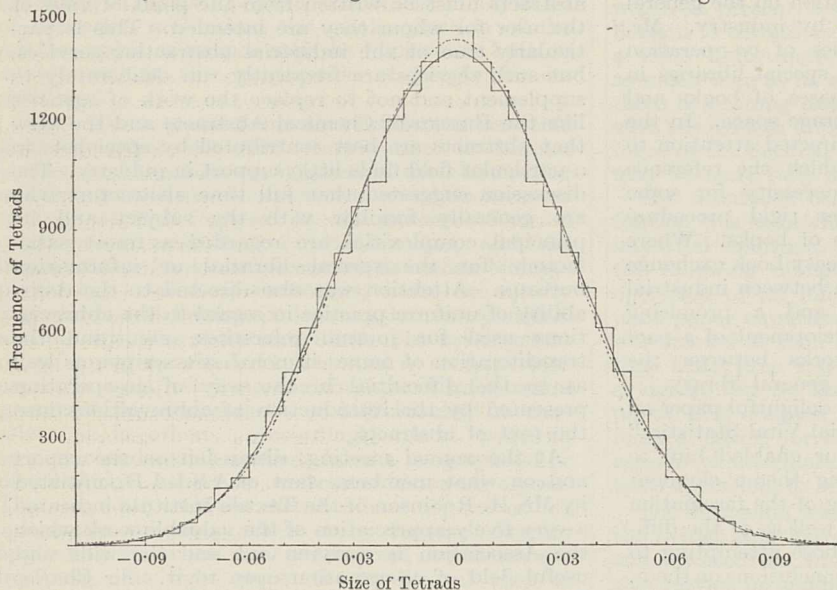


FIG. 1. Frequency distribution of tetrad differences. Best-fitting curve (Type IIA Pearson Curve) ———. Best-fitting Probability Curve - - - - -

coefficients. We owe both the discovery of fact and the devising of the tetrad criterion to Prof. C. Spearman.

The inference drawn from this is that the abilities measured by the mental tests are divisible into two factors each, one being common to all (the general factor, g), while the other is in each case specific and independent (the specific factor, s).¹

* Summary of a paper read on Aug. 24 to the Tenth International Congress of Psychology at Copenhagen.

I have re-tested my earlier correlation results of twenty to twenty-three years back² by this criterion, and find that, so far as they go, they do support Spearman's two-factor theory. But a statistically adequate proof of the theory needs a large random sample of cases (several hundreds) and, especially, a large number of not too similar mental tests of intellectual ability—much larger than those applied in any research up to the present date.³

To fulfil these conditions, I have organised a research during the past year with the help of Prof. Spearman and Dr. W. Stephenson of University College, London. Dr.

Stephenson has devised a series of twenty tests of apparently non-overlapping intellectual ability, selected not *a priori* but after much preliminary trial, which received the approval of Prof. Spearman, and has applied them for me to 300 boys, aged 10½–11 years, drawn from twelve elementary schools of the L.C.C., forming a homogeneous random 'sample' of adequate size for statistical purposes. The total number of positive tetrad differences is 14,535 (and there is an equal number of negative tetrad differences, of course). It has since been found necessary to reject one of the tests and one of the correlation coefficients. There remain 11,356

positive tetrads (and an equal number of negative ones) which form a smooth frequency curve, the mathematical properties of which I am now working out.

I have found that the best-fitting frequency-curve is a Type IIa Pearson curve, with equation

$$y = 1412 \left(1 - \frac{x^2}{1188}\right)^{13.669} \quad [\text{unit of grouping} = 0.005]$$

The curve is platykurtic, with $\beta_2 = 2.81446$. (For a 'probability' curve, $\beta_2 = 3$). $\chi^2 = 20.69494$ (for 21 groups), and therefore $P = 0.41537$,—a good fit. The standard deviation, $\sigma_t = 0.031289$.

If we compare this with the 'theoretical' Spearman-Holzinger value⁴, $\bar{\sigma}_t = 0.02827 \pm 0.002586$, we find an excess of 0.003019, which is 1.167 times the probable error. This means that the odds are about 4 to 3 against such a deviation,—a good correspondence of observation with theory.

The best-fitting probability curve to the distribution is

$$y = 1448 e^{-x^2/78.32}$$

This is far less good a fit than the Type IIa Pearson curve above-mentioned, since for it $\chi^2 = 39.21517$, and therefore $P = 0.0114809$,—a poor fit.

The small size of P is partly due to the large number (21) of groups in each half of the frequency-distribution. Actually both curves appear to fit the distribution closely, when superposed upon it, and the superiority of the Type IIa curve only becomes visually apparent in a large-scale drawing, such as would be too large to reproduce here.

¹ Spearman, C. "The Abilities of Man". London, 1927, pp. 74, 75.
² Brown, William. "The Essentials of Mental Measurement", First Edition 1911, Cambridge, pp. 114, 116.

³ Pearson, K. and Moul, M. "The Mathematics of Intelligence, I. The Sampling Errors in the Theory of a Generalized Factor." *Biometrika*, vol. 19, p. 261, Dec., 1927.

⁴ Spearman, C. and Holzinger, K. "The Average Value for the Probable Error of Tetrad Differences". *Brit. J. Psychol.*, vol. 20, part 4, p. 370, April, 1930.

University and Educational Intelligence

BIRMINGHAM.—Prof. W. Stiles has been elected dean of the Faculty of Science to succeed Prof. S. W. J. Smith whose term of office has expired.

OXFORD.—Dr. F. Homes Dudden, Master of Pembroke College, delivered on Oct. 5 his valedictory address as retiring vice-chancellor. In it, after paying tribute to the memory of the late Dr. G. Claridge Druce, of whom he spoke as the greatest English field botanist of his generation, he extended the welcome of the University to Prof. Plaskett, the new Savilian professor of astronomy. He announced that the extension of the Radcliffe Science Library would be taken in hand at once, though the additional space thus secured would at first be used to relieve congestion in the main Bodleian building. Among benefactions he mentioned the gift of £1000 from Prof. J. M. Baldwin for the capital endowment of the Edward Bagnall Poulton Fund; and as recent interesting developments he enumerated the experimental establishment of a bureau for the prosecution of research on the ecology and population problems of wild animals, and the proposed establishment of an Institute of Ornithology to collect and co-ordinate information concerning the numbers, distribution, and habits of British birds.

ON November 4, at 8 P.M., Mr. H. Ramsbotham, Parliamentary Secretary to the Board of Education, will open the building extension of the Chelsea Polytechnic, Manresa Road, London, S.W.3, and distribute diplomas and certificates to students.

THE Trustees under the will of the late Viscount Leverhulme have instituted a number of post-graduate studentships in chemical engineering. These studentships, which are of the annual value of £250 each, are tenable at the Ramsay Memorial Laboratory of Chemical Engineering, University College, London. They are open to graduates in chemistry or engineering who also have an adequate acquaintance, gained by employment or otherwise, with factory or business conditions. The holders of the studentships may, at the discretion of the Ramsay professor of chemical engineering, either follow the ordinary course of study, leading to the College diploma in chemical engineering, or a special course of study in that subject, or carry out original research work. It is particularly appropriate that these studentships should be associated with the memory of Lord Leverhulme, since chemical engineering research and practice have always played a very large part in promoting the development and success of the great industrial organisation which he founded. Two studentships are to be awarded immediately. Applications for these should be addressed to the Secretary, University College, Gower Street, London, W.C.1.

THE London County Council's programme of lectures and classes for teachers includes under the headings of Science and Domestic and Health Subjects items which should enable teachers to make good some of the alleged deficiencies in present practice. A course of lectures and demonstrations by Mr. F. J. Pearson at the Institute of Education in "General Science for Senior Pupils", will direct attention to the advantage of framing science syllabuses on a wider basis than that traditionally employed. Courses of lecture-demonstrations by Prof. J. R. Partington at East London College, in "The Chemistry of Daily Life", and by Prof. Chas. R. Darling at the Borough Polytechnic, in "Physical Science in the Modern Home", will illustrate the application of the principles of science and scientific knowledge to vocational and other useful purposes, and link up work in the laboratory with work in the kitchen. Biology presents special difficulties as a practical school subject, especially in urban schools. Assistance in overcoming them will be the aim of a course of ten lectures by Miss von Wyss, beginning next January, at the Institute of Education. Food and dietetics will be dealt with in a course of lectures by Prof. Winifred Cullis, beginning in February.

RURAL schools in the United States of America have for many years presented peculiar problems of great difficulty and importance. Their importance is apparent in view of the fact that schools in rural districts (population under 2500) have an enrolment of nearly eleven million children and are staffed by four hundred thousand teachers. As schools have to a large extent been administered as a local district affair, and as wealth has been largely concentrated in urban districts, the schools in the rural districts have suffered from lack of financial support comparable with that enjoyed by city schools. The backward condition of large numbers of them has been known in a general way, but few research agencies have interested them-

selves in this field. A notable contribution to knowledge of the subject has been published by the United States Office of Education in the form of a pamphlet (*Bulletin* No. 3 of 1932), entitled "Status of Teachers and Principals Employed in the Rural Schools". Within rather wide limits, school boards of most rural communities still hire whom they please, agree among themselves concerning professional standards, and bargain with the candidates for the lowest possible salary rates. It appears that the average annual stipend is 926 dollars. Nearly forty per cent of the entire number of teachers are employed in one-room schools. Nearly one-fourth of this group are twenty years of age or younger, and about four per cent are not more than eighteen. The most extreme status problem, the report says, is presented by the negro teachers of one-room schools, upwards of eighteen thousand in number, who receive, on an average, only 314 dollars a year, and have received an education equal to only about $2\frac{1}{2}$ years above the elementary school standard.

Calendar of Geographical Exploration

Oct. 19, 1920.—Flora and Rivers of South-East Asia

F. Kingdon Ward reached the Tra-mu-tang and the marble gorge of the Salween, just above which the glacier-fed torrent from the Gomba La enters. The torrent was followed to the Salween-Irrawaddy divide. On this journey Kingdon Ward verified the conclusion that the Mekong-Salween divide up to the 28th parallel forms roughly the boundary between a Chinese flora to the east and an Indo-Malayan to the west. He also made some observations on the deglaciation and morphology of the region. Kingdon Ward has continued his explorations in the mountain masses of south-west China and its borders and has combined botanical work with geographical discovery.

Oct. 21, 1883.—Greely in the Arctic

Lieut. A. W. Greely and his party were obliged to winter at Cape Sabine, their third winter without supplies. A few depots were found which had been left by Sir George Nares and W. M. Beebe, but all stores were exhausted before the spring. When the sun reappeared in 1884, some of the party died of starvation and the relieving steamers did not reach Cape Sabine until June 22. Greely and his party were found almost at the point of death, but with their scientific instruments in order and with their great collections of specimens intact. Greely's party had been conveyed to Lady Franklin Bay in 1881 as the American contingent of the series of circumpolar stations arranged for at an international polar conference held in Hamburg in 1879. A relief ship should have reached the party in 1881, but failed to do so until 1884, with lamentable consequences for the unfortunate party, which in spite of great misery and suffering, heroically continued its scientific work during the whole of the period. Much geographical survey work was carried out, especially in Grinnell Land and along the north coast of Greenland.

Oct. 21, 1928.—The Alai-Pamir Expedition

The Alai-Pamir expedition returned to Osh, whence it had started on June 19. It was a joint expedition organised by the Notgemeinschaft der Deutschen Wissenschaft in Berlin and the U.S.S.R. Academy of Sciences in Leningrad, in charge of

W. Rickmers Rickmers, who had in 1913 conducted an expedition in the same region. The results of this work are not yet published in full, but much new topographical detail is already available. The scientific staff of the expedition collected much meteorological, ethnological and biological data.

Societies and Academies

PARIS

Academy of Sciences, Sept. 5 (vol. 195, pp. 505-524).—L. Mangin: Notice on Roland Thaxter.—Gr. C. Moisl: The sudden breaks of probability in stochastic evolutions.—Jean Mirguet: The paratangent of a point ensemble.—Benjamin Meisel: A property of the strain in a plane problem of the theory of elasticity.—P. F. Papcovitch: The general solution of the fundamental differential equations of elasticity, expressed by three harmonic functions.—Léon Auger: The movements of pulsating reeds in organ pipes. An experimental study of the movements of the tongue of a vibrating reed, recorded photographically, with varying wind pressure.—René Hardy and Bertrand-Lepaute: A direct reading stroboscopic radio-compass.—A. da Silveira: The Raman effect in saline solutions.—C. Gaudfrey: Correction and addition to the description of equiline and folliculine.

GENEVA

Society of Physics and Natural History, July 7.—E. Cherbuliez and Fr. Meyer: New researches on the fractionation of casein. According to recent results, casein contains at least two different constituents, one called α , insoluble in dilute ammonium chloride, whilst the other, β , is soluble in this solvent. The authors have proved that the β part itself consists of at least two substances, one precipitable in the saline solution at $pH = 3.6$ and constituting the greater part of the soluble fraction (γ), the other remaining in solution under these conditions and precipitable by acetone (δ). The proportions by weight of the three fractions in the casein have been approximately determined: α , 65-70 per cent; γ , about 30 per cent; δ , 2 per cent. Moreover, these proportions appear to be variable. The three constituents have been also characterised by their percentage composition, especially by differences in sulphur and phosphorus, and their varying proportion of tryptophane.—E. Cherbuliez and Mme. J. Stephani-Cherbuliez. The influence of the intramuscular introduction of oil on the proportion of lipases in the blood serum. As the result of work on antituberculous chemotherapy by means of oil solutions of compounds of copper, the authors have taken up the old problem of the influence of the introduction of foreign fats on the lipolytic power of the organism. In tests made on man, extending over several weeks, they have proved that intramuscular injections of olive oil and of solutions of drugs in this oil do not appreciably modify the proportion of lipases in the serum. Further work should show if the lipolytic powers, especially the leucocytes, undergo modification in the course of the treatments indicated.—W. Bader: The synthesis in two stages of acetic acid from water gas. Methanol is first prepared using vitreous oxide or sulphide catalysts, in which the spacing of the active points is not the same as in crystalline cata-

lysts. Then the methanol as methyl phosphate is combined with carbon monoxide at 300°–320°C. and under a pressure of 100–200 atmospheres. The catalyst is a cuprous-phosphoric complex dissolved in the acid. Only acetic acid and methyl acetate are formed in this reaction.—A. A. Bron and E. Briner: Researches on the catalytic dehydration of some phenols. The authors have dehydrated a certain number of phenols, and specify the action exerted by certain chemical groups on the tendency to dehydration.—P. Bolle and E. Briner: The chemical activity of nitric acid in solution. The results deduced from the study of reactions of nitration and of absorption of nitric oxide by nitric acid show that these reactions are due to the non-dissociated fraction of the nitric acid.—E. Briner and H. Biedermann: Peculiarities of the chemical reactivity of ozone in the absence of oxygen. By replacing oxygen by nitrogen as a diluent of ozone, it has been recognised that the oxidising power of ozone on benzaldehyde is reduced to one atom of fixed oxygen for each molecule of ozone consumed.—A. J. Weigle and R. Luthi: The abnormal dispersion of amyl alcohol for short wave-lengths. The dielectric constant of a solution of amyl alcohol in a very viscous oil (Shell BL3) has been measured at –10°C. for waves varying between 334 and 2.8 metres wave-length. The dielectric constant diminishes since the dipoles of amyl alcohol no longer take up a definite position in the electric field. Moreover, this decrease does not correspond with that predicted by the Debye theory. These experiments give interesting information on the structure of liquids.—J. Weigle and H. Saini: A new apparatus for the exact determination of the dimensions of crystalline networks. An apparatus based on the Seemann-Bohlin principle has been constructed by the authors. Making use of interferences of high order, the crystal dimensions can be measured with an accuracy of about 1 in 100,000. This apparatus can be used for the determination of coefficients of thermal expansion of crystal networks.—W. H. Schopfer: The supposed vitamin action of some amines. The author's experiments, made with histamine, tyramine, glucosamine, hordenine, betaine, choline, ethylamine and ethylenediamine show that it is impossible to attribute the slightest vitamin action to these substances.

ROME

Royal National Academy of the Lincei, April 17.—L. Cambi and L. Szegö: Sulpho-salts of copper and iron. In its magnetic behaviour, the sulpho-salt $KFeS_2$ approximates to pyrites, ferrous sulphide, and many complex ferrous salts, whereas the sulpho-salts $K_mFeCu_nS_p$ recall, on one hand, pyrrhotine, and, on the other, those ferric sulpho-salts in which the iron present is assumed to have the structure of the ferric ion. The tendency to assume states approaching the diamagnetic state at low temperatures is observed with the paramagnetic sulpho-salts of iron. The sulpho-salts now under consideration are diamagnetic, as also are the copper sulphides.—Enea Bortolotti: Deformations of higher species and systems of forms for a V_m in R_n .—E. Gugino: The geodetic curvature of the lines of a Riemannian space of n dimensions.—U. Broggi: A generalisation of the developments in series of determinant functions.—Maria Cibrario: The reduction to canonical form of the linear equations to the partial derivatives of the second order of mixed type.—T. Viola: Functions of continuous limited variation towards the right.—A. Masotti:

A theorem of unicity relating to Poisson's equation.—M. Zeuli: A generalisation of the centre of the osculatrix sphere.—N. Cioranescu: The determination of a harmonic function by the initial global conditions.—Ruy Luis Gomes: The limits of the normal derivative of a simple layer potential.—G. Colonnetti: Influence of the shearing force on the deflection of a beam. (2) Further proof of the fact that the shearing force influences the deflection of an inflected beam is obtained by consideration of the case of a lattice girder with parallel top and bottom members.—F. Conforto: Impulses in isotropic elastic bodies.—D. Graffi: Adiabatic invariants as a method of approximate integration of differential equations.—G. Krall: Distant limits of the motion of a planetary system.—U. Barbieri: Astronomico-geodetic station on Bric Torniola, July 1928.—G. Viola: The periodicity of the mean annual temperature in relation to that of sunspots. For Naples, Rome, and Gaeta, the period of variability of the mean temperature is about one-half of the frequency period of sunspots. These results are at variance with those of Köppen, according to whom the mean temperature curve exhibits a course opposite to that of the sunspot curve.—Joan Y. Placinteanu: The equilibrium between matter and radiant energy. In studying the radiation of the stars, Eddington advanced the hypothesis that this radiation is always accompanied by variation in the total mass of the star, the atoms of matter undergoing transformation into particles of radiant energy, and Stern deduced a formula for calculating, for the case of thermodynamic equilibrium, the number of particles per c.c. The author now considers the conditions when photons are present and shows that Stern's formula does not then apply.—D. Bocciarelli: Radioactivity of potassium. Occhialini's method of magnetic analysis, devised for studying the β -radiation of rubidium, has been used for investigating the still feebler radioactivity of potassium.—T. Carpanese: Granite, vesuvian, ilmenite, and titanite from Monte Rosso di Verra (Monte Rosa group).

SYDNEY.

Linnean Society of New South Wales, May 25.—H. J. Carter: New Guinea and Australian Coleoptera. The paper contains descriptions of twenty-two species as new, in the families Georyssidae (1 species), Buprestidae (4), Tenebrionidae (9), Cistelidae (3), and Cerambycidae (5).—J. G. Churchward: Inheritance of resistance to bunt, *Tilletia tritici* (Bjerk.) Winter, and other characters in certain crosses of 'Florence' wheat. 'Florence' was crossed with four susceptible commercial Australian varieties of wheat, each cross giving a similar result. A graph representing distribution of F_3 families in 5 per cent classes for bunt infection shows a trimodal curve indicating a single factor difference for bunt resistance. Experimental results of the crosses are given, and also results of observations on the occurrence of grass clumps and the inheritance of chaff colour.—G. A. Currie: Some notes on the biology and morphology of the immature stages of *Harporbittacus tillyardi*. The larvæ and pupæ of *Harporbittacus tillyardi* E.P. are described for the first time. Notes on the biology of the insect are given and, as the larvæ of Australian Bittacidae have hitherto been unknown, their feeding and other habits are described.

Royal Society of New South Wales, June 1.—W. H. Love: The mitotic activity of normal and malignant tissues and its modification by X-rays. This study is made from the biological, physical, and mathematical points of view. A theory of the occurrence of mitosis in normal tissue cultures (fibroblasts), and in Jensen's rat sarcoma, is developed and applied to several aspects of the problem of cell division. The quantita-

tiye modifications produced by X-rays in the mitotic activity of these tissues are then studied experimentally and analytically. Within certain limits, the experimental results are in good agreement with the predictions of analysis. Outside these limits there is, in some experiments, a marked divergence between the two. The significance of this divergence is considered, and an explanation, supported by experimental evidence that seems conclusive, is advanced.—J. C. Earl and N. F. Hall: The chemical changes involved in the formation of aminoazo-compounds (1). By examining the volume-temperature curves of methanol solutions containing amine hydrochlorides and sodium nitrite, an indication has been obtained of an intramolecular rearrangement of amine nitrite to an intermediate compound prior to the formation of diazocompound or nitrosamine. When the solution is kept neutral by employing equimolecular proportions of amine hydrochloride and sodium nitrite, the change does not take place, nor, in the case of aniline, does the solution show any coupling with alkaline β -naphthol. Addition of a small quantity of acid to such a mixture brings about the formation of diazocompound as shown by the coupling reaction with β -naphthol (*cf.* Wallach, *Annalen*, 257, 319).—Thelma M. Reynolds: Note on the action of titanium tetrachloride on tetracetyl- β -*d*-glucosido-glycollic ester. Tetracetyl- β -*d*-glucosido-glycollic ester (Fischer and Helferich, *Annalen*, 333, 81; 1911) reacts with titanium tetrachloride in the same manner as the fully acetylated sugars (Pacsu, *Ber.*, 61, 1508; 1928) giving acetochloroglucose, whereas the β -glucosides previously studied (Pacsu, *loc. cit.*; *J. Amer. Chem. Soc.*, 52, 2563; 1930) were rearranged into the corresponding α -glucosides.

Forthcoming Events

MONDAY, Oct. 17

KING'S COLLEGE, LONDON.—Prof. Claude F. A. Schaeffer: "The Excavations at Ras Shamra in Syria—the Results of the Four First Expeditions, 1929–32", at 5.30 (succeeding lectures on Oct. 20 and 21).

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Heath Clark Lectures).—Prof. Carl Prausnitz: "The Teaching of Preventive Medicine in Europe", at 5 P.M. (succeeding lectures on Oct. 18, 19, 20 and 21).

TUESDAY, Oct. 18

EUGENICS SOCIETY—(at the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—Dame Helen Gwynne-Vaughan: "The Contribution of Plants to the Study of Heredity", at 5.30 P.M.

HACKNEY AND NEW COLLEGE, LONDON.—(Drew Lecture at the Memorial Hall, Farringdon Street).—Prof. John Macmurray: "The Conservation of Personality."

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—Air Commodore J. A. Chamier: "Air Power", at 5.30 P.M. (succeeding lectures on Oct. 25, Nov. 1, 8, 15 and 22).

UNIVERSITY OF LEEDS.—Prof. John Garstang: "Further Discoveries at Jericho", at 8 P.M.

ROYAL COLLEGE OF PHYSICIANS—(Harveian Oration).—Sir George Newman, at 4 P.M.

WEDNESDAY, Oct. 19

FOLK-LORE SOCIETY—(at University College, Gower Street, W.C.1).—Mr. Bertram Thomas: "Arab Folk Stories Heard in the Rub' al Khali", at 8 P.M.

THURSDAY, Oct. 20

BEDFORD COLLEGE FOR WOMEN—(Fawcett Lecture).—Dr. C. R. Fay: "Women as Wage-earners and the Significance thereof in the Development of Economic Theory", at 5.15 P.M.

CHADWICK PUBLIC LECTURE—(at the Royal United Services Institution, Whitehall).—Sir Humphry Rolleston, Bart.: "The Pioneers and Progress of Preventive Medicine", at 5.15 P.M.

CHILD STUDY SOCIETY, LONDON—(Cockburn Memorial Lecture).—Dr. P. B. Ballard: "Thirty Years' Progress in London Education", at 6 P.M.

INSTITUTION OF ELECTRICAL ENGINEERS—(Inaugural Address).—Prof. E. W. Marchant, at 6 P.M.

FRIDAY, Oct. 21

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS—(Annual General Meeting).—Mr. R. J. Walker (Presidential Address).

Official Publications Received

BRITISH

Colony and Protectorate of Nigeria. Annual Report on the Geological Survey for the Year 1931. Pp. ii+40+4 maps. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2s. 6d. net.

Ordnance Survey. Re-Levelling of London, commenced January, 1931. Abstracts of Secondary Lines (giving Values in Advance of publication, on the Newlyn Datum, for use with existing Large Scale Maps.) by Brigadier H. St. J. L. Winterbotham. Pp. 51+1 plate. (Southampton: Ordnance Survey Office.) Paper, 7s. 6d. net; cloth, 8s. 6d. net.

Battersea Polytechnic. Calendar of Evening and Afternoon Courses and Classes for Session 1932–33. Pp. 31. Free. Technical College for Day Students and Day School of Art and Crafts. Calendar, Session 1932–33. Pp. 50. 3d. Domestic Science Department and Training College. Full-time Day Instruction, Afternoon and Evening Classes, Session 1932–33. Pp. 32+1 plate. 3d. Department of Hygiene and Public Health. Session 1932–1933. Pp. 23. 3d. (London.)

The Quarterly Journal of the Geological Society of London. Vol. 88, Part 3, No. 351, August 29th. Pp. 311–515+plates 19–30+cxv. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

The Year's Work in Librarianship. Vol. 4, 1931. Edited for the Library Association by Arundell Esdalle. Pp. vii+296+4 plates. (London: The Library Association.) 7s. 6d. net; to Members, 5s. net.

East London College (University of London.) Calendar, Session 1932–1933. Pp. 211. (London.) 1s.

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Vincent, for the Year 1931. Pp. vi+32. (Trinidad.) 6d.

Papers and Proceedings of the Royal Society of Tasmania for the Year 1931. Pp. iv+136+19 plates. (Hobart: Tasmanian Museum.) 10s.

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Lucia, 1931. Pp. iv+43. (Trinidad.) 6d.

University of London: University College. Faculty of Medical Sciences, University Centre for Preliminary and Intermediate Medical Studies. Courses for Dental Students, Session 1932–1933. Pp. vi+269–304+12. (London.)

FOREIGN

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 373–375: Hyperfine Structure of Mercury Spectrum, VI, by K. Murakawa; Hyperfine Structure of Arc and Spark Spectra of Barium, by K. Murakawa; Diffraction of Cathode Rays by Single Crystals, Part 2: Mean Inner Potentials of some Crystals, by K. Shinohara. Pp. 299–322+plates 11–13. 35 sen. No. 376: Über Rotenon, den Wirksamen Bestandteil der Derriswurzel, Mitteilung I–XIII. Von S. Takei, S. Miyajima und M. Ono. Pp. 26. 20 sen. (Tokyo: Iwanami Shoten.)

University of Chicago. Publications of the Yerkes Observatory, Vol. 7, Part 2: A Study of the Spectrum of γ e Aurigae. By Edwin B. Frost, Otto Struve and C. T. Elvey. Pp. vi+52+3 plates. (Chicago: University of Chicago Press; London: Cambridge University Press.) 8s. 6d. net.

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 7, No. 2. Rédigé par E. S. Russell. Pp. 171–336. (Copenhagen: Andr. Fred. Høst et fils.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending 31st December, 1931. By William Henry Fox. Pp. 86+4 plates. (Brooklyn, N.Y.)

Field Museum of Natural History. Zoological Series, Vol. 18, No. 10: Mammals of the Kelley–Roosevelts and Delacour Asiatic Expeditions. By Wilfred H. Osgood. (Publication 312.) Pp. 191–339+plates 9–11. (Chicago.) 75 cents.

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 80: Studies on the Sounds emitted by Revolving Aircscrews. Part 2: Experiments with Model Aircscrews. By Jūichi Obata, Yakei Yosida and Sakae Morita. Pp. 389–440. 0.67 yen. No. 81: On Hollow Spindle-shaped Liquid Jet. By Kyōzi Itō. Pp. 441–467+8 plates. 0.50 yen. (Tōkyō: Koseikai Publishing House.)

Proceedings of the United States National Museum. Vol. 80, Art 21: Insects of the Order Orthoptera of the Pinchot Expedition of 1929. By A. N. Caudell. (No. 2921.) Pp. 7. (Washington, D.C.: Government Printing Office.)

Proceedings of the Imperial Academy. Vol. 8, No. 7, July. Pp. xix–xx+275–329. (Tokyo.)