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Political Principles and Native Affairs in Africa

DURING his recent visit to England, General Smuts, by his utterances on matters of public policy, did much to enhance a reputation which already stood high. His philosophical breadth of view and his appreciation of the gravity of the issues which need to be faced, whether he dealt with the affairs of South Africa or surveyed the situation in the world at large in relation to imperial policy, assured his position as a protagonist in any future reasoned approach to the solution of the ills of modern civilisation. If, therefore, his views on certain questions are made the occasion of comment in relation to the application of scientific principles to problems of government with which he is concerned, it cannot be imputed to him as a fault that his outlook is that of a party politician. None the less it is essential to remember that General Smuts, like other leaders in a modern democracy, must work through the medium of party machinery.

This limitation cannot be ignored in matters affecting, or affected by, the position of the native population of South Africa. Whereas in a crown colony or protectorate difficulties and problems of native life can be made the subject of impartial scientific inquiry and settled by administrative action, in the Union of South Africa they may be, and almost invariably are, brought into the heated atmosphere of everyday politics, since in some form or other in a population in which black outnumbers white by something like three to one, the native question is near to all.

The history of the native question in South Africa is largely a history of party conflict; and even now it is only slowly and partially that the results of scientific inquiry are being applied to the amelioration of conditions brought about by indifference to the study of native institutions. This renders it all the more gratifying that General Smuts should have been in a position to announce that measures are in prospect for the improvement of conditions of native life, and more particularly, that additions may be made to their lands. This last, indeed, is an urgent necessity, for which those best acquainted with native institutions and conditions have long pressed in order that the ethos of native communal life might not be denied the opportunity of full expression.

On the other hand, when General Smuts presses for the transfer to the Union of the

Protectorates of Bechuanaland, Basutoland and Swaziland, the relation of the native question to political feeling within the Union may well give pause, lest a too hasty assent be given to the transfer to a Dominion Government of native peoples who have placed themselves voluntarily under imperial jurisdiction. To suggest this is in no sense to impugn the good faith of the people of South Africa ; but where the sense of the colour bar is strong, and is reinforced by an economic competition which is bound to increase, it must inevitably be difficult to ensure that it will not affect administration, even when the position and interests of the voter are not directly implicated.

On the other hand, it might be contended that the trend of native legislation in South Africa is reassuring. From 1927 it has secured throughout the four provinces of the Union the unification of principle in native administration, establishing on a firm basis respect for native institutions and the social codes of those natives who live under the tribal system ; and it aims at the principle of the complete segregation of black and white—in which it has the firm support of the more advanced element in the native community. Thus it may be maintained that it provides a sufficient guarantee that the administration of the Protectorates will be no less sympathetic under the Union than it has been under the Imperial Government.

In so far as concerns the preservation of the *status quo* in the Protectorates, there can be no question that this argument carries weight. Yet there are those who, looking at the facts within the Union with the eye of impartial inquiry, point out that the policy of segregation in a practical sense is inoperative; and further, that it does not as a matter of fact provide that opportunity for the development of the native within the framework of his own tribal institutions, even though these may be modified or adapted in such a way as to train him to become a participating member in the community, which was anticipated by those who first advocated this policy.

In Africa, if anywhere, it is necessary to take long views, and neither the system of reserves for the tribalised native, nor the regulation of the detribalised population took full account of the effect which would follow from the existence of a large urbanised native and coloured element in active economic competition with the lower grade of white labour. The policy of segregation has restricted, rather then fostered, native development in certain directions. Such, for example, is the effect of legislation confining to the reserves the holding of land by natives. This has put an end to the advantageous practice of farming out the land by land-owners to native squatters on a crop-sharing basis, and in some areas has now affected adversely the amount of land under cultivation. It has also checked manual training, from which at one time much was hoped for the material and intellectual development of the native. Natives returning to the reserves can find no opportunity in tribal culture for the exercise of the skill they have acquired and, consequently, have ceased to interest themselves. Schoolmastering and the ministry virtually afford the only prospect of advancement, and here the opportunities are necessarily limited.

It may, however, be asked, to what conclusion does this tend ? Admitted, it may be said, that the present position of the native within the Union is the outcome of racial conflict, both white and black races are intruders, and the Bantu have been in the country very little longer than the white man. If, therefore, we regard, as we must, the interests of a white South Africa as necessarily prevailing, this need not affect the very different conditions upon which the Protectorates will come into the Union. The answer to this contention must be that it is not sufficient that the *status quo* should be maintained. No action must be taken which in any way may prejudice the opportunity for dispassionate discussion of the lines along which the native tribes of the Protectorates may be assisted towards their future standing, whatever that may be. In present conditions their future is a part of the problem of black Africa as a whole, and its discussion lies outside the range of local political theory or prejudice. Can the same assurance be given by the Union ?

The future of Africa is bound up with the fate of her native populations. A proposition so crudely obvious would seem scarcely worth statement, if it were not for the fact that it cannot be too strongly emphasised to enforce the corollary that the problem of the future of the African peoples cannot be solved without the application of the results of intensive scientific study. That contact with European civilisation everywhere is rapidly affecting native cultures and organisation is obvious ; yet apart from certain private or semi-private efforts, no systematic attempt is being made to ascertain its mode or direction, or whether in the long run, if unchecked, it will

prove permanently harmful to the well-being of Africa as a whole. Only a few weeks ago it was felt necessary to direct attention in the columns of NATURE (Oct. 20, p. 585) to the urgency of an appeal from men of science and others in the daily Press to secure public interest in expenditure, small in relation to the importance of its object, upon an investigation of the mentality of the African native—an investigation by the results of which the whole future policy of native education and training may be fundamentally affected.

The proposed investigation of the mentality of the African natives was coupled with a suggestion for an inquiry into their pathology and hygiene. The urgency of the medical problem is so patent that it has overshadowed the no less urgent significance of the more purely anthropological investigation. For, as Sir Grafton Elliot Smith has pointed out, this latter is no more than a preliminary inquiry. It is, however, imperative that it should be undertaken, before it is possible to enter upon the consideration of the wider question of the interaction of the changing African and his changing environment, and the modifications in political and social organisation which that interaction must entail.

It is usual to assume—or, at least, in relation to the proposed inquiry, it has been assumed and asserted—that the African is of inferior or backward mental character. To many, however, this seems an open question, to which the inquiry, it is hoped, will reveal the full answer. In part the assertion seems to be contradicted by many well-attested facts, but for the moment discussion may be set aside. What is important to note is the fact that, so far as the anthropologist is concerned, the scientific line of approach recognises differences in culture as the product of racial history and environment without attempting to evaluate them in terms of a higher or lower mentality. Each is the adaptation best fitted to its conditions in so far as it successfully conduces to survival. For the politician, however, cultures are apt to be graded as 'higher' or 'lower' and translated into terms of race as 'superior' and 'inferior', these terms carrying with them the implication that the 'superior' race is justified in assuming control of the 'inferior'. Hence 'racial problems' and the attempts, of which the results deserve careful study, to convert the native African into a dark-skinned European, with consequences which have been far from happy, as may be seen in our older African colonies.

It is the merit of the system of 'indirect rule', and of the modifications of it which have been applied in our African dependencies, other than those of West Africa, that it has recognised differences of culture and race in the contact of African and European, and except in certain specific matters, has as a matter of principle admitted the suitability of African culture for the African at his present stage of development. It is a strange commentary on our attitude in the past to 'backward' peoples that this should not be obvious.

The special significance of the proposed inquiry into the mentality of the African is that it comes at a moment when it is becoming increasingly apparent that 'indirect rule', the reserve system and other measures of a like character, are a 'half-way house' in which the native may live for a considerable length of time, but which eventually must be evacuated. Administrative action, working with justice and sympathy, may retard that evacuation ; it may dissipate the shock of social and moral dislocation inevitable as a concomitant of the change ; it cannot avert it indefinitely. Whether it is to be a halfway house on the road to degradation or virtual extinction as has happened to most of the American Indians, or to a fuller development of the best of African culture in alliance with that of the white races, is a grave responsibility which rests upon those by whom the future of the African will be shaped.

In seeking the direction in which this future lies, and in estimating the trend of changing conditions in Africa, due weight must be given to the volume and direction of native opinion, which is becoming increasingly articulate at the same time as it grows in force and precision. Africa is no longer entirely plastic in the hands of the administrator. Yet both in South Africa, in the support given to segregation, and in West Africa, where the native critic tends to regard 'indirect rule' as a means adopted by the white man to keep the black man in his place, native opinion is averse from the preservation of native custom as merely static. Whether, with its co-operation, the administration may be able to foster the development of a distinctive African culture, which has absorbed such elements of European civilisation as will ensure survival, for the time being must rest on the knees of the gods. It will demand efforts strenuous and long enduring, and no less scientifically planned.

War by Poison

"Gas!" : the Story of the Special Brigade. By Major-General C. H. Foulkes. Pp. xv+361+16 plates. (Edinburgh and London: William Blackwood and Sons, Ltd., 1934.) 30*s*. net.

THE use of 'gas' in war has been defended by several British and American writers on the ground that it is less inhumane than bullets and high explosives. It is pointed out that in the last years of the War, only about 3 per cent of the gas casualties of the Allies died, and the great bulk of the remaining 97 per cent made complete recoveries in a short time. General Foulkes advocates it on quite other grounds: if properly applied, he says, it causes far more casualties than any other arm, and the deaths amount to 20–40 per cent of the casualties. Consequently it offers the best means of ending a war that is settling down to a condition of protracted siege.

This great discrepancy in the mortality is due to different methods of using gas. At first, in April and May 1915, the Germans used clouds of chlorine released from cylinders installed in their trenches. They did not use them again on the British front until December because the prevailing wind was against them, but later in 1916 they made four more cloud attacks. Although the British troops were then provided with gas masks, the casualties averaged 876 in each attack, with a mortality of 24 per cent. Yet the Germans then discontinued this method, and used only shells, which caused very few casualties and scarcely any fatalities, until mustard gas was introduced.

Why did the Germans give up such an effective method? The troops disliked it, as it involved heavy labour in bringing up and installing the cylinders, and it inevitably subjected them to artillery retaliation. Then they had to wait an indefinite time, perhaps months, for a favourable wind of the right strength, and sometimes, even then, it veered round and blew the gas on to themselves. As the cloud attacks were seldom followed up, their effects were unknown, at any rate until long afterwards. The most important reason, however, was that in September and October 1915, the British replied with cloud gas attacks at Loos and the Hohenzollern Redoubt with considerable effect. The German High Command then realised that a mistake had been made in introducing this weapon on the Western Front, where the prevailing wind was against them, and in order to discourage us from continuing its use, they stopped it and suppressed all references to gas casualties in their own ranks.

From July 1916 until July 1917, the Germans fired great numbers of shells filled with non-persistent liquids, either lachrymatory (xylyl bromide, for example) or lethal (diphosgene). Neither of them caused many casualties, and the mortality was only 6 per cent, but they had some tactical value, because they forced our troops to wear their masks or drove them into the dug-outs. Then the Germans began to use mustard gas (dichlorodiethyl sulphide) and the British casualties increased enormously, but the mortality amongst them fell further to 2·5 per cent. Except the first unexpected attacks with chlorine gas, this was undoubtedly by far the most successful of the substances used by the Germans, because it affected the whole body, and persisted for a long time in consequence of its low volatility and the very small concentration that sufficed to produce casualties.

In July 1917 the Germans also began to use shells charged with a 'sternutator', diphenylchloroarsine, which, in the form of a cloud of minute particles, produces running at the eyes, coughing and especially sneezing so severe that it may render it impossible to wear a gas-mask. As the particles have no Brownian movement and the substance is a practically non-volatile solid, it is only partly removed from the air by the activated charcoal of the respirator, but fortunately the British had had warning, and consequently added a layer of cheese-cloth to the box respirator, and this filtered out the particles. The high explosive used in the German shells to reduce the substance to a particulate cloud was not effective; the particles were too large. An officer of the British gas service discovered that it is far better to volatilise it by heat, and this led to the idea of a thermogenerator in the form of a sort of smoke candle, or contained in a shell. If the War had lasted until 1919, it was intended to use them on a very large scale charged with the even more potent compound, diphenylaminechloroarsine.

The evolution of gas tactics in the British Army followed rather a different course. The Special Brigade, consisting largely of men with chemical training, showed great enterprise and initiative, but was hampered at first by the breakdown of the British system of supply by contractors. As there were not enough shells for high explosive and shrapnel, naturally not many could be obtained for gas filling, so the Brigade continued to use clouds of chlorine and afterwards of phosgene ($COCl_2$), which is much more lethal. Then the Stokes mortar was introduced, and as this fired a thin-walled shell and had a very rapid rate of fire, it was very suitable for producing the required high concentration of gas. In 1917 the Livens projector came into use, and this fired a thin-walled drum containing 30 lb. of phosgene. As the projector consisted simply of a solid drawn steel

tube ¼ in. thick, it could readily be manufactured in large quantities. A large number of them were simply buried in the ground up to their muzzles and fired simultaneously by electricity. Thus a high concentration was suddenly and unexpectedly generated in the enemy trenches, and the casualties and fatalities were severe. The Germans also adopted the projector, but they failed to understand that the drums must be of large capacity and that they must be used in large numbers in a limited area.

In the British service, the technique of the gas cloud was improved by the introduction of the 'retired cylinder' method of attack. The inconvenience and danger of installing the cylinders in the front line trenches were avoided by placing them some 600 yards to the rear, either in trucks on a light railway, or carefully camouflaged. As the clouds penetrated with the wind to a depth of 12 miles or more, this did not interfere with the effectiveness, but it was of course necessary to withdraw our troops for a time from the trenches in front of the cylinders. This device was to have been tried on a very large scale in 1918, but was prevented first by the German attack in March, and afterwards by the advance of the Allies, which did not allow of the necessary arrangements being made. Nevertheless, a number of smaller gas attacks of this sort were made, and appear to have been very successful.

This is the best book that has been published on gas warfare. It does not profess to deal fully with the chemistry, physics or physiology, but it does discuss at considerable length the tactics of gas attacks, which is of fundamental importance. Much of the matter has not appeared before, and the book is illustrated not only by numerous photographs but also by maps of the Western Front prepared by the Ordnance Survey. General Foulkes, as Director of Gas Services, was able to collect information about the German gas casualties which throws an entirely new light on the subject. It is evident, however, that he is less interested in defence, and although he mentions the various types of gas-mask that were used during the War, he makes no allusion to the great improvement that has been effected since 1918. The present mask of moulded rubber is so comfortable that it can be worn indefinitely without diminishing seriously the fighting value of the troops, and this must have a great effect on the gas warfare of the future.

In his enthusiasm, General Foulkes is inclined occasionally to forget the limitations of gas warfare. After the Armistice he went to India to advise the Government there, and to study the possibilities of gas in frontier fighting. He says: "Here, of course, gas would be particularly valuable, as the fighting consists largely of a struggle for hill-tops, the evacuation of which can be forced by a very small expenditure of gas ammunition." Surely a bare, rocky hill-top under a scorching sun is very unsuitable for the production of that high concentration of gas upon which the author insists.

General Foulkes discusses somewhat briefly possible gas attacks upon the civil population in future wars. He says: "While fully admitting the grave dangers to cities of attacks from the air I do not believe that gas in bombs or in the form of spray would inflict anything like as much loss of life as H.E. . . . I might point out that the conditions in a town are very different from those on the battlefield: houses, for instance, if their occupants are taught to use them properly, can be made tolerably safe places of refuge against gas [for some further information on this, see J. Davidson Pratt, *Chemistry and Industry*, Oct. 19, 1934], whereas they increase the effect of H.E. owing to the danger of falling masonry and outbreaks of fire." Everyone who has really studied the matter will probably agree with this statement.

"Is it worth it?" is the question which Field-Marshal Lord Cavan asks in the introduction, but this raises the further question: Is gas warfare really worse than war by high explosive, or even than fighting with sword and spear on the same scale? What we have to abolish upon our developing globe is war, not war by poison.

ARTHUR MARSHALL.

Resonance Radiation

Resonance Radiation and Excited Atoms. By Prof. Allan C. G. Mitchell and Prof. Mark W. Zemansky. (Cambridge Series of Physical Chemistry.) Pp. xvi+338. (Cambridge: At the University Press, 1934.) 18*s*. net.

THE fundamental phenomenon with which this book is concerned, namely the re-emission of absorbed radiation without change of wave-length, would appear to be one of the simplest of atomic processes. No doubt it is, but before reliable information regarding the individual atom can be obtained from the observations, a great many difficulties, both experimental and theoretical, have to be overcome. For example, since the results are largely dependent on the intensity distribution of the existing radiation, a suitable source, satisfying certain rather exacting requirements, is essential. The pressure of the absorbing gas is another important factor. If this is too high, complications arise owing to atomic collisions and re-absorption of the resonance radiation. If, on the other hand, it is too low, the resonance radiation will be too weak to observe.

The existence of metastable levels, the presence of foreign gas, the hyperfine structure of the levels and the influence of magnetic and electric fields are other factors of which account may have to be taken.

A great deal of experimental work has been done in this field, but in view of the difficulty of interpreting the observations, it is not surprising that some of the results have been inconclusive and even mutually contradictory. Progress has undoubtedly been hampered also by the lack of any comprehensive survey of the subject and by diversity of notations. The present volume appears therefore most opportunely and meets the requirements of the situation in an altogether admirable manner. The authors are both active and successful research workers, and their treatment of the subject is authoritative and critical. It is also comprehensive, ranging over such a variety of topics as to preclude even a mere enumeration of them in a brief notice. Some idea of the kind of problem discussed may be obtained, however, by reference to a few of the more important, such as, for example, the contours of absorption lines, methods of estimating life times of excited atoms, phenomena associated with atomic collisions, and the polarisation of resonance radiation.

The presentation is interesting and lucid. Each chapter is provided with a bibliography, and there are thirteen appendices containing mathematical derivations and tables. The index appears adequate and a careful scrutiny failed to disclose more than two very trivial misprints. The authors are to be congratulated upon the conspicuous success of their undertaking; they have not only produced a valuable record of scientific achievement but in addition have ordered and systematised the subject in a manner which will be of the greatest assistance to future endeavour. W. E. C.

Sir Robert Morant

Sir Robert Morant, a Great Public Servant. By Dr. Bernard M. Allen. Pp. ix+318+4 plates. (London: Macmillan and Co., Ltd., 1934.) 12*s.* 6*d.* net.

ENGLAND has known that in Morant she had a great public servant, but how large had been his contribution, towards legislation and through administration, to the progressive development of the social services of education and public health was scarcely known beyond his intimate friends and colleagues and keenest critics.

Dr. Allen tells the story in four chapters of quiet and attractive language and judicious appreciation without apparent restraint or exaggeration, trusting to the cumulative effect to give a full picture of his subject. Each chapter records great achievement but ends in disaster. In Morant we see no trained disciple, but one of Nature's giants endowed with the sentiments and zeal of a missionary, and the steel of his character edged on the rough grindstone of hard circumstances and passionate opposition. The first is a fascinating chapter of boyhood and youth at Winchester and Oxford; of straitened means; of a young man on whom the shadows of life were already making an indelible impression and inciting to high endeavour, and of the fading away of cherished hopes of social service through the Church of England.

"Siam" is less attractive but none the less necessary. Although the chapter closes with the temporary crushing of Morant's spirit, his responsibilities, his insight into the 'perplexities and confusions' of high policy in a troubled State, the jealousy which at length gathered round him, and above all his isolation, seem a preparation, better than he could know, for the gigantic task that was maturing for him at home—a strengthening of his natural capacity to stand alone against tremendous odds.

Morant sought and obtained a humble post in the Education Department. Within seven years he became the permanent head. With dynamic energy he had thrown himself into the confused situation, mastered the facts, made his knowledge and power indispensable to ministers promoting legislation and settled his own mind as to what England needed. He urged the necessity of an expert central authority for the whole of our educational system, and localised "guidance of brains" (the local education authorities) to watch, consider and advise upon educational arrangements of all grades and of every type. In his brilliant fight for legislative authority for these latter objects and to save the non-provided schools, Mr. Balfour and his powerful adviser drew on themselves the opposition of almost the whole Liberal party, of the forces of Dissent and of the resisting school boards and their supporters, concentrated in the House of Commons in another great Parliamentary fighter—Mr. Lloyd George. But they succeeded, though not perhaps to their entire satisfaction.

In administration it was the same—boundless energy and new lines of development. The occasion of a slip, however (the Holmes Circular), gave his opponents their chance and they brought him down. Morant was transferred to the Local Government Board and by the whirligig of circumstances found himself the formidable adviser of the outstanding opponent of the Education Bill, who was reconstituting the service of public health. But he had spent his wonderful energy and succumbed to a swift attack of septic pneumonia.

Morant's mistakes have no part in the lasting influence of his great services. R. B.

Short Notices

Bentley and Driver's Text-Book of Pharmaceutical Chemistry. Revised by Dr. J. E. Driver. Second edition. Pp. xv+538. (London: Oxford University Press, 1933.) 16*s.* net.

THE second edition of this book was rendered necessary by the publication of the 1932 "Pharmacopœia", and is a great improvement on the first edition. The book consists of an introduction, a section on analytical methods, one on inorganic compounds, one on organic compounds and an appendix.

The best two chapters in the book, in the section on analytical methods, are those written by Dr. Prideaux and dealing with hydrogen ion concentration and the methods for determining it. It is not often that this subject is dealt with in such a clear and lucid manner. In the description of the methods of analysis of carbon compounds there are one or two omissions. No mention is made of accelerators for the Kjeldahl method for nitrogen and the only method described for halogens is that of Carius, though the "British Pharmacopœia" uses the method of Piria and Schiff for trichloracetic acid.

The reviewer has found that students of pharmacy have generally a limited knowledge of organic chemistry, and to the majority of them this is the most difficult part of pharmaceutical chemistry. One of the stumbling blocks is the correct understanding of the ethylenic linkage, for unless this is very carefully explained, they imagine it to be a strong point, instead of a weak one in a chain of carbon atoms. It would have been a great help if a short description of Baeyer's strain theory could have been incorporated in the chapter dealing with unsaturated hydrocarbons.

The chapter on glucosides contains no reference to the digitalis group or to the newer term 'glycosides'. The article on vitamins gives a fairly good idea of the present position regarding these substances, but implies that the sterols are the only unsaponifiable alcohols. Bibliographical references are given at the foot of each page and these should prove useful to those students desiring further information. The illustrations are numerous and for the most part useful.

It is stated in the preface that the book is a textbook for those studying for the examinations in pharmaceutical chemistry of the Pharmaceutical Society and similar examinations. As such it fulfils its mission. S. G. S.

Erinnerungen: Bekenntnisse und Betrachtungen. Von Gottlieb Haberlandt. Pp. vii+243. (Berlin: Julius Springer, 1933.) 10.80 gold marks.

THIS little book, as its sub-title suggests, comments in fresh and lively fashion upon the topics that pass inevitably in review in these reminiscences of eighty years spent largely in the service of botany in Germany. They thus reveal in pleasant fashion the striking personality of its author, who is best known in England as the author of "Physiological Plant Anatomy".

It is amusing thus to learn that Haberlandt became a botanist in the first place because the external appearance of Julius Wiesner's college in Vienna for the study of anatomy and physiology of plants was more attractive than that of the college in which studies of German language and literature were proceeding, and secondly because the necessary dissection made the study of structure in the animal world less congenial. In his early days, the great textbook of Sachs makes the strongest impression, but the young doctor does not go to Würzburg but to Schwendener at Tübingen, whose monograph upon the mechanical principle in the anatomical structure of Monocotyledons has just appeared. Thus early is made the link between structure and functional performance, and this line of thought is developed after Schwendener's removal to Berlin, during years as *Privatdocent* first at Vienna and then at Graz. Here appeared the "Physiological Plant Anatomy" upon which Haberlandt's fame largely rests, though with his transference to Berlin in 1910 as successor to Schwendener, a second period of activity began in which developmental physiology was more prominent. To this period belong the studies of the physiology of cell division which are still profoundly influencing botanical development, though his early suggestion of contributory 'hormones' is now giving way to less definite suggestions of 'growth substances', of which the Utrecht school would restrict the influence to an effect upon cell extension.

Many a botanical reader outside Germany will be grateful for the opportunity thus presented to share, even in this one sided way, in a discussion with Haberlandt of topics which remain of perennial interest wherever botanists are gathered together.

Field Studies in Ecology. By Dr. R. Bracher. Pp. 100. (Bristol and London: J. W. Arrowsmith, Ltd., 1934.) 2*s.* 6*d.* net.

THIS little book on practical work in connexion with plant ecology will be found very useful alike to students and to teachers of botany. Her experience in conducting field work in connexion with the University of Bristol has enabled the author to condense in a small compass all that is essential in a practical study of ecological problems. This she sets forth in a clear and concise manner, with suitable illustrations and with practical hints on methods of investigation, on mapping and on determining the various factors which influence the vegetation: light, atmospheric and soil moisture, acidity or alkalinity of the substratum. The synopsis of British plant communities in the earlier part of the volume is exceedingly well arranged and cannot fail to give the student a very clear account of the various plant communities and their constituent plants. The book can be warmly recommended to prospective students of ecology both in schools and at the universities as a handy guide to their practical studies.

Pyramid Prophecy

IT is now ten years since Mr. David Davidson published his first book on prophecy made from the measurements of the Great Pyramid of Gizeh. That book is now in its fifth edition, and has been followed by eight smaller publications, all of which have been given wide publicity in the public Press, through full-page advertisements and otherwise.

The latest pamphlet, a quarto of seventy pages, is entitled "The Hidden Truth in Myth and Ritual and in the Common Culture Pattern of Ancient Metrology" (Leeds : The Author, 47 Park Square ; London : Williams and Norgate, Ltd., 1934. 2*s*. 6*d*.) ; and metrologically the chief contention is that the various systems of measures in the ancient world were all derived from one system invented "to form a standard basis of reference for the many loosely formulated primitive systems of measures". If this were the case it is an important discovery. But unfortunately we stumble immediately against an astonishing series of statements, such as the following : "Surely, however, a 'widespread . . . diffusion of customs and institutions' necessarily implies widespread commercial intercourse ; and does not the latter postulate the need for a standard system of measures as a common basis for exchange and barter ?" It seems strange that such a sentence could ever have been written in a world where the pound and the dollar fluctuate as they do, and the metric system has not yet been adopted by the English-speaking countries.

The essential point is that all primitive measures were based on a 'primitive inch' invented by Mr. Davidson and equal in length to 1·0011 British inch. The method by which this is proved is interesting. A passage in Horapollo ("Hieroglyphics", 1, 5) reads : "To represent the current year they (i.e., the Egyptians) depict the fourth part of an aroura ; now the aroura is a measure of land of an hundred cubits. And when they would express a year they say a quarter." Mr. Davidson states that the reason why the quarter-aroura represented the year was that its circumference, if circular, would be equal to 3652·42 of the primitive inches which he has invented. This is taken to prove the existence of the primitive inch ; and Sir Flinders Petrie is rebuked in heavy type for refusing to believe it.

Actually, however, Mr. Davidson is demonstrably wrong. The meaning of the passage in Horapollo is this : The Egyptian word for the quarter-aroura is *ḥsb ;* and in classical Egyptian the word for the current year is spelt *ḥa·t-sp*, where *a* represents alif, and *t* is the feminine ending which was dropped in pronunciation in the third millennium. This word *ḥa·t* occurs in Coptic as *ha-* or *hi-*. Horapollo plainly means that in his time the two words *ḥsb* and *ḥa·t-sp* were pronounced the same ; and all exponents of Egyptian morphology will support this explanation.

The point, however, on which Mr. Davidson lays greatest stress is the pyramid's "Displacement Factor". This is derived from his theory (for which there is no evidence) that the pyramid in building fell short of its intended measurements, by an error. Of the most accurately built ancient building in the whole world this is impossible to believe. It is further stated that in consequence of this error the pyramid was left incomplete at its top platform, as it was found that the apex-pyramid or cap-piece was too big to fit. There is, of course, no evidence of the existence of this cap-piece ; and it is incredible that Khufu would have left his pyramid incomplete because the original cap-piece did not fit. He would simply have ordered a new one.

The error is said to have happened thus. Fairly early in building, the few casing-blocks that survive were laid in the middle of each side to guide the workmen. Of those that were added later, and have perished, Mr. Davidson says that they tapered until at the corners they were only half the correct thickness. Now this could never have happened by mistake ; for the stones would not have fitted unless they were specially graduated ; and that it did not happen has been shown by Sir Flinders Petrie ("Pyramids and Temples of Gizeh", p. 84) : "On all the casing, and on the core on which the casing fitted, there are lines drawn on the horizontal surfaces, showing where each stone was to be placed on the one below it. If the stones were merely trimmed to fit each other as the building went on, there would be no need to have so carefully marked the place of each block in this particular way." These points, with the corner sockets, prove that the casing was deliberately planned and there can have been no error. The "Displacement Factor" therefore falls to the ground.

Naturally we begin to ask : Why should the Great Pyramid demonstrate the fate of Britain and the Lost Tribes when it has no connexion with either ? Mr. Davidson makes the connexion by inventing "Proto-Hebrews" who are said to have instructed the Egyptians in the building. There is no evidence for them ; but that does not, of course, influence the belief of Mr. Davidson and his followers in them.

Anyone who may still wonder whether Mr. Davidson's book actually explains a divine revelation should open the volume at random; he will find endless numerological jugglings and fictitious lines drawn in the pyramid. What Divine Being ever conceived descended to such puerilities? Truth, on the other hand, is known by its simplicity. For Christians the Bible is good enough, without seeking for guidance in the structure of the Great Pyramid. But since Mr. Davidson quotes from the Bible in support of his theories, it is quite fair to quote against him from St. Mark's Gospel, xiii, 22: "For there shall arise false Christs and false prophets, and shall shew signs and wonders, that they may lead astray, if possible, the elect."

RUPERT GLEADOW.

Modern Street Lighting

IN his presidential address to the Junior Institution of Engineers delivered on December 14, Mr. C. C. Paterson chose as his subject "Modern Street Lighting", laying stress on the necessity of making roads safe for traffic. It is important to remember that the number of licensed road vehicles in Great Britain has more than doubled during the last ten years. Even with the reduced maximum speed of 30 miles an hour in street lighted areas, good illumination is required for safe driving during night time. The great source of danger is that the eye has to function in conditions in which there is so little light. The eye sees by contrast either of colour or brightness. If everything were of the same colour and uniformly bright, and the visibility of the atmosphere were perfect, it would be impossible to distinguish objects from their backgrounds as there would be no contrast.

The illumination produced by bright sunshine is of the order of 8,000 foot-candles. On an overcast day, daylight falls from about 700 f.c. to 100 f.c. just before dusk. About half an hour after the sun sets, the illumination is about 5 f.c. At this point a number of drivers switch on their lights, and about ten minutes later when the illumination is 2 f.c. about 60 per cent of the cars have their lights on. When the illumination falls to 1 f.c. seeing is bad and car sidelights are beginning to glare. As the light falls to 0·1 f.c. the contrasts which give such good discrimination in full daylight are very slight, and the elements of the retina which give us the sensation of colour are weakening in their action. A man with a brown jacket and grey trousers now appears to have clothes of a uniform dark colour, but we are unable to say what colour it is. The dark grey lorry which can be seen clearly by daylight against a somewhat lighter grey road surface now disappears, as the contrast is not sufficient.

The problem of good street lighting is to find how to make the contrasts sufficiently distinct. For good seeing, the maxim is to make contrasts as distinct as possible, and this leads to the simple rule "make the road surface as bright as possible". Street lamps from this point of view should not be designed to light up objects on the road, but the road itself. Objects on the street are usually seen as dark things against a bright background, and this is the effect which street lighting should enhance. It is often true that when we drive behind a motor headlight, we see because its horizontal beam lights up the object itself rather than the road. But this projector beam is 20–30 thousand foot-candles, which is many times greater than would be possible under good street lighting conditions. For general street lighting, it would, taking expense into account, be impossible to make the objects brighter than the street.

The first step towards improving lighting is to make the road form a light background by means of its polish or shiny nature. Light can be directed on to the road in such a way that it reflects like a mirror. It does this when the light is directed along the road instead of on it. It is surprising what unpromising materials reflect light in this way. An asphalt road surface well polished by traffic reflects light excellently. A rough non-skid road surface does so also in a less degree. It is the same kind of effect as that produced by the moon when it shines towards us over water. Fortunately, as roads are at present surfaced, the conditions are often ideal for securing an uninterrupted bright path of light along their whole length. For an expenditure of three watts per foot run of road, we can obtain an illumination of 0·5 f.c. as seen on a white surface.

The two guiding principles used in modern street lighting are increasing the road brightness by specular (mirror) reflexion and increasing it by diffuse reflexion. The modern designer uses street illumination only as a rough guide to find the total amount of light available in the street. It is little use to specify road lighting by means of the 'minimum' illumination produced. Judging, as is usually done, the relative merits of two systems of lighting by the 'minimum' illumination produced is sometimes quite misleading. The real criterion is to find out which yields the highest road brightness with a given street surface condition.

If a road is so wet as to be like a still sheet of

water, very little light is diffused, the chief road brightness coming apparently from the image of the lamp. So far, means have not been found of rendering visibility anything like as good under wet as under dry conditions.

The use of a large quantity of light merely to claim compliance with a higher class of specification of the British Standards Institution without ensuring that it gives a proportionally higher road brightness is wasteful. Competition in illumination is useless, but competition in road brightness is of real value and importance. However, it is inadvisable to skimp the light and reduce its amount to the minimum required for the road surface. A certain amount of light on buildings and fences makes a great difference to the appearance of the lighting effect and sometimes aids visibility.

Mr. Paterson's address contains much novel matter, and it looks as if our ideas on street lighting would be considerably modified in the next few years. To all who drive motor-cars or ride bicycles, a good road brightness is essential as safety depends on it. Only in this way can we safely eliminate the use of headlights and the risky situations which arise from their use on busy roads.

Polarimetric Methods in Chemistry*

By PROF. T. M. LOWRY, C.B.E., F.R.S.

ARREST OF MUTAROTATION

FURTHER fortuitous observations showed that the mutarotation of nitrocamphor is not an independent intramolecular process, but depends on extramolecular circumstances, since under favourable conditions it may be arrested more or less completely over a period of several days. This discovery (which was made more than twenty years before Kurt Meyer's experiments on the aseptic distillation of ethyl acetoacetate in alkali-free vessels of silica glass) was also the result of a fortunate accident. The mutarotation of a solution of nitrocamphor in chloroform had been followed to completion during a period of about eight days, but had been accompanied by some loss of solvent (and possible concentration of the solution) by evaporation. The remainder of the solution had been left in the small graduated flask in which it had been prepared, and there was no reason to suspect that it would behave in any respect differently from the sample in the polarimeter tube. It was therefore a great surprise when, at the end of seventeen days, on attempting to confirm the *final* reading, it was found that the residue in the flask gave a rotation almost identical with the *initial* reading recorded more than a fortnight before. The transfer of the solution to the polarimeter tube, however, sufficed to initiate the mutarotation, which then proceeded with the same velocity as before.

Nearly ten years later, a further series of experiments was being made on the catalysis of mutarotation by acids and bases. It was then observed that solutions of nitrocamphor in chloroform, to which trichloracetic acid had been added, developed an intolerable and pungent odour. This observation showed that the peculiar inertness of chloroform was due to its oxidation to carbonyl chloride or phosgene, and to the consequent elimination of traces of nitrogenous bases, in the form of inert carbamides. The same series of experiments had already shown that some of these bases have an amazing catalytic activity. Thus an acceleration of mutarotation was detected as a result of adding piperidine to benzene in the proportion of 1 part of the base in 10 million parts of the solvent. This acceleration was also one of the earliest examples of a phenomenon which has since become very familiar, namely, a catalysis by bases, which could not be attributed to the presence of hydroxyl ions, and was therefore outside the scope of the conventional theories of catalysis by acids and bases, as developed and used by Ostwald and his colleagues.

An immediate sequel to this discovery was the arrest in silica vessels of the mutarotation of solutions of nitrocamphor in benzene and in ether, to which traces of an anticatalyst had been added. Subsequent experiments showed that mutarotation could also be arrested in solutions of tetramethylglucose in chloroform, benzene, ethyl acetate and pyridine ; and Owen developed to a fine art the process of arresting, almost at will and with very few failures, the mutarotation of solutions of tetra-acetylglucose in dry ethyl acetate.

The climax of this work was reached when Faulkner found that the mutarotation of tetramethylglucose could be arrested both in cresol and in pyridine, but proceeded too rapidly for convenient observation in mixtures of these two solvents. Since these mixtures gave velocities of mutarotation which were much greater even than in water, it was clear that the essential factor in promoting mutarotation was not an oxygenated solvent, or an ionising solvent (as had been suspected at earlier periods), or even the ionisation

* *Continued from p.* 921.

of the sugar by an acid or basic catalyst (as most other workers had assumed), but that an amphoteric solvent must be provided to serve as a complete catalyst for the process.

PROTOTROPY

The migration of a hydrogen atom, in compounds such as nitrocamphor and the sugars, was thus shown to depend on the addition and removal of a proton at two opposite poles of the organic molecule. Since no satisfactory name had been adopted for this important group of isomeric changes, I proposed in 1923 to describe them by the term *prototropy*. The migration of a proton was, however, regarded as only a special example of the more general phenomenon of *ionotropy*, in which a radical migrates from one part of a molecule to another either as an anion or as a cation.

The addition and removal of the ion from the two poles of the organic molecule may be either simultaneous or consecutive, but in either case it leaves behind a positive or negative charge. In order that this type of isomeric change may proceed, it is essential that these opposite charges should be neutralised. The electronic theory of valency allows us to recognise that this is done by the rearrangement of bonds which accompanies prototropic change, since a valency electron is thereby transferred *through the interior of the molecule*, to neutralise the charge of the proton, which is transferred *through the amphoteric solvent*.

The migration of a hydrogen atom, to which the most fertile types of mutarotation are due, was thus linked up to an extended definition of acids and bases, which I set out in 1923, at a time when it must have been in the minds of many other workers, and which was described more fully by Brönsted a few months later. Thus, if we define an acid and a base as a proton donor and acceptor respectively,

$$B + HA \rightleftharpoons \overset{+}{B}H + \overset{-}{A}$$

where B is the base and HA the acid, the migration of a proton in a prototropic compound under the combined action of a base B and an acid HA can be expressed by the equation

$$B + HS + HA \rightleftharpoons \overset{+}{B}H + SH + \overset{-}{A},$$

used by Brönsted and Guggenheim, where HS and SH represent the two isomeric forms of the substrate.

The process of isomeric change, as set out above, can be regarded as an electrolysis of the organic molecule between positive and negative poles, provided by the acid and basic components of the amphoteric solvent. This mechanism has therefore been described as an "electrolytic theory of catalysis by acids and bases". Similar conditions, however, prevail in all conjugated systems, and these can now be formulated in general terms, as systems in which opposite charges at the ends of the system can be neutralised by a migration of valency electrons through the system.

ROTATORY DISPERSION

At the time when the earlier measurements of mutarotation were made, it was customary to measure the optical rotations of organic compounds only for the yellow sodium line. Work on rotatory dispersion had indeed been suspended almost completely since the death of Biot in 1862, and the discovery of the Bunsen burner in 1866. It was, however, certain that little progress could be made in elucidating the origin of optical rotatory power, or in predicting its magnitude, until the values of the rotatory power were known over a wide spectral range, instead of for a single casually determined point on the curve of rotatory dispersion.

The ignorance then prevailing in reference to this important aspect of the subject is shown by the fact that, when Drude wished to test his equation for optical rotatory dispersion, he was only able to make use of data for quartz, since the rotatory dispersion of no one of the hundreds of optically active compounds prepared and studied by organic chemists was known with sufficient accuracy to be used for this purpose; and his equation for magnetic rotatory dispersion was tested on data for five wave-lengths only, for carbon disulphide and for creosote.

Experiments carried out in order to supply the data required to determine the form of the curves of rotatory dispersion in organic compounds soon led to definite conclusions. Thus in 1913 I was able to show, with T. W. Dickson, that the optical and magnetic rotations of many simple organic compounds for eight wave-lengths in the visible spectrum could be expressed by *one* term of Drude's equation:

$$\alpha = k/(\lambda^2 - \lambda_0^2).$$

In the following year we found that *two* terms of opposite sign:

$$\alpha = k_1/(\lambda^2 - \lambda_1^2) - k_2/(\lambda^2 - \lambda_2^2),$$

could be used in the same way to express the anomalous rotatory dispersion of ethyl tartrate. This result confirmed the conclusion reached at a much earlier period by Biot and by Arndtsen, that anomalous rotatory dispersion has its origin in the superposition of two partial rotations of opposite sign and of unequal dispersion. These partial rotations may be due to very diverse

causes, ranging from the presence of two optically active absorption bands in the same molecule, to the case in which two liquids of opposite rotatory power and unequal dispersions are arranged in series in separate polarimeter tubes. This diversity has resulted in a certain amount of controversy as to the *origin* of the partial rotations which give rise to anomalous rotatory dispersion, but the essential facts represented by Drude's equation are established beyond dispute.

Simple and Complex Rotatory Dispersion

On the basis of observations such as these, we proposed to describe as *simple* those rotatory dispersions which can be expressed by one term of Drude's equation, and as *complex* those which cannot be so expressed.

This classification is more fundamental than the earlier classification of those rotatory dispersions which increase progressively with decreasing wave-length as *normal* and of those which exhibit an inflexion maximum or reversal of sign as *anomalous*. Thus, no progress can be made in studying the optical rotatory power of organic compounds until the observed *total rotations* have been resolved into their component *partial rotations*. On the other hand, the distinction between normal and anomalous rotatory dispersion in compounds such as ethyl tartrate depends only on the relative magnitude of the two rotation constants, k_1 and k_2, of a Drude equation with two terms of opposite sign.

In general, simple rotatory dispersions are only observed when the characteristic frequencies of all the partial rotations lie close together in the Schumann region, giving a dispersion ratio $\alpha_{4358}/\alpha_{5461} = 1{\cdot}6$ approximately. Thus, in the sugar series, the partial rotations associated with the nine asymmetric carbon atoms of cane-sugar give rise to a simple dispersion ; but this is not always so, since even in a sugar the characteristic frequencies of the radicals may cover a wide range in the Schumann region, and the foot of the absorption bands often extends into the ordinary ultra-violet.

Rotatory Dispersion in Absorbing Media

Additional partial rotations of lower frequency give rise in the region of transparency to complex or anomalous rotatory dispersions. In the region of absorption they give rise to the remarkable anomalies which have been known since 1896 as the *Cotton effect*. These anomalies are much more dramatic than those observed in the region of transparency in compounds such as ethyl tartrate. Thus the specific rotation of camphor vapour, which is only about 55° in the yellow visible region, rises rapidly to + 2,000° on entering the region of absorption, then passes through a zero value at about 3000 A. and finally falls to a negative maximum of about − 1,800° before emerging from the absorption band.

In the remarkable case of tetra-acetyl-μ-arabinose, $H[CHOAc]_4.CHO$, the partial rotations associated with the three asymmetric carbon atoms cancel out. The whole of the rotatory power is therefore due to the partial rotation associated with the carbonyl group. This gives rise to a symmetrical loop, with equal and opposite maxima $[\alpha] = \pm 1{,}200°$ on either side of a zero rotation at 2909 A. The form of this loop cannot be expressed by Natanson's form of Drude's equation, in which the width of the absorption bands was attributed to a 'damping factor'. It can be represented, with a maximum deviation of 200°, by the equation of Kuhn and Braun, who assumed a probability distribution of *frequencies* in the absorption band ; but this deviation is reduced to 30° by using the equation of Lowry and Hudson in which the absorption is distributed symmetrically on a scale of *wave-lengths*.

Induced Dissymmetry

The existence in camphor and its derivatives of a partial rotation having the characteristic frequency of the ketonic absorption band was attributed by Lowry and Walker in 1924 to the *induced asymmetry* (or better *induced dissymmetry*) of the carbonyl group. According to this conception, the symmetrical carbonyl group becomes dissymmetric under the influence of the unsymmetrical field of an optically active molecule, when coupled sufficiently closely to an asymmetric carbon atom. It therefore contributes directly to the optical activity of the molecule, whereas less polarisable groups, such as $>CH_2$ or $>CMe_2$, contribute relatively little to the total rotation, even when they are exposed to a similar dissymmetric field.

This hypothesis has received support from the molecular theory of optical rotatory power, recently developed by de Mallemann and by S. F. Boys. According to their theory, optical rotatory power in a region of transparency depends on a product of four refractivities divided by the square of the wave-length of the light. It has been shown that this theory can only be extended to the region of absorption by postulating an additional centre of dissymmetry within the chromophoric group in optically active aldehydes and ketones. This extension is in harmony with the conception of induced dissymmetry, which thereby receives important confirmation.

Obituary

BARON DE GERLACHE

ADRIEN DE GERLACHE DE GOMERY died in his sixty-ninth year on December 4. When a young lieutenant in the Belgian navy, he conceived the idea of organising an expedition of his own to explore the antarctic regions and had his plans complete in 1894 for a voyage of adventurous discovery. Before he succeeded in raising the very modest sum needed to purchase and equip the *Belgica*, he was induced to make scientific research the main object of the expedition, and with this in view he secured the voluntary help of a group of enthusiastic young specialists including Prof. H. Arctowski as geologist and Dr. F. A. Cook, the only member with polar experience, as surgeon. Roald Amundsen was first officer and the crew was half Belgian and half Norwegian. The *Belgica* sailed in August 1897 and spent some time amongst the islands of Tierra del Fuego, not reaching Hughes Gulf on the coast of Palmer Land until January 23, 1898. Here Gerlache discovered the strait which now bears his name cutting off three large islands from the northern extension of Graham Land. He explored and charted the coasts of this strait and large geological and natural history collections were made. The commander and his scientific staff were now at cross-purposes. He aspired to push on, perhaps to the Pole; they were anxious to remain investigating the rocks and glaciers, birds and marine organisms of a region never before touched by science. The ship went on.

Fast ice prevented any approach to the southern part of Graham Land, and the *Belgica* was headed south-west in an endeavour to reach a high latitude. Gerlache entered the pack early in March, too late in the season, and was unable to extricate the ship, which was frozen in. Thus, contrary to his plan, Gerlache was committed to the first wintering in the antarctic regions, for which the ship was ill-prepared and the provisions unsuited. During the year that followed, the *Belgica* drifted in all directions with the pack, sighting no land but making valuable soundings. The health of all on board suffered greatly, and Danco, one of the scientific staff, died of exhaustion. Before this drift, nothing whatever was known of winter conditions in the Antarctic, and the meteorological observations were thus very important. It was largely due to the courage and tenacity of Gerlache that the party emerged with all its collections in good condition. The large number of antarctic expeditions in the early years of the twentieth century eclipsed to some extent the pioneer work of the *Belgica*; but the imposing array of scientific results produced at the cost of the Belgian Government is an abiding monument.

Gerlache continued to interest himself in polar matters. He commanded the *Belgica* in the Duke of Orlean's scientific expedition to the East Greenland Sea in 1905 and he promoted the building of a fine ice-protected ship designed for sporting cruises about Spitsbergen. The ship was built, and though the project failed, Gerlache had the satisfaction of transferring her to Sir Ernest Shackleton in 1914 and superintended her adaptation as the *Endurance* for the ill-fated expedition to the Weddell Sea.

The slow publication of the *Belgica* results, long suspended by the War, left Gerlache with the last volume of the official narrative practically finished but still unpublished at his death. King Albert created him a Baron in recognition of his great achievements, but Gerlache remained one of the most modest of men and generously allowed his scientific staff all the credit for the work of his expedition. H. R. M.

DR. N. E. BROWN

NICHOLAS EDWARD BROWN, or "N. E. Br", as he was known to botanists all over the world, died on November 25 at his residence in The Avenue, Kew Gardens, after a few months' illness. This indefatigable taxonomic botanist seemed as keenly interested as ever in his subject at eighty-five years of age, and he was still busy with a monograph of *Conophytum* (a segregate from *Mesembryanthemum*), for which he had prepared a number of beautifully drawn and coloured plates with minute dissections. He was a very good botanical artist, and a skilful microscopist, being a member of the Quekett Club.

Brown was a native of Redhill, and was educated at the Reigate Grammar School. On leaving school he was employed for a few years in the latter town as curator of Mr. Wilson Saunders' Museum of Natural History, whence he migrated to the Kew Herbarium in 1873. There he remained until his retirement in 1914. His work at Kew was mainly concerned with the botany of tropical and South Africa, and he was the acknowledged authority on the flora of the latter country. It was largely through his efforts that the "Flora Capensis" was completed. He was an expert on succulent plants and such difficult families as *Asclepiadaceae*, *Ericaceae*, *Euphorbiaceae*, *Iridaceae*, etc. For many years after his retirement, Brown studied the large genus *Mesembryanthemum*, finding in that assemblage a great number of smaller genera.

Brown had been an associate of the Linnean Society since 1879, and in 1921 was awarded the Captain Scott Memorial Medal by the South African Biological Society in recognition of his work on the South African flora. In 1932, the University of the Witwatersrand, Johannesburg, conferred on him the honorary degree of doctor of science. He was a life-long philatelist. J. H.

PROF. MIKHAILO HRUSHEVSKY, a prominent Ukrainian historian, died in Moscow on November 26, aged sixty-eight years. He was for many years president of the Ukrainian Scientific Shevchenko Society and editor of many scientific journals in Lwow and Kiev.

News and Views

Presentation to Sir Arthur Evans

ON December 17 Sir Arthur Evans, at a meeting of friends and colleagues held at the Society of Antiquaries, was presented with a portrait bust of himself in marble in recognition of his services to archæology, and in commemoration of the completion, in a fourth and final volume, of his great work on the excavation of the Minoan site of Knossos in Crete. The bust is the work of Mr. David Evans, a former Rome Scholar in sculpture. It represents Sir Arthur in academic robes and wearing the medal of the Society of Antiquaries, of which he was the first recipient. The greatness of Sir Arthur's contribution to the study of prehistoric archæology, more especially in the Mediterranean area, was fully recognised by Lord Rennell, who presided, and Prof. R. M. Dawkins, who recounted the more notable achievements of Sir Arthur's career. Lord Rennell, in making the presentation, referred to his work as the source of much of the recent fervour for archæological research, which is doing so much to reconstruct past history on more solid foundations and to confirm the authenticity of tradition. It is salutary at times to be reminded that in 1900, when Sir Arthur Evans made his first discovery at Knossos, the great bronze age culture of the Mediterranean, which has since been revealed as one of the more salient phases in the progress of man to a higher civilisation, survived only in a haze of tradition.

THE magnitude of the reconstruction which has given reality to that tradition in a wealth of data accumulated by excavations on sites in Crete, of which Knossos is the most important and impressive, was indicated by Prof. Dawkins in his brief correlation of the site at Knossos with those other areas of excavation in Crete which both supplement and help to interpret it. In like sense he also dwelt on the account of Knossos which appears in Sir Arthur's complete study, "The Palace of Knossos". As he pointed out, there will be found in that work not only a full account of the excavation of the site and the facts which have been revealed at each stage of its uncovering, but also a comprehensive and graphic picture of the whole civilisation of the Minoan age as it flourished in other parts of Crete, as well as of its relations with the world outside. On this side of Sir Arthur's work as a prehistorian it is not possible to dwell here in detail, but to many the imaginative insight which has been displayed in linking up the civilisation of Crete with that of other peoples of the Mediterranean and the near East has been a source of constant inspiration. It was, perhaps, as well that Sir Arthur Evans, in returning thanks, should have reminded those who were present that it was this aspect of his studies which had first attracted him from the Celtic art of Britain to the Ægean.

Memorial to the late Prof. T. E. Peet

A PROPOSAL to commemorate the services of the late Prof. T. Eric Peet to Egyptology and prehistoric archæology is put forward in a letter which appears in the *Times* of December 18 over the signatures of Lord Derby, Sir Robert Mond, Prof. R. M. Dawkins, Prof. Alan H. Gardiner and others interested in the studies with which the name of Prof. Peet is associated. His premature death in February last at fifty-one years of age was a grave loss to archæology, and came at a time when he seemed at the point of reaping a well-deserved reward for many years of strenuous work. It is suggested that the memorial should take the form of a Thomas Eric Peet travelling fellowship, open to the graduates of any British university who are studying either the Ancient Egyptian language and Egyptology, or the prehistoric archæology of the Mediterranean and the Near East. The fellowship will be attached to the Institute of Archæology in the University of Liverpool, the university with which Prof. Peet was connected all his life and in which he held the Brunner chair in Egyptology for fourteen years. For this purpose an appeal is made for a minimum capital sum of £1,000, the income from which would admit of an award in every fourth year. Should any further sum be raised, it would be utilised in a more frequent award or in grants in aid to approved students. Not only do Prof. Peet's services to archæological studies, which enhanced the prestige of British scholarship, deserve some form of lasting recognition, but the manner in which it is proposed to commemorate them should secure the support of all who are interested in promoting the study of the early history of civilisation.

Jubilee of Prof. W. R. Williams

ON December 20, the Lenin Academy of Agricultural Science is celebrating the jubilee of the scientific work of Prof. W. R. Williams, of the Timiriaseff Agricultural Academy, Moscow. Prof. Williams has obtained an international reputation by his original views on soil science, and on the part played in the world's history by mankind's maltreatment of the soil. He has attributed the decay of former civilisations to the spread of arable farming which has always accompanied expanding populations, as he believes that only by a system of farming in which the land is frequently returned to grass can the soil's 'crumb structure' be preserved and its fertility maintained. In a paper presented to the second International Soil Congress, he indicated the sociological significance of his ideas in planning the agricultural reconstruction of Russia, and reiterated the need for a balanced system of mixed farming, in which grassland and animal husbandry would play a leading part. Throughout his life he has been an ardent protagonist of the school that believes that the goal of agricultural science is to preserve the fertility of the earth rather than to stimulate it for immediate profit and leave a legacy of exhausted soils to posterity. His strongly expressed views have provoked frequent criticism; but they have succeeded in

focusing attention on what may shortly become one of the most pressing problems confronting agricultural science.

Augustus George Vernon-Harcourt, 1834–1919

ON Christmas Eve occurs the centenary of the birth of Augustus George Vernon-Harcourt, president of the Chemical Society in 1895–97, professor of chemistry in Christ Church College, Oxford, and one of the Metropolitan Gas Referees. The son of Admiral F. E. Vernon-Harcourt and grandson of Edward Harcourt, Archbishop of York, he was a nephew of William Vernon Harcourt (1789–1871), one of the founders of the British Association and brother of Leveson Francis Vernon-Harcourt (1839–1907), who from 1882 until 1905 was professor of civil engineering at University College, London. A. G. Vernon-Harcourt was educated at Cheam and Harrow and entered Balliol College with a scholarship in natural science, and after studying under Sir Benjamin Collins Brodie (1817–80) became his assistant. In 1859 he was made Lee's reader in chemistry and began contributing papers to the *Chemical News* and the Chemical Society. His earliest researches related to oxidation, and from these he passed to others on the rate of chemical change which—in conjunction with those of Berthelot in France and those of Guldberg in Norway—were to establish on a quantitative basis Berthollet's law of mass action. In much of his work he collaborated with William Esson (1838–1916), the Savilian professor of geometry. In the engineering world he was known for his investigations on coal and coal-gas. When he became a Metropolitan Gas Referee, the old sperm candle of the law of 1860 was the legal standard of illumination, but this was eventually replaced by the 10-candle pentane lamp of Vernon-Harcourt. An interesting episode in his later years was the banquet given in 1910 by the Chemical Society to five of its oldest members who had served as president. The five were Sir Henry Roscoe, Dr. Hugo Müller, Sir William Crookes, Prof. William Odling and Prof. Vernon-Harcourt. Of the five, Vernon-Harcourt, who died on April 23, 1919, was the last survivor but one, Odling outliving him a few years.

The New Star in Hercules

EARLY on the morning of December 13, Mr. J. P. M. Prentice, who is a regular meteor observer at Stowmarket, noticed a bright star in an unusual position and telegraphed to the Royal Observatory at Greenwich. The message was received at 5^h, and Mr. Martin promptly secured a spectrum of the nova with the Yapp reflector. The Nova had an apparent magnitude of about 3, and exhibited a typical Nova spectrum with emission lines of hydrogen and helium. By a fortunate chance, a break in the clouds occurred over Greenwich at $12^h\ 40^m$, which enabled Mr. Acton to observe the star's position with the transit circle. Its apparent position at transit at Greenwich on 1934 Dec. 13 was R.A. $18^h\ 5^m\ 38{\cdot}3^s$, Dec. $+45°\ 50'\ 52{\cdot}9''$. The star is very close to the present position of the sun in Right Ascension, but its northerly declination makes it an accessible object at twilight. It is plainly visible to the naked eye, situated about 10° north-west of Vega. A photographic plate was exposed on the astrographic telescope at Greenwich on the evening of December 13, which enabled the nova to be identified with a fifteenth magnitude star on the Franklin Adams plates. It has accordingly risen about twelve magnitudes. Further spectra have been secured at Greenwich and at the Solar Physics Observatory, Cambridge. From an examination of the spectrum, the Astronomer Royal, who spoke briefly on the subject at the meeting of the Royal Astronomical Society on December 14, concluded that the star had just passed its maximum brilliancy when discovered. Assuming the absolute magnitude at maximum to be −6, the Nova is about 2,000 light years away. Subsequent developments in apparent magnitude and spectrum are being watched with interest at a number of observatories. So far as has been ascertained, there was no independent discovery of the Nova. Its position was, of course, communicated through the usual channels on December 13.

Earthquakes of December 15

Two destructive earthquakes, one of great strength, were felt in different parts of Asia on December 15. Of the slighter, the time of occurrence is not stated, but it may have been the one recorded at Alipore (Calcutta) at 2.15 a.m. (Indian time) or 8.45 p.m. on December 14 (G.M.T.). From the early reports, it appears that more than twenty persons were killed and about a hundred injured, and that at least 25 villages were destroyed. The shocks were strongest in the neighbourhood of Chapakjur, between Diarbekr and Mush, or about ninety miles south of Erzerum. Both Diarbekr and Mush are close to centres of earthquakes of semi-destructive intensity. The second and stronger earthquake was widely recorded. According to the report issued from the Kew Observatory, the first movements were recorded there at 2 h. 8 m. 31 s. (G.M.T.), the epicentre being at a distance of about 4,500 miles. In the largest oscillations that arrived at 2 h. 34 m., the earth movements at Kew exceeded 0·01 in. These are the largest recorded since July 18, due to an earthquake in the Pacific, but they are less than half those from the Bihar earthquake of last January 15. The seismogram at Bombay shows that the epicentre was about 1,300 miles from that city, from which it would seem that the earthquake occurred in Tibet a few seconds before 1 h. 58 m. (G.M.T.). From such a source we are unlikely to receive direct evidence. In the *International Seismological Summary*, however, we find recorded many earthquakes with their centres in that country, an origin that agrees rather closely with the distances given above, being that of the strong earthquake of October 8, 1924.

Racial Problems in Africa: a Suggestion

MUCH interest has been aroused by a suggestion for dealing with the native problem in East and South Africa, which has been put forward by Col. Carbutt, Chief Native Commissioner for Southern Rhodesia. Writing in the annual publication appearing under

the auspices of the Native Affairs Department, and pointing to the problems which arise from the development side by side of the white and black populations, it seems that he advocates the formation of a dominion in which the interests of the black population would be paramount. Such a dominion, which would permit of the civil and political development to the full of the black population, might, it is suggested, comprise the present territories of Uganda, Tanganyika, Nyasaland and Northern Rhodesia, where white settlement and development have not reached a stage, such as that, for example, in Kenya and Southern Rhodesia, which would prove an insuperable obstacle to this policy. Inevitably, some sacrifice would be involved, but in other areas, in compensation, the interests of the white population would be recognised as paramount. Col. Carbutt stresses the argument, of which indeed the force must be patent to everyone, that a solution of the native problem is vital for the future of the commonwealth of British peoples, and at the same time maintains that such a solution as he suggests would be acceptable to, and indeed welcomed by, the natives themselves. It would appear already to have been received with some measure of approval in Africa, if mainly as representing an advance toward the idea of a federation of the two Rhodesias and Nyasaland, or even of a united East and South Africa.

THE proposal that a dominion should be formed north of the Zambezi constituting what would be, virtually, a vast self-governing reserve for native tribes is an adaptation to conditions in East and South Africa of a proposal put forward some years ago by the late Prof. J. W. Gregory. Prof. Gregory, who was convinced that, on the whole, intimate contact between white and coloured races was harmful to both, thought that the solution of the world's racial problem lay in some such territorial segregation of the white and the coloured races according to their respective adaptation to climatic and other conditions. The black races were to be confined mainly to the tropical belt. The proposal now put forward by Col. Carbutt has the merit that while it might follow as a logical development of the policies of segregation and 'indirect rule', it would afford opportunities for cultural, political and economic development of the native along the lines of his own institutions and without too abrupt a break with tradition, such as will be, it is becoming increasingly obvious, if not impossible, at any rate extremely difficult to secure in present conditions. Clearly the political status of such a dominion would have to be such as to entail a lengthy period of tutelage, pending the attainment by the native of an adequate measure of competence in the conduct of affairs, and to ensure avoidance of difficulties such as have arisen in Liberia.

Science and Armaments

IN an address before the Bristol Section of the Institute of Chemistry on December 10, Dr. Herbert Levinstein asserted that the destructive power of science in war is absurdly overrated, and that the application of chemical science to war has not made war more dangerous either to soldiers or to civilians. He argued further that scientific warfare is more humane and, because its continual inventiveness introduces an element of surprise, is more likely to bring a war to an early conclusion. The great wastage of life in the War of 1914–18 was due to lack of invention, to reliance on mere numbers of men or projectiles and on obsolete tactics. Dr. Levinstein stressed further the close connexion between chemical industry and chemical warfare, asserting that the prohibition of chemical warfare in the Treaty of Versailles was not due to the horrors of such warfare but to disparity in strength between German chemical industry and that of other countries. He regards as unworkable the suggestion that chemists should agree not to produce any substance used for warlike purposes, because differences between warlike and non-warlike substances are too subtle to be effective.

DR. LEVINSTEIN'S address was doubtless provocative by design but to what purpose is obscure. A discussion on the relative humanity of various methods of warfare is as futile and beside the mark as it is unscientific. Moreover, chemical industry at the present time is scarcely so undeveloped in Great Britain as to merit the rather dubious support which its relation to chemical warfare may lend it. A satisfactory and scientific approach to armament, as to disarmament, is that indicated by Major Lefebure in his book "Scientific Disarmament". The piecemeal discussion of this difficult question is always dangerous and Dr. Levinstein's treatment goes far to nullify the value of his warning that the possibility of chemical warfare cannot be excluded merely by treaty provisions. The moral aspects of the participation of the scientific worker in preparation for warfare were rather too lightly dismissed by Dr. Levinstein, whose remarks here were all the more disappointing because of the need for clear thinking and close discussion by scientific men of this important matter. The creation of a definite professional opinion and code may be a slow process, but it should not be dismissed as impossible. On the other hand, there are definite spheres in which the chemist and other scientific workers can render important services in national defence to which no suggestion of extending the area of conflict can be attached. One such proposal is contained in a long article in the *Retail Chemist* for December in which an organisation of all the chemists of the country to deal with the effects of poison gas attack on the civilian population is advocated. The First Aid posts for gas casualties suggested by Major-Gen. P. S. Wilkinson, of the Order of St. John of Jerusalem, is another such practical proposal in which the knowledge and experience of the chemist might be of direct service to the community.

Artificial Nuclear Transmutations

LORD RUTHERFORD, in his Ludwig Mond lecture at the University of Manchester on December 10, described how recent work in the study of artificial nuclear transmutations is giving rise to a new

chemistry, concerned not with the outer layers of the atom but with the nucleus itself. The transmutations of one element into another involves adding or subtracting a particle, charged or uncharged, to or from the nucleus, and this may be effected in many cases by bombardment with foreign particles. A few of these particles may enter the nucleus, and this may sometimes lead to the emission of a particle from the nucleus itself. The first of such transmutations was accomplished in 1919, when nitrogen was disintegrated by α-particle bombardment with the liberation of fast protons. More recently, a new type of disintegration has been discovered in which a neutron is emitted. In these cases the residual nucleus in the transformations is stable. In the cases investigated by M. and Mme. Curie-Joliot, an artificial radioactive element is formed by bombarding a light element with α-particles. Fermi and his collaborators have found that a very large number of elements can be disintegrated by neutron bombardment, giving artificial radioactive elements. The neutron, on account of its lack of charge, can penetrate the heavy nuclei when α-particles would be turned back. Finally, Lord Rutherford directed attention to the accomplished production of nuclear disintegration, using bombarding particles artificially accelerated by high voltages instead of the particles emitted from natural radio-elements.

Science and Road Traffic

In his lecture before the British Science Guild on December 19, Col. Mervyn O'Gorman discussed the application of science to the problems of road traffic. Road traffic, he said, is not replaceable by other distributive agencies, and its prosperity is indeed advantageous to them. The magnitude of motor transport as an industry is such that it has more employees, involves more capital wealth, and pays larger taxation to the State than almost any other industry in England. Inprovement which is being, and must be, sought in safety of distribution by road involves getting the largest amount of road distribution achieved per single accident. The business of evolving the necessary instruments, the analytical methods, the interpretation of data, and similar work on the accident ratio is the proper function of science, especially physics, mechanics, mathematics, chemistry, geology, metallurgy, statistics, physiology, psychology, etc. A committee should be formed to advise and undertake research, and it should not contain road interests (financial or professional) and it should receive all the specific 'road and traffic' information that it needs from the Ministries of Transport and of Health, the Home Office and from witnesses. Following the precedent of the successful Aeronautical Research Committee at its foundation in 1908, it should report direct to the First Lord of the Treasury. Its members should be paid, and should all be scientific men, preferably nominated by the Royal Society in conjunction with the Department of Scientific and Industrial Research. The committee having been formed, it should be free to formulate and verify its own theories in the study of safe traffic flow, economic flow, pedestrian flow, etc., these being the frameworks of various long-range researches.

Maternal Mortality

Sir Hilton Young, the Minister of Health, received on December 11 a deputation from the Maternal Mortality Committee. Mrs. H. J. Tennant, introducing the deputation, said that it represented more than 3,000,000 women and was the outcome of a meeting on the subject of maternal mortality held in November. Mrs. Barton said that malnutrition, though not a primary cause, is a contributing factor to maternal mortality, and she fears that the block grant system of Exchequer grants is less effective in stimulating local authorities than the former percentage grants. Lady Barrett dealt with the question of ante-natal care, and the necessity of improving the training of doctors and midwives. Miss Gregory considers that midwives ought to have a two- or three-year course in a first-class hospital. Other speakers stressed the importance of maternity and child welfare services. The Minister, in reply, said that the problem of maternal mortality is giving him grave concern. The maternity and child welfare services of local authorities are being steadily developed, and he considers that no financial check has been placed upon them by the alteration in the grant system. There is no evidence that there is any close relation between malnutrition and a high maternal mortality rate. Nevertheless, the conditions in depressed areas are such as to give rise to anxiety, and the position is receiving the close attention of the administration. He outlined measures that are being taken to improve maternity and child welfare services throughout Great Britain, and alluded to special inquiries and investigations that are being made in districts where the maternal mortality rate is abnormally high.

Further Tests of the Medium Rudi Schneider

In the *Proceedings* of the Society for Psychical Research for October is published a further report on the alleged psychic phenomena occurring in the presence of the medium Rudi Schneider. Under the joint authorship of Mr. T. Besterman and Mr. O. Gatty, the paper describes an attempt to look for confirmation of the infra-red phenomena previously reported, and generally to conduct tests by instrumental means. As an example of the kind of methods to be used in experimental work with the so-called physical phenomena, the report seems to be a step in advance, and the results suggest that through such instrumental means a better idea of the nature of the phenomena may be obtained. Generally speaking, the present results were negative. The interruption of the infra-red rays as previously reported by Dr. Osty in Paris and by others in Great Britain received no confirmation, in spite of a series of careful observations; and through the help of of Dr. C. G. Douglas it was ascertained that the medium's breathing, which was considered of sufficient interest to reproduce in a recent series of talks

broadcast by the B.B.C., had nothing supernormal about it, being merely somewhat shallow and quite normal considering the muscular movements made by the medium during the trance. Thus the report as a whole contains no good evidence that Rudi Schneider possesses supernormal powers; and further controversy concerning the case can therefore be postponed until positive evidence is adduced based upon the kind of instrumental methods outlined in the present report.

National Institute of Industrial Psychology

THE annual report of the National Institute of Industrial Psychology appears in the *Human Factor*, vol. 8, No. 12. The Institute is approaching a critical period in its career, when lack of funds may seriously curtail its research work. The report stresses this fact, and describes the work accomplished along various lines, touching on investigations in factories, warehouses, offices and shops, investigations of the processes of distribution, vocational guidance, research and educational work. A vocational guidance scheme has been launched in Bristol; and large-scale experiments in Fife, and in Borstal institutions, have been completed this year. Researches into the possibility of simplifying and modifying tests of manual skill, and of devising tests for mathematical and linguistic ability, and the part played by rhythm in manual work are being continued. A study of the use of practical performance tests of intelligence and, on the vocational selection side, the analysis of three occupations, namely secretarial work, nursing and secondary school teaching, have been completed.

Liverpool Geological Society

THE seventy-fifth anniversary of the foundation of the Liverpool Geological Society was marked by a scientific conversazione, under the presidency of Dr. R. G. Wills, held in the Department of Geology, of the University of Liverpool, on December 11. The assembly commenced with the reading of the minutes of the first ordinary meeting of the Society in 1859, after which the Society's Medal was presented to Mr. Emil Montag, Swiss consul in Liverpool, for services rendered to the Society during his twenty-four years' active membership, his editorship, his contributions to British and Swiss geology and his work in providing facilities for study in Switzerland. Prof. H. H. Read, Herdman professor of geology in the University of Liverpool, vice-president of the Society, then delivered a short lecture on earthquakes, followed by a demonstration of the University seismograph. Dr. E. Neaverson lectured on palæontological exhibits, and there was a demonstration of rock-cutting and of new maps. Amongst the exhibits on view at the conversazione was an interesting collection of fossils, new instruments and minerals, the latter including specimens of two new British minerals recently found in Scotland; chondrodite, found in association with metamorphic limestone, and stichite, found in association with ultra-basic rocks.

THE Liverpool Geological Society, which publishes an annual *Proceedings*, has made many valuable contributions to geological history, and among its most distinguished members in the past were George H. Morton, one of its founders, and author of the "Geology of the Country Around Liverpool" (1863). After the Geological Survey had examined the area, a second edition of Morton's work was issued in 1891. The Rev. H. H. Higgins made valuable discoveries of fossil ferns in the Ravenshead railway cutting near Rainhill in 1870, and H. C. Beasley described the well-known labyrinthodont footprints from Storeton quarries, Cheshire, which G. H. Morton later named *Cheirotherium stortonense*. Despite what may be called a geological and palæontological poverty amongst the rocks of its sandstone area, the Liverpool Geological Society has kept research well to the fore in its history, and its *Proceedings* contain many valuable contributions to geological science.

Apparatus for Photographic Reproduction

THE reproduction of documents, drawings, etc., by photography is, of course, widely practised. It is possible by direct photographic printing to do such work without a camera. With sheets of translucent material of which only one side is used for the design or writing, such a method is capable of furnishing a paper negative which may be used for printing positive copies. The same method may be used for making readable copies which are negatives only in respect of black and white. If, however, the sheets of the original have matter on both sides, this simple method of printing is not possible, and it is necessary to use the method of 'reflex' photographic printing to make a negative, from which positive copies are made by printing through. Reflex printing consists in placing a sheet of the sensitive paper in contact with the matter to be copied, and exposing through the sensitive paper. Differential reflection from the design and its background is sufficient to give a printable image. These methods have long been known and used for the reproduction of copies of the same size as the originals. A very convenient portable apparatus comprising lamps, printing frame and automatic exposure timing device, which we have examined, has now been placed on the market by Messrs. Bornett and Co., Ltd., 7–8 Idol Lane, E.C.3. This apparatus is known as the "Rectophot Rapid Reproducer" and is made in two sizes, the smaller of which will deal with papers 13½ in. × 10 in.; the larger with 22 in. × 15 in.

Synthetic Compound with Vitamin B_2 Activity

As is well known, lactoflavin induces growth in rats fed on a vitamin B_2 free diet. In a lecture at the Kaiser Wilhelm Institute for Medical Research in Heidelberg, Richard Kuhn, who with P. György discovered the biological activity of lactoflavin, reported that he had synthesised a compound with the same properties as lactoflavin. The synthetic substance was prepared by interaction of a suitable derivative of 1-nitro-3, 4-xylol with *l*-arabinamin, with subsequent reduction of the product formed and condensation with alloxan. 0·015 mgm. of this substance prevented hypovitaminosis in rats. This dose is of the same order of magnitude as that required for lactoflavin, whereas the corresponding

synthetic substance without the two methyl groups on the benzene ring was completely inactive in this dose. The synthetic substance combines with the protein of the 'yellow ferment' of Warburg, prepared according to the method of Theorell, yielding a catalytically active compound, thus behaving exactly like lactoflavin. The optical rotation in alkaline solution of the two substances is the same. In order to decide definitely whether the two compounds are identical in every respect, Kuhn intends to prepare compounds containing the ribose and xylose radical, instead of arabinose, for comparison.

Irrigation in India

THE report on "Irrigation in India in 1931–32" (Delhi: Department of Industries and Labour) shows that the total irrigated area in British India in that year fell slightly below thirty million acres, of which more than half was in the Punjab and the Madras Presidency. In the whole area, the figures represent slightly more than 12 per cent of the area sown, rising to 34 per cent in the Punjab and 93 per cent in Sind. Among the largest new irrigation works in progress is the construction of a dam at Mettur on the Cauvery to store flood waters. About half this work was completed by the end of the year. The works in connexion with the new Lloyd barrage at Sukkur in Sind are approaching completion.

Research in Dairying

THE annual report for 1933 of the National Institute for Research in Dairying, University of Reading, contains a summary of the work done during the year in the various departments, and brief abstracts of papers published from the Institute. Reference is made to the death of the first director, Dr. Stenhouse Williams, in whose memory a new library building has been erected. Attention is also directed to the financial stringency from which the Institute is suffering, and which will necessitate the abandonment of valuable work now being conducted in the Physiology Department and the Nutritional Laboratory unless additional funds are forthcoming within the next few months.

Exhibition of Architecture

AN exhibition of an interesting character has recently been opened at the new premises of the Royal Institute of British Architects, 66 Portland Place, London, W.1. Here is to be seen a collection of more than 1,200 large photographs of buildings and many models showing recent developments in architecture throughout the world. It has taken two years to bring together this international collection, which is well displayed and is divided into subjects such as public buildings, hospitals, schools, houses, which enables the visitor to compare the designs of leading architects in different countries side by side in a manner which is seldom possible. The exhibition does not deal with planning or construction, but for those interested in these matters there are a few sets of drawings and particulars showing all the stages through which a project must pass before a building can reach completion; the extent of this detailed work will probably be a surprise to the layman. The exhibition is open to the public without charge from 10 to 6 until January 5.

American Association for the Advancement of Science

THE ninety-fifth meeting of the American Association for the Advancement of Science will be held at Pittsburgh commencing on December 27. On December 31, the retiring president, Dr. Henry Norris Russell, will deliver an address entitled "The Atmospheres of the Planets". Among the general addresses to be delivered are: Prof. E. A. Horton, "*Homo sapiens*, Whence and Whither"; Prof. Arthur B. Lamb, "Crystallogenetic Adsorbents"; Dr. A. Franklin Shull, "Weismann and Hæckel: One Hundred Years"; Prof. H. H. Newman, "Twins reared apart and the Nature-Nurture Problem"; Dr. Mark H. Liddell, "The Auditory Spectrum". Prof. Albert Einstein will deliver the Josiah Willard Gibbs lecture of the American Mathematical Society on December 28. On December 30, there will be a symposium on the relation between science, especially scientific organisations and institutions, and the Press. Speakers will represent the universities, technical and medical schools, the National Association of Science Writers, Science Service, the Associated Press, the Hearst Service and representative newspapers. Further information about the meeting can be obtained from Dr. Henry B. Ward, American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D.C.

Announcements

SIR ISIDORE SALMON, chairman and managing director of Messrs. J. Lyons and Co., Ltd., has been elected president of the Decimal Association, in succession to Lord Hirst.

THE Karl Sudhoff medal has been awarded by the German Society of the History of Medicine, Natural Sciences and Technique to Prof. T. Györy, professor of the history of medicine in the University of Budapest.

THE annual meeting in 1935 of the British Medical Association will be held at Melbourne on September 11–13, under the presidency of Sir Richard Stawell, consulting physician to the Melbourne Hospital.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Education Office, Town Hall, Hanley, Stoke-on-Trent (Dec. 31). An assistant in the Technological Department of the Royal Scottish Museum, Edinburgh, 1—The Director (Jan. 12). A principal of the Northern Counties' Training College of Cookery and Domestic Science, Newcastle-upon-Tyne—The Secretary (Jan. 14). An assistant in natural history in the University of Aberdeen—The Secretary (Jan. 20). A Dunville professor of physiology and a J. C. White professor of biochemistry in the Queen's University of Belfast—The Secretary (Feb. 28). A chemist in the Admiralty Chemical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1.

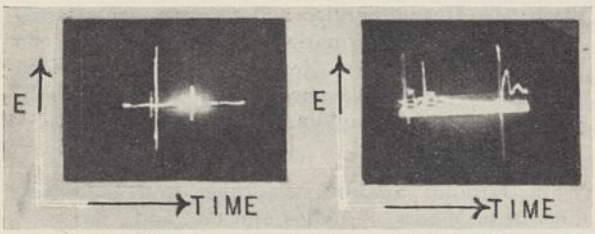
Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 974.

The Lightning Flash as Source of an Atmospheric

DURING the last few years we have made, on the roof of King's College, London, a series of observations on the rapid variations of the earth's electric field associated with thundercloud discharges, using a Wilson sphere as the conductor exposed to the earth's field, and a cathode ray oscillograph, with photographic registration, as the recording instrument[1]. In this way we have been able to follow the evolution of an atmospheric wave-form from the discontinuous change of field associated with near flashes to the type of radiation field, with its high-frequency detail, observed at greater distances. These experiments, together with allied investigations carried out at the Slough Radio Research Station of the National Physical Laboratory, were described at the recent meeting of the International Scientific Radio Union in London (September 1934).



(*a*) (*b*)

FIG. 1.

The observations have, however, more than radiotelegraphic interest, for they yield information relating to the nature of a thundercloud discharge. In the older measurements made using the relatively sluggish capillary electrometer, the effect of a net change of field was shown by a single discontinuity on the photographic record. With the string electrometer (as used here by Dr. J. T. Henderson and one of the writers) or cathode ray oscillograph, it is found that, while the most frequent type of discharge is one which takes place in a single 'step', the next most frequent type is one consisting of two or three components. The existence of these component 'steps' obviously indicates that a thundercloud moment is frequently destroyed in a series of partial discharges.

Now if atmospherics originate in lightning flashes, we might expect them to have the same tendency to occur in groups, and this is indeed found to be the case, the order of magnitude of the time intervals between successive components being the same as that observed in the net change observations made on near discharges. Two examples of such grouping are shown in the accompanying records. Fig. 1(*a*) shows a cathode ray oscillographic record of the electric field E during a group of three component disturbances, the wave-forms being unresolved because the time-base stroke is relatively slow (0·1 sec.). Fig. 1(*b*) shows another group of three discharges with a repeating time-base of 0·005 sec. duration. Here the atmospheric wave-forms are delineated and it is seen that the components of the group have very similar wave-forms.

It is obvious that this grouping of the net change 'steps' and atmospheric impulses of similar wave-form is to be correlated with the multiple flashes recorded by Walter and others using a moving camera. We may not, perhaps, be able to classify a thundercloud discharge as a relaxation oscillator, but the intermittent type of discharge appears similar to the familiar periodic sparking of a Wimshurst machine, steadily driven, to which a small Leyden jar is connected.

An interesting feature of the multiple flashes (and the resulting multiple atmospherics) is that a relatively big component discharge is very frequently associated with a relatively long succeeding interval, and vice versa; and in the case of many multiple flashes, the interval between any two successive partial discharges is actually proportional to the magnitude of the first partial discharge. The significance of this would appear to be as follows. We must regard the charge pouring into the head of the channel as reaching a certain critical value before a partial discharge takes place. Whatever be the (variable) amount lost in a component discharge, it appears to be replenished at a constant rate until the same critical value is again reached. An analogous effect would be provided, in the Wimshurst machine experiment cited above, by some agency which, when a spark was in progress, quenched it after a short interval of time which varied from spark to spark.

These experiments, like the allied investigations at Slough, have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.
F. W. CHAPMAN.

Wheatstone Laboratory,
King's College,
London.
Nov. 26.

[1] Chapman, NATURE, **131**, 620, April 29, 1933.

The Mass of the Neutron

THE mass of the neutron is considered by Chadwick[1] to be above 1·003 and probably to lie between 1·003 and 1·008. He gives the most probable value as determined by bombardment of boron by α-particles as 1·0067. The validity of this value rests on the assumption that γ-rays are not emitted in the process. Curie and Joliot[2] give a much higher (1·012) and Lawrence and others[3] a much lower (1·0002) value.

On the basis of the values of Fig. 1, and the mass data of Aston and Bainbridge, it seems that a probable lower limit of 1·0052 can be set for the mass of the neutron, by the use of a different

reaction from that of Chadwick. The reaction is:

$$\underset{14\cdot008\pm 0\cdot0028}{N} + n \rightarrow \underset{11\cdot0110\pm 0\cdot0005}{B} + \underset{4\cdot00216\pm 0\cdot0004}{He} \quad (1)$$

Fig. 1 indicates that in this reaction kinetic energy is usually lost, due presumably to the emission of γ-rays or to the production of an artificial radioactivity. This energy contributes to the γ-ray and radioactive energy, which may be denoted by $E_{\gamma+r}$ However, five disintegrations have been obtained: one by Feather, one by Meitner and Philipp, and three in this laboratory, in which kinetic energy is *conserved*. If in this case, $E_{\gamma+r}$ has a positive value, the energy represented by it must be produced from the corresponding amount of mass $m_{\gamma+r}$.

On this basis, the minimum mass of the neutron is 1·0052 and its actual mass (m_n) is given by

$$m_n = 1\cdot0052 + m_{\gamma+r}.$$

The greatest uncertainty here is due to the large probable error in Aston's determination of the atomic mass of nitrogen.

The mass of the neutron may also be determined by means of the reaction

$$\underset{9\cdot0155\pm 0\cdot0006}{{}_4Be_1^9} + \underset{4\cdot00216\pm 0\cdot0004}{{}_2He_0^4} \rightarrow \underset{12\cdot0036\pm 0\cdot0012}{{}_6C_0^{12}} + n(+\gamma) \quad (2)$$

from the velocities of the particles and the angles between their tracks. Since the angles are usually unknown, the mass of the neutron can be found only when its maximum velocity is attained.

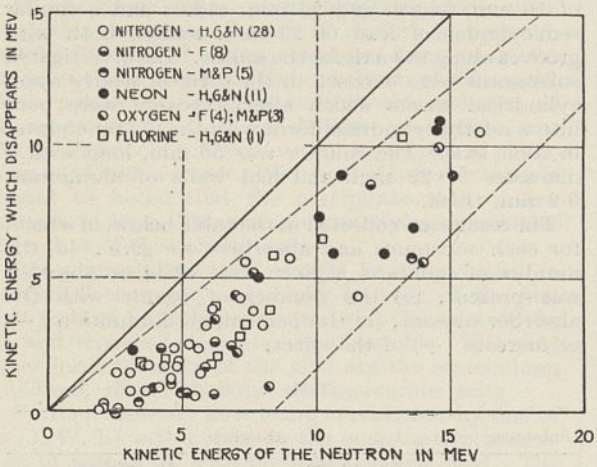


FIG. 1.—The kinetic energy which disappears in a nuclear reaction in which the nucleus specified is disintegrated by capture of a neutron. This energy may be emitted as a γ-ray, or, as has been found of the nitrogen (16) produced from fluorine, the energy takes the form of an induced radioactivity.

The fastest known neutron (energy = 16·1 mev.) produced by a fast α-particle (E = 8·761 mev.) was obtained by Harkins, Gans and Newson from reaction (2). Three other neutrons of energy 15 mev. were obtained by the same reaction. Feather obtained a neutron of 12 mev. energy by the same reaction but by the use of a slower α-particle (5·25 mev.). On account of the fact that the geometry of his apparatus is different from that of the others, the angle θ involved in Feather's work is somewhat doubtful, so his work is not used in obtaining the average value of the mass of the neutron. The calculations are summarised in the accompanying table, in which θ is the angle between the direction of the α-particle and that of the neutron. If the value of θ is greater than that given in the accompanying table, then the true result for the mass of the neutron is less than that given in the table.

Mass of the Neutron as Determined from that of Beryllium by Reaction 2.

Observer	K.E.-particle in mev.	Number of neutrons	Average K.E.-neutron	θ	Mass of neutron
H	8·761	1	16·1	0°	1·0059
H	8·761	3	14·7	0°	1·0073
F	5·253	1	12	90°	1·0052
D	7·683		14·2	0°	1·0068
M	5·253	1	13	0°	1·0053
M	5·253	1	14	0°	1·0042

H = Harkins, Gans and Newson. F = Feather. D = Dunning. M = Meitner and Philipp.

The average of all of the masses, except that of Feather, is $m_{av.}$ = 1·0059, and the average of the two masses obtained by us is 1·0066 as has already been pointed out, but since it is only the maximum kinetic energy of the neutron that should be used, we may put our value of the mass as 1·006.

While the reaction utilised for the determination of the mass of the neutron is different from that used by Chadwick, the basic assumptions involved are the same, namely, that no γ-ray is emitted by the same individual atom which emits the neutron. Also the nucleus which is produced, ${}_6C_0^{12}$, is assumed to be formed in its normal state. If it is in an excited state its mass is greater by m^*.

Thus the mass of the neutron is, as determined by

Chadwick : $1\cdot0067 - (m_\gamma + m^*)$
Average of H. and G. : $1\cdot0066 - (m_\gamma + m^*)$.

After a consideration of all of the factors involved, and especially since the term $-(m_\gamma + m^*)$ represents a negative value—unless it is zero, which is by no means certain—we suggest that the value 1·006 be used for the neutron until more accurate positive ray work is done, and also the knowledge of the magnitude of this term becomes more definite. This is only very slightly less than the value proposed by Chadwick. It should be recognised that the term $(m_\gamma + m^*)$, if not zero, would have a different magnitude in the reaction used by him from what it has in that used by us. The accuracy of the lower limit for the mass, 1·0052, is set by the accuracy of the positive ray work on which it is based.

WILLIAM D. HARKINS.
DAVID M. GANS.

University of Chicago.
Oct. 23.

[1] Chadwick, J., *Proc. Roy. Soc.*, A, **136**, 702; 1932.
[2] Curie-Joliot, *C.R.*, **197**, 237; 1933.
[3] Lewis, Livingston, Henderson and Lawrence, *Phys. Rev.*, **45**, 497; 1934.

The 1933 Everest Climbing Expedition and Oxygen

IN his book "Everest", Mr. Hugh Ruttledge tells us that the best route to the top, planned out by Norton, is "difficult and dangerous . . . imagine a house-roof covered with loose snow of such consistence that it cannot hold the feet and thus prevent a slip". Work is required "of the most arduous and exacting nature". Mr. Smythe was often knee-deep and even thigh-deep on these ledges, and great climber as he is, gained only 50 ft. in an hour. He says "the difficulty of the mountain, the evil effects

of altitude, the possibility of being benighted, the risks of sudden storms, and the danger of exhaustion, are so serious that oxygen should be taken if it can aid the climber. . . . Prior to 1933 there were those to whom the thought of it was abhorrent, I confess to a similar prejudice".

"There is no doubt that long residence at Camp IV and above allowed deterioration to set in."

One climber on returning to the base camp recorded that his "body was a horrible sight . . . all the ribs sticking out and hardly anything on my arms and legs at all". Three climbers suffered from dilated hearts. The rapid recovery of most of the climbers was very noticeable during the return march.

Before the start of the last Everest climbing expedition, I directed attention to Dr. Argyll Campbell's experiments which showed that animals could not be acclimatised to live for long at altitudes above 18,000 ft. Owing to want of oxygen, deterioration set in, and the animals finally showed degeneration of certain organs, such as the heart and liver. They recovered if exposure to the low concentration of oxygen was terminated before deterioration had advanced too far. Dr. Campbell recently has confirmed his previous results; animals can live in a concentration of oxygen equal to 12 per cent of one atmosphere, but not for more than six weeks in one equal to 10 per cent. I ventured to urge the need for the climbers to use oxygen breathing apparatus.

Dr. Raymond Greene says that, according to the modern theory, acclimatisation takes place in three ways: (1) increase in the number of red cells which carry oxygen in the blood; (2) increase in ventilation of the lungs; (3) possibly by active secreting of oxygen into the blood by the lungs. There is no sure evidence of this last. Dr. Greene lays stress on the fact that deep breathing washes carbon dioxide out, and so lowers the normal acidity of the body, but the kidneys correct this by secreting more alkali. There may be a lag in the kidney effecting this correction. To effect this and develop more red cells and the breathing powers, a slow ascent to the base camp is needed.

Dr. Greene leaves out of account a most important means of acclimatisation, one which has been pointed out by Dr. Campbell, namely, hypertrophy of the heart. We know that a hare has a much larger heart than a rabbit, in order to meet the demands made upon it in the effort of rapid flight. The output of the heart and the volume of blood circulating each minute is made much greater by the athlete developing a large, strong heart. This is what the climbers develop by spending ample time in climbing to the base camp and then to the foot of the North Col. It is recorded that "The local Thibetans exhibit greater energy on the Rangbuk glacier than the still comparatively unacclimatised Sherpa porters". We may be sure that these Thibetans must, for their size, like a hare, possess large and powerful hearts. The heart, the blood, the breathing muscles, are all developed by slow acclimatisation, while the nervous system becomes accustomed to enduring the want of oxygen at high altitudes.

During the time spent above 18,000 ft., the limit of possible acclimatisation for prolonged exposure, the vital organs, heart and brain, are maintained at the expense of the other parts of the body, hence the signs of deterioration and wasting.

Experienced Himalayan climbers have the advantage of hearts already developed by previous expeditions. They can climb above the North Col and reach 28,000 ft. and spend even three nights as Mr. Smythe did at 27,400 ft. in a tent carried there by the porters, but even they climb with difficulty, owing to shortage of oxygen. Mr. Smythe reports what apparently were hallucinations. He saw things in the sky and thought he was accompanied when he was alone. He was quite unable to face, above 28,000 ft., a piece of rock climbing which he says he would have tackled under ordinary Alpine conditions. All the time the climbers are deteriorating, and it is a question whether any climber will have a heart stout enough to take him to the top even under the most favourable conditions of weather and snow.

The use of oxygen breathing apparatus is now admitted to be wise for the last and very difficult part of the climb, and for helping the porters to carry material up to the higher camps. It is noteworthy that the breathing of oxygen during the night entirely cured a porter of bad frost-bite, after he had returned from Camp VI to the North Col camp. Two other porters who were much less affected, and therefore were not given oxygen, each lost digits.

LEONARD HILL.

Experiments on the Fermi Effect

WE have studied the intensity of the Fermi effect obtained under identical geometrical conditions, when screens of different materials are interposed between the beryllium-radon source and the substance in which the Fermi effect is excited.

The absorbing blocks were: a semicylinder of gold of 50 mm. length and 26 mm. radius and a similar semicylinder of lead of 23 mm. radius, both with grooves along the axis for the source. The investigated substances were exposed in the form of nearly semicylindrical sheets which after exposure were bent into a nearly cylindrical form with the Geiger counter in their axis. The counter was 50 mm. long with a diameter of 22 mm. and had walls of aluminium 0·2 mm. thick.

The results are collected in the table below, in which, for each substance and absorbers, we give: (*a*) the number of counts in a given time when no absorber was present, (*b*) the number of counts with the absorber present, (*c*) the percentage diminution (−) or increase (+) of the effect.

Table 1.

Substance	Absorber					
	Pb − 19 mm			Au − 22·5 mm		
	a	*b*	*c* Per cent	*a*	*b*	*c* Per cent
Silicon	4002	3370	−16	4290	3140	−27
Aluminium	4260	3412	−20	2881	1984	−31
Silver	1128	1170	+ 4	2360	2875	+22
Iodine				1756	2056	+17

The experiments show a marked difference in behaviour of light and heavy substances. In the last case the effect is increased when the absorber is interposed, which shows that the exciting rays undergo some transformation in the absorbing matter. We put forward the following hypothesis. The capture of a neutron by a heavy nucleus without emission of a heavy particle can take place only when the energy of the neutron does not exceed a

certain value. If the energy of the neutron is too high the neutron loses in a nuclear encounter a part of its energy, which is emitted in the form of a γ radiation.

From this point of view the increase of the Fermi effect would be due to the production of slow neutrons in a number more than compensating for the loss of primary slow neutrons due to absorption. That the slow neutrons are active in producing the Fermi effect in heavy elements is made plausible by the experiments of Meitner[1], who used the probably slow neutrons excited in beryllium by the γ-rays of radium.

The block of gold weighing 963 grams was kindly prepared for us by the Polish State Mint and the gold was lent by the Bank of Poland.

Experiments are being continued.

M. DANYSZ.
Mirosław Kernbaum J. ROTBLAT.
Radiological Laboratory, L. WERTENSTEIN.
Society of Sciences, M. ŻYW.
Warsaw, Poland.
Dec. 1.

[1] *Naturwissenschaften*, **22**, 759, Nov. 9, 1934.

Use of Phosphomolybdic Acid in Chemical Analysis

DURING some recent investigations into the structure of the salts of the 12-heteropoly acids, and, in particular, those of 12-phosphomolybdic acid, it was found that the salts of certain monovalent elements were sparingly soluble. This led us to test whether this fact could be made use of in chemical analysis.

It was found that, using phosphomolybdic acid, a solution containing 1 part of cæsium in approximately 500,000 of water could be detected—a far more sensitive test than that of chloro-platinic acid. With potassium, using a concentrated solution of phosphomolybdic acid, a definite precipitate was formed in an acid solution containing 1 part of potassium in 10,000 of water. With such dilute solutions it should be noted that the precipitate takes a few minutes to form. This test is distinctly more sensitive than that of the cobaltinitrite.

Phosphomolybdic acid should be very useful in analytical chemistry, especially in view of the fact that sodium phosphomolybdate and the salts of the di- and trivalent elements are all soluble. The only other insoluble salts of the acid are the ammonium, rubidium, silver, thallous and mercurous salts.

Further tests are now being carried out by one of us (J. W. I.) with a view to the quantitative estimation of potassium with phosphomolybdic acid. The precipitate obtained consists of potassium phosphomolybdate, $K_3PMo_{12}O_{40}.nH_2O$. The water content has not yet been definitely ascertained, but we have reason to believe that it is not greater than $2H_2O$ and probably zero. The structure is closely related to that of $H_3PW_{12}O_{40}.5H_2O$ recently determined by Keggin[1].

The precipitate is very stable, and X-ray powder photographs show that its constitution is unchanged after heating for several hours at 120° C., whereas potassium cobaltinitrite decomposes on heating.

J. W. ILLINGWORTH.
J. A. SANTOS.
Physical Laboratories,
The University,
Manchester.
Nov. 2.

[1] *Proc. Roy. Soc.*, A, **144**, 75; 1934.

Oxygen Preparation from Sodium Peroxide

THE account in NATURE of November 17, p. 778, by Dr. Newton Friend and Mr. S. Marks of an explosion which occurred during the preparation of oxygen from sodium peroxide and water interested us particularly, since in 1924 we had a similar experience. The oxygen was being prepared by dropping water on to solid sodium peroxide in a flask, without heating, and was being led through drying tubes to an ozoniser. The water contained a little cobalt chloride to catalyse the decomposition of the peroxide.

The reaction proceeded quietly for some time, producing a steady stream of oxygen; then suddenly, without any apparent change in the conditions, an extremely violent explosion occurred in the flask, with results similar to those described by Messrs. Newton Friend and Marks. The conditions differed from theirs in that the explosion occurred spontaneously without the introduction of a glowing splint: the ozoniser was undamaged, and it is therefore not very likely that the explosion was initiated by the discharge. We attributed the explosion to the presence of free sodium in the peroxide, and have since avoided this method of preparation as dangerous.

G. H. CHEESMAN.
9, Compton Road, D. R. DUNCAN.
London, S.W.19.
Nov. 22.

Chemical Linkage

IN the Research Items in NATURE of October 20, certain arguments are advanced in opposition to the views which we expressed in a recent paper published in the *Journal of the Chemical Society*, and without going into detail we wish to take the opportunity of pointing out that: (1) We cannot call to mind any evidence, chemical or physical, for the alleged non-equivalence of the oxygen atoms of the nitro group; the introduction of the 'resonance' linkage is a hypothesis which, in order to maintain a difference of linkage, renders its experimental detection impossible. (2) The existence of two electrons with *parallel* spin in the ground level of the oxygen molecule is definitely established by spectroscopic evidence. (3) X-ray spectra reveal the geometrical arrangements of atoms or ions in the crystal lattice and it is true that it is possible to draw definite conclusions with regard to the physical forces present in simple cases. This is, however, by no means possible in complex cases. Thus KIO_3, $CaSnO_3$ and the double salt KF, MgF_2 all possess exactly the same arrangement in the crystal lattice. Similarly, the complex salt $[Co(NH_3)_6]Cl_2$, which possesses a characteristic absorption spectrum, has the same lattice as $[Ni(NH_3)_6]Cl_2$, which fails to give a Raman line for a nickel-NH_3 linkage, and as $(NH_4)_2SiF_6$, which sometimes crystallises with one or more additional molecules of ammonium fluoride.

R. F. HUNTER.
R. SAMUEL.
Department of Chemistry,
Muslim University,
Aligarh.

I AM still not convinced that the equivalence of the two oxygens in the nitro group is "established" by the zero dipole moment of *p*-dinitrobenzene, nor does the existence of two electrons with parallel spin

in the ground level of the oxygen molecule prove that the molecule is unsymmetrical. It is also true that the "generally accepted deductions" from crystallographic evidence are in favour of the existence of the complex cations $[Co.6NH_3]^{+++}$ and $[Ni.6NH_3]^{++}$ as well as of the complex anion $[SiF_6]^{--}$. It is perhaps desirable to add that, since the note was written, my doubt whether the theoretical views of the authors of the paper would 'hold water' when subjected to a critical examination has been confirmed by consultation with theoretical physicists, who concur in the view that the chemical deductions are based upon an inexact interpretation of current physical theories.

THE WRITER OF THE NOTE.

Power in Social Psychology

I DO not know how far the columns of NATURE are suitable for the discussion of "power" (in the human community). But when I find no less than three of the nine chief reviews in the issue for December 8 dealing with this question, and Dr. Snow and myself being scolded for "false methodology" and the want of a "robust" political faith, it is perhaps permissible to point out that the class-war dogma which underlies this sort of criticism has no scientific standing.

Social psychology, like every other branch of human ecology, is still in the squinting, vaguely exploratory stage of infancy; we have no adequate description of social "power", no analysis of its miscellany of factors and no clear conception of its attainment or the scope of its operation. We have clear definitions of legal "powers", but these definitions are independent of any qualifications by disregard, resistance or inaccurate or insufficient enforcement. This belatedness of social psychology is a misfortune for the world but it is a fact. That "robust" political faith to which the reviewer urges Dr. Snow, is really emotional doctrinaire mysticism born of impatience and trying to compensate for its poverty of assembled knowledge by a tawdry 'dialectic'.

The premeditated achievement of social resultants is a business for clearer heads and a stouter patience. Formal education, adult education, social stimulation, the mechanisms of production and distribution, a complex of diverse forces, all come into that process. Politicians and rulers of men have to 'get results', but as Dr. Snow's recent novel demonstrates admirably, it is a primary crime against science for a man of science to produce 'results' unjustifiably.

So far as I am concerned, I am not a propagandist but an experimentalist in projection. This class-war stuff, this 'dialectic materialism' is essentially unscientific talk, pseudo-scientific talk; it is literary, pretentious, rhetorical. As sincere, patient and steadfast scientific analysis spreads into human biology we shall begin to get the general concepts of human relationship and social process clear and plain —and then we shall not need to worry about "power"; power will flow to the effective centres of direction. Stalin in our recent conversation accused me of believing in the goodness of human nature. I do at any rate believe in man's ultimate sanity. The political and social imaginations of very many people nowadays seem to me to be obsessed by the transitory triumphs of violence in various countries, and a lot of this talk about the need to organise the illegal seizure of power for direct creative (revolutionary) ends by those masses of the population which presumably have the most unsatisfied desires, is due largely to a lack of perspective in the outlook of the intelligentsia and a want of patience and lucidity in their minds. There is a limit to the concentration of power in human society, beyond which it becomes ineffective and undesirable. The limit has been passed in Germany and Russia to-day.

H. G. WELLS.

I CANNOT answer for the implications Mr. Wells has drawn from the other reviewers. For myself, I am amazed that he does not see himself as a propagandist among his other rôles. Others do; and that is good enough for scientific purposes. Talk of the *seizure* of power in present-day England is, of course, just rubbish. That question has not been raised. What was being discussed was, 'From which fulcrum would the lever for change to the Wellsian World State be finally applied?' Mr. Wells seems to see it in the people in key positions, but paradoxically enough he complains that they have not the brains to see. What then? My contention was that it is not simply an intellectual "seeing" that he must seek but an active desire, a liking for his world solution.

Mr. Wells has left out the emotional content in assent to a social solution. His letter repeats it in simply demanding more scientific examination, as if objective science covered the whole of life, and yet he bases his case on two scientifically unverifiable assertions:

(1) He believes in man's ultimate sanity, meaning, I suppose, that he *feels* people in key positions will ultimately accept his solution.

(2) Power will flow to the effective centres of direction, meaning that he *feels* this will be so although he does not see it happening to-day in Russia and Germany.

I do not see why he should expect others to share his sanguine feelings.

H. LEVY.

Relationship of Soils to Manganese Deficiency of Plants

MANGANESE deficiency disease is confined to soils of *p*H 6·7 or more and occurs especially on heavily limed sandy podsols. Most neutral and alkaline soils, however, evidently contain ample quantities of manganese in a form available to plants. A method of chemical analysis has been found which appears to measure the amount of this available manganese.

(1) The soil is first leached with normal ammonium acetate of *p*H 7·0. This removes the manganese which can take part in the base-exchange reaction at such a high *p*H. The amount of this manganese is very small for all alkaline soils, and is well below one part per million of soil for the very fertile calcareous grey soils of the Wimmera districts (Victoria), on which no symptom of deficiency has ever been seen.

(2) The residual soil is then leached in the cold with the same reagent containing 0·2 per cent quinol in solution. (Each leaching is completed in about seven hours.) This second treatment dissolves only those manganic compounds which can oxidise quinol at *p*H 7 with reasonable speed.

This 'active MnO_2' (using a conventional formula to represent manganic oxides) exceeds 100 parts of manganese per million of soil in the healthy soils tested, and is less than 15 parts in soil associated with manganese deficiency. This is the only test

of many tried which shows a clear difference between healthy and 'deficient' soils.

It seems to follow that manganese is absorbed by the root without first passing into the soil solution as the ion Mn^{++}; the absorption might be either direct as colloidal MnO_2, or by reduction of MnO_2 at the root-soil interface—a reduction which becomes steadily more difficult as the *p*H rises, until only very active MnO_2 can take part in the reaction.

This same test may be expected to show whether it is dangerous to lime on acid soil; trouble may follow if the total manganese dissolved by ammonium acetate and quinol at *p*H 7 does not exceed about 15 parts per million of soil. This suggestion cannot be tested here at present, since manganese deficiency following overliming has as yet been proved on only one Australian soil, itself abnormal. It is thought also that light may be thrown on the state of manganese in the soil horizons by leaching with buffer solutions (such as ammonium acetate) of varying *p*H values, with or without the addition of reducing agents (such as quinol) capable of bringing about definite *r*H values. The details of the work will appear in the *Proceedings* of the Royal Society of Victoria.

G. W. LEEPER.

School of Agriculture,
University,
Melbourne, N.3.
Oct. 18.

Publication of *Nomina Nuda*

DR. VAN DER HORST'S communication in NATURE of December 1, p. 852, is of much interest in giving exact information with regard to the conformation of the burrow of an Enteropneust—a subject about which little is known. Without wishing to detract in any way from the value of his note, I find it necessary to criticise one part of it. It is well known to workers in systematic zoology that great inconvenience is caused by the publication of *nomina nuda* or names which are unaccompanied by diagnoses of the new species to which they refer. The binomial designation given to the new species of which a description is to be published later by one of Dr. van der Horst's students is presumably of this character. It may indeed prove to be the case that the form of the burrow is by itself distinctive of the new species; and it might perhaps be argued that since this had been described and figured the name is valid. There are probably few zoologists, however, who would recognise a species of which the type-specimen was a mass of sand and mud containing no part of the animal itself except some of its slime.

The trouble given to taxonomists by introductions of this kind is very real. It is often necessary to waste time and print by explaining why the date of the first mention of a name cannot be accepted as the valid date. Many instances are known in which the *nomen nudum* has not been reprinted, but it remains to encumber the literature. The most troublesome cases, however, are probably those in which controversy is possible on the question whether a name is a *nomen nudum* or not. I feel confident that the great majority of systematists would agree with me in requesting the editor of NATURE to delete all such names from future communications sent for publication in his pages.

SIDNEY F. HARMER.

Melbourn, Cambs.
Dec. 1.

Design of Theodolite Axes

IN NATURE of September 15 a letter from Prof. A. F. C. Pollard points out that the cylindrical bearings adopted for the vertical axis of the Wild precision theodolite leads to a systematic error of the "order of two to four seconds" in the horizontal angles. We, in Egypt, have not had much experience with theodolites of the Wild design, but we have found that the substitution of cylindrical for the old Y-bearings for the telescope (trunnion) axis of English theodolites has not been found to be an improvement but very much the reverse. Whilst the instrument is new, the errors arising from this fault in design do not obtrude themselves, but as soon as the bearings become worn or one of the standards gets slightly bent, the telescope comes to rest in a different position every time it is raised or lowered in elevation. The error arising from this defect is of an 'accidental' nature and may, in an extreme case, amount to one minute.

Another defect in modern English design adopted by some firms is the tightening arrangement for taking up wear in the levelling screws. The old-fashioned method of making a vertical radial cut along the centre of the trivet arm and placing a binding screw at its outer end was perfectly satisfactory and should never have been given up. The modern designs either do not work at all or they grip the screw at one point only instead of along the whole length of the thread.

In addition to these defects, we have had trouble owing to the poor optical qualities of the modern telescopes. Distant points which are easily sighted with an old-fashioned theodolite are invisible in a modern telescope. This is probably due to the adoption of the internal focusing arrangement. The introduction of an additional lens (or lenses) in the optical system cuts out light and impairs the definition.

Speaking generally, the so-called 'dust-proof' covers are a continual source of trouble. We have never found one which keeps out the dust. Also they make the theodolite much more difficult to keep in good order.

Leaving out of account modern instruments of the Wild type, the old Troughton and Simms six-inch theodolite of thirty years ago was the nearest approach to a perfect instrument for field triangulation that has yet been made. We have not found any modification in the design of this type of instrument which has not been found by experience to be a change for the worse.

F. S. RICHARDS.

Survey of Egypt,
El-Giza.

MR. F. S. RICHARDS'S letter is an interesting corroboration of the points raised in my original communication and it is hoped that theodolite manufacturers will give the criticisms of Rannie and Dennis, as well as those of Richards, the attention they deserve.

Mr. Richards's remarks about levelling screws are important. In the paper by Rannie and Dennis, to which I have given the reference, it is recorded that badly designed levelling screws were a source of error in the readings of the instrument. In their case, changing the positions of the levelling screws and clamping them strained the alidade axis. Mr. Richards complains that in modern designs the screw-spindle of the levelling screw is imperfectly clamped.

These imperfections can be completely and readily

eliminated by correct design. I have described the correct design of the tapped seating for screw-spindles on p. 52 of my monograph on "The Kinematical Design of Couplings in Instrument Mechanisms" (Adam Hilger, Ltd.) and also in the Thomas Hawksley Lecture[1] for 1933. In the latter will also be found a description of the correct design for the seatings of the ends of the levelling screws for a theodolite, which is just as important as the correct design for the seating of the screw-spindle if strains are to be reduced to a minimum.

A. F. C. POLLARD.
Imperial College of Science and Technology,
South Kensington.
Nov. 29.

[1] *Proc. Inst. Mech. Eng.*, **125**, 154 and 177; 1933.

The New Star in Hercules

THE discovery of this star in the early morning of December 13 by Mr. J. P. M. Prentice at Stowmarket was kindly reported to the Solar Physics Observatory at Cambridge by the Astronomer Royal later in the same morning. Watch has been kept the whole of each night since, the star being circumpolar, and spectra were obtained with the Newall telescope in the early mornings of December 14 and 15. The spectrum is of the usual Nova type, just after maximum brightness, consisting of bright bands of hydrogen and of ionised metals with absorption borders on the side of shorter wave-length. The unusual features on this occasion are the outstanding strength of the displaced absorption lines due to Mg II at 4481 and the fact that the velocity of approach given by the hydrogen and other absorption lines has shown a decrease from about 500 km./sec. to about 250 km./sec. between December 14 and 15. This decrease of the velocity of the first outburst was shown by Nova Geminorum 1912, but it is not a usual feature in Novæ.

F. J. M. STRATTON.
Solar Physics Observatory,
Cambridge.

Red 'Water-Bloom' in Iceland Seas

COMMENTING on Mr. John Hart's note[1] on blood-red water-bloom caused by a ciliate in South African Seas, I may refer to a description of exactly the same thing caused by apparently the same organism, but in Iceland waters, published in *Meddelelser* from the Danish Kommissionen for Havundersögelser (Ser. Plankton 1, No. 8, p. 27; 1909). Hence this phenomenon seems to be, if of short duration, widely distributed, and has previously been recorded.

OVE PAULSEN.
Plankton Laboratory,
Hellerup, Denmark.
Oct. 10.

[1] NATURE, **134**, 459, Sept. 22, 1934.

Points from Foregoing Letters

LIGHTNING may take place either in a single discharge or step-wise, according to evidence obtained with the string galvanometer and the cathode ray oscillograph. Study of the atmospherics which originate in lightning flashes has led Prof. E. V. Appleton and Mr. F. W. Chapman to the view that, when intermittent, lightning is similar to the discharge from a Wimshurst machine to which a small Leyden jar condenser is connected, the frequency between successive discharges being often proportional to the magnitude of the first spark. It seems as though the electrical energy used during the first lightning stroke is being replenished at a constant rate, until a critical value is reached.

A knowledge of the mass of the neutron is important in calculating the energy involved in atomic transmutations. Prof. W. D. Harkins and Dr. D. M. Gans obtain as the most probable value for this constant, 1·006 (oxygen = 16).

The radioactivity induced in silver and iodine by bombardment with neutrons (obtained from a beryllium-radon source) is greater if the neutrons are first passed through a thick barrier of gold or lead; the opposite is true of the radioactivity induced in the lighter elements, silicon and aluminium. This result, obtained by a group of Polish investigators, leads them to the view that the capture of a neutron by a heavy nucleus without the emission of any heavy particle (Fermi effect) can take place only when the energy of the neutron does not exceed a certain value.

Phosphomolybdic acid will detect two parts of cæsium in a million of water, and will precipitate one part of potassium in ten thousand parts of water; it is therefore more sensitive than the cobaltinitrite test, according to Mr. J. W. Illingworth and Mr. J. A. Santos.

Chemical combination, according to Prof. R. F. Hunter and Prof. R. Samuel, consists always of the coupling of atoms by means of the entry into the same group in the molecule of two electrons possessing opposite (antiparallel) spin. They disagree with the views that a single electron can act as a bond, and that two electrons coming from one of the atoms only can act as a link, as envisaged by Sidgwick in the case of one of the oxygens in the nitro group ($-NO_2$), and they claim that all evidence points to the two oxygen atoms in the nitro group being linked in identical manner. Their views were criticised in a Research Item, the writer of which now states that he believes their theoretical conceptions to be unsound.

Manganese, in small quantities, is essential to plants. Mr. G. W. Leeper describes a method of determining the available manganese in soils, and suggests a mechanism for its absorption by plants. He finds more than 100 parts of this element per million in 'healthy' soils; less than 15 parts per million leads to manganese deficiency diseases. This condition is likely to occur in alkaline soils (pH 6·7), particularly in podsols, and it is inadvisable to render such soils more alkaline by the addition of lime.

Mr. F. S. Richards directs attention to several imperfections in the design of the axes of theodolites used in survey work, and also in the optical qualities of the telescopes. Prof. Pollard expresses the hope that theodolite manufacturers will take note of the various suggestions which are being made.

Research Items

Uganda and Zimbabwe. The existence of ancient earthworks in Northern Buddu, Uganda, known to the natives as *Biggo bya Muzenyi* ("The Stranger's Forts"), was reported so long ago as 1909 in the *Uganda Official Gazette*, and a report on the "ancient trenches", with plans, was made by A. D. Combe, field geologist, in 1922, but is unpublished. Mr. E. J. Wayland now contributes some notes on these earthworks and other adjacent remains to the *Uganda Journal*, 3, No. 1, accompanied by Mr. Combe's plans, which are published for the first time. The fortifications, as originally described, consisted of an outer rampart and ditch extending for more than 2¼ miles, with flanks resting on the Katonga River, and interior works on a low hill in the centre of the position. The ramparts, much weathered, were still 3–6 ft. in height and the ditch 4 ft. deep. In the centre are two artificial mounds 10–12 ft. high. Small outlying forts exist some six and four miles respectively to west and east. The usual Baganda tradition attributes the origin of these works to a stranger who entered Uganda from the north. Fragments of circular pottery dishes about 4 ft. in diameter were found by Mr. Combe. At Ntusi, 7¼ miles south-west from Biggo, traces of apparently irrigation works and middens were examined, and pottery was found here which did not resemble anything now made in Uganda. Although a pottery pipe belonging to a native blacksmith's forge was found, there was no trace of metal. Other traces of occupation are pit-dwellings and shafts of unknown purpose. These works have been attributed to immigrants from Abyssinia who passed on to build Zimbabwe; but this is improbable. There is, however, a strong probability that, though less ancient, they are a more primitive form of the Zimbabwe structures, and like them of Bantu cultural origin.

Algerian Stone Age. The site of a rock-shelter in the neighbourhood of Oran, Algeria, has been investigated by M. Paul Pallary, in a series of excavations, which began in 1928 in response to a suggestion made by M. Boule in the previous year. A detailed account of the site has now appeared (*Mem.* 12, *Inst. de Paléontologie humaine*). The sides of the ravine in which the shelter was situated have long been known to have been honeycombed with habitations of prehistoric man, and the site of the Abri Alain, as M. Pallary has named it, was visited by him in 1906, when he obtained examples of a microlithic industry. The shelter itself has now disappeared, owing to quarrying operations, but the remains of the deposits lie on the site. Fortunately, one portion of the floor was found to have been left undisturbed. This showed four distinct levels under a sealing of calcareous deposit. Of the four levels the two lower are of a yellow colour, above them is a layer of black earth and above that one of chocolate-brown. The black earth level contains a very large number of crushed shells, whereas in the lower levels shells are rare and intact. The characteristic microlithic industry of the site, however, shows little to differentiate the yellow from the black strata, except possibly a slight difference in refinement of workmanship. M. Pallary considers that the results of the excavation support his view, in which he is opposed to his archæological colleagues, that certain pedunculate implements, usually classed as Mousterian, are late and must be regarded as neolithic. This view, it is held, follows from the fact that such implements are, as a rule, found on the surface of shell-heaps. M. Pallary appends a bird's eye view of the stone age cultural succession in North Africa, in which the primitive hand-axe and Acheulean culture are regarded as comparable to the European industries, while 'Aterian' for a localised Mousterian is rejected, and *inter alia*, the term 'Ibéro-Maurusian' is regarded as preferable to 'Capsian' on the ground of priority and conformity to the practice of scientific nomenclature.

Nematodes of the Belgian Coast. "The Free-Living Nemas of the Belgian Coast (2). With General Remarks on the Structure and System of Nemas", by L. A. de Coninck and J. H. Schuurmans Stekhoven, Jr. (*Mém. Mus. R. d'His. Nat. de Belgique*, No. 58, Dec. 1933), is a continuation of the first monograph by the latter author and Adam, in the same publication (No. 49, 1931). Extensive collections were made of mud and sand in the environment of the Canal of Zeebrugge, between Heyst and Zeebrugge, in and around the harbour of Ostend and in the Zwyn. Ten different habitats were investigated, the samples sieved through fine gauze of varied sized mesh and all the nemas counted. Interesting results were obtained, certain forms predominating in certain habitats. It was found that where Chromadoridæ prevailed an *Enteromorpha* species was abundant, the Monhysteridæ liked sandy and shelly districts, whilst the abundant *Bathylaimus assimilis* was found among decaying leaves of *Statice limonium* growing in the sand in a shallow channel filled with brackish water. The discussions on the relationships of the genera and families are very helpful, for the group is an exceeding difficult one. The larvæ and young forms often differ considerably from the adults, and great care must be taken to distinguish them. 2,408 individuals were studied, consisting of 63 species belonging to 39 genera. Several of the species are new to science, and many new to the Belgian fauna.

The Genus *Mallomonas*. Dr. W. Conrad, in his work "Revision du Genre *Mallomonas* Perty (1851) incl. *Pseudomallomonas* Chodat (1920)" (*Mém. Mus. R. d'His. Nat. de Belgique*, No. 56. Brussels, 1933), adds much to his former monograph on the same subject, published in 1927 (*Arch. Protist.*, 59). He now abolishes altogether Chodat's genus *Pseudomallomonas*, the members of which merge naturally into *Mallomonas*, and attaches great importance to the scales which ornament the cell in the different species. Setiform appendages, present in many forms, although distinctive, have in his opinion only a relative value, for they vary in the same species and are easily lost on fixation. *Mallomonas* is an interesting genus with several peculiar features. Besides the curious armature of scales, conical, triangular, quadrilateral, elliptical, discoidal or circular, which are arranged in various ways round the cell and vary little, there may be darts or needles of peculiar shapes, and one or two chromatophores may be present, or these last are sometimes so reduced as to be scarcely perceptible. The shape of the cell is circular, oval or elongated with a long flagellum and sometimes a collar, and the cysts formed inside the cells are very characteristic.

New Echinoderms from Puerto Rico. Austin H. Clark, in two papers, "A New Genus of Brittlestars from Puerto Rico" and "A New Starfish from Puerto Rico" (*Smithsonian Misc. Coll.*, **91**, Nos. 13 and 14. Johnson Fund. "Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep". Pubs. 3248 and 3249, May 1934), describes some interesting new starfishes. One of these is a curious Ophiuran representing a new genus of the family Hemieuryalidæ. *Quironia johnsoni*, n.gen. et sp., resembles *Sigsbeia* but with certain distinctive features. The family as at present understood includes ten genera, of which six occur in the West Indies. Of these six West Indian genera, four are known only from the Caribbean region, one is found also in other parts of the tropical Atlantic and one is represented also in the Galapagos Islands. In the second paper a new species of *Odinia* is described. This is specially interesting as the family to which it belongs, although well represented on the Atlantic coasts of Africa and of Europe, is known from the Caribbean region only from the single somewhat problematic genus *Hymeno discus*, which was described from a single species represented by two evidently young individuals.

Resistance to Cutting of Vegetable Tissues. Henri Prat has recently described an ingenious apparatus for determining the force required to drive a safety razor blade through the tissues of a plant, under conditions which are standardised in application (*Canad. J. Res.*, **11**, No. 4). The method is open to criticism in points of detail, but the differences in the behaviour of different regions of the same grass internode are obviously far too great to be masked by any of the experimental errors associated with the method. In these preliminary observations the new method has probably told the author nothing that is not readily deduced from the known developmental history of the grass shoot, but any attempt to introduce new numerical data in the comparison of biological qualities deserves sympathetic consideration.

Effect of Cane Molasses on Swamp Soil. Further investigations on the rôle of organic matter in plant nutrition are discussed by T. R. Bhaskaran and others (*Proc. Ind. Acad. Sci.*, **1**, No. 4, 155). A solution of molasses, an abundant by-product of the sugar industry consisting of easily fermentable sugars with a small percentage of minerals and nitrogen, was added to soil samples, and the whole submerged by addition of water. The supernatant solution was then analysed at intervals for several weeks. The sugars are mostly decomposed a few days after addition, forming lactic, acetic, propionic and butyric acids, minute quantities of ethyl alcohol, acetaldehyde and fusel oil. The gaseous products consist of abundant carbon dioxide with small amounts of hydrogen, methane and other hydrocarbons, arising presumably from bacterial action. Most of the carbon dioxide produced is lost from the soil system. The acid products of fermentation bring about the solution of increasing quantities of minerals, which, however, are reprecipitated after about a month, when the concentration in the solution resumes its original value. The concentrations of iron and aluminium early assume toxic values, but decline later to the initial level. Dissolved iron is present in the ferrous condition, perhaps in association with organic acids. The solubility of phosphorus is not affected, but considerable amounts of potassium and calcium dissolve and remain in solution for two months. The treatment with molasses causes a temporary increase in the bacterial content of the soil, whilst Actinomyces and fungi show a rapid decline. Protozoa are also adversely affected, whilst the growth of yeasts is inhibited entirely. Some of the most prominent bacterial forms include *B. subtlis*, *B. graveolens*, *Sarcina*, and other forms yet unidentified.

Geology of the Orkneys. In a lecture delivered at the Geological Society on November 7, Sir John Flett announced that the geological survey of the Orkneys has now been completed on the six-inch scale, and that definite information has become available on many hitherto obscure or debatable points. The structure of the area is simple, and consists essentially of a broad gentle anticline in the West Mainland and a syncline in the North Isles. Scapa Flow is bounded on three sides by important faults. The basement rocks of granite and schist are exposed near Stromness and present many of the characters of the Strath Halladale granite and the Altnaharra type of Moines. Over a thin basal conglomerate lies a series of grey and blue flagstones probably 10,000 ft. thick with two well-defined fossiliferous horizons with *Pterichthys milleri* and *Coccosteus minor*. The Middle Old Red Eday beds are sandstones, flags and reddish marls, with a fish-bed containing *Tristichopterus alatus*. Basalt flows are present in this and the succeeding Hoy sandstones. Close correlation has been established between the Stromness, Rousay and Eday beds of Orkney and the corresponding Achanarras, Thurso and John o' Groats beds of Caithness. The Upper Old Red sandstones of Hoy, which are unfossiliferous and probably 4,000 ft. thick, are separated from the beds below by a great unconformity marking the erosion of thousands of feet of strata. Numerous dykes of bostonite, camptonite and monchiquite traverse both Middle and Upper Old Red Sandstone, but their age is still undetermined.

Submarine Terraces around Japan. In an interesting paper (*Earthq. Res. Inst. Bull.*, **12**, 539–565; 1934), H. Yabe and R. Tayama describe the relief of the sea-bed around Japan and Korea. The coasts of both are surrounded by submarine terraces, from four to nine in number. The three upper terraces (of depths 0–30 m.) occur only in certain areas. The next three (of depths 40–60 m., 80–100 m. and 120–140 m.) are well developed in nearly all parts, the sixth attaining in one place a width of 15 km. Below this is a scarp always steep and distinct, that forms the outer margin of the continental shelf around Japan. The seventh terrace ranges in depth from 200 to 230 m., and in width to 20 km. The eighth and ninth terraces (of depths 300–350 m. and 600–800 m.) are limited in distribution. All the terraces are crossed by deep furrows lying along continuations of adjoining river-valleys, and not differing from them essentially, obviously submerged river-valleys. There are also what appear to be fault-valleys, etc., usually parallel to the general trend of the coast-line, especially on the Japan Sea side, while others, as in Sagami and Suruga Bays, trend radially to the coast.

Pressure Waves from Explosions. We have received from the Safety in Mines Research Board, Paper No. 88, "The Pressure Wave sent out by an Explosive" (3), by Messrs. W. Payman and D. W. Woodhead.

This is really a continuation of the investigation of the ignition of firedamp by coal-mining explosives, upon which one, at any rate, of the authors has been engaged for some years past. Previous investigations have led to the conclusion that these ignitions might be caused by flame from the explosive, the shock wave of the explosion or the projection of particles in a chemically active or an incandescent state. Although these factors are not really separable in practice, attempts have been made to examine them independently by experiment, and this paper is a preliminary account of the application of *Schlieren* photography to the waves sent out by working charges from blown-out shots of explosive either unstemmed or very slightly stemmed. The photographs show that, in addition to the main shock wave, there are certain conical prominences, of which two types appear to have been observed, namely *open* prominences and *cored* prominences. It would appear that the open ones are due to the projection at high speed of particles producing conical wave systems, whilst there is still some doubt as to the nature of the agent producing the cored prominences, two explanations being forthcoming. It cannot be said that any definite conclusions have yet been reached or that the investigation has up to the present yielded practical results, but, of course, it is scarcely fair to judge by such inconclusive experiments.

Segregation of Polonium in Bismuth Crystals. In order to explain the effect of impurities on the magnetic properties of bismuth crystals, Goetz and Focke assumed that the impurities segregated into a superlattice structure in the crystal. A. B. Focke has recently investigated this hypothesis by an ingenious method (*Phys. Rev.*, Oct. 1). A bismuth crystal is made containing polonium as an impurity, and the distribution of ranges among the polonium α-particles emitted normally from a crystal face is studied with a Geiger counter. Steps in the distribution curve indicate the presence of planes in the crystal in which the polonium is segregated. With a small concentration of polonium, the atoms of the latter were apparently segregated into small regions in planes spaced at $0{\cdot}54\,\mu$ separations parallel to the (111) planes and at $0{\cdot}90\,\mu$ separations parallel to the $(1\bar{1}1)$ planes. These separations are independent of the rate of growth of the crystal and of heat treatment. The addition of tellurium suppresses the layers parallel to the $(11\bar{1})$ planes and apparently gives a lamellar arrangement of the polonium atoms, with planes parallel to the (111) planes and having a separation of $1{\cdot}1\,\mu$.

Isotopic Ratio of Oxygen and the Atomic Weight of Hydrogen. The atomic weight of hydrogen determined by the mass-spectrograph is 1·00778 ($O^{16} = 16{\cdot}0000$), the values given by Aston and Bainbridge being in very close agreement. The value on the chemical standard, $O = 16{\cdot}00$, is obtained by dividing by the conversion factor, f, which is equal to the ratio of the physical atomic weight of oxygen to the chemical value. The physical atomic weight of oxygen is calculated from the ratio $O^{18} : O^{16}$, which according to Babcock (1929) is 1 : 1250, whilst Mecke and Childs (1932) give 1 : 630, and Aston (1932) 1 : 536. The value of Mecke and Childs gives 16·0035 for the atomic weight of oxygen ($O^{16} = 16{\cdot}0000$), and for the conversion factor, f, 1·00022. This gives 1·00756 for the atomic weight of hydrogen derived from the mass-spectrograph data, on the standard $O = 16{\cdot}00$. This value is considerably lower than the accepted chemical value. According to Moles, the mean of the values for the chemical atomic weight of hydrogen obtained by five different authors is $1{\cdot}00777 \pm 0{\cdot}00002$. In order to investigate this discrepancy, H. Muckenthaler (*Phys. Z.*, 35, 851; 1934) has re-determined the ratio $O^{18} : O^{16}$ by the mass-spectrograph, and has obtained a value of $1 : 1058 \pm 69$, the actual figures varying from 830 to 1300. Taking the ratio as 1 : 1000, the physical atomic weight of oxygen is 16·00240, and f is 1·00015. The atomic weight of hydrogen on the chemical standard would then be 1·00778 divided by 1·00015, that is, 1·00763, which is in better agreement with the chemical value. The author also describes experiments which indicate that the lighter isotope of hydrogen, H_1^1, diffuses more rapidly through heated palladium than the heavier isotope, H_2^2.

Petroleum Products as Insecticides. Under the auspices of the Institution of Petroleum Technologists, a useful paper on "The Utilisation of Petroleum Products as Horticultural Spray Materials" was read at a meeting at the Royal Society of Arts on November 13, 1934, by Dr. Hubert Martin of the Long Ashton Research Station, Bristol. Dr. Martin showed that the ovicidal and insecticidal properties of petroleum oil sprays applied to trees in winter are independent of the base of the oil, of its type of emulsification and of its viscosity over a wide range. Petroleum oils for summer insecticides must be highly refined, and their efficiency seems to depend upon a sufficient degree of viscosity, and upon a relative instability of the emulsifier. The relative values of several emulsifiers are described, and their use in combined insecticides is also reviewed. Petroleum oils can be used as 'wetters' or 'spreaders' for other insecticides, and this property was dealt with by Dr. Martin. The account should prove of great interest to scientific horticulturists.

Taste and Chemical Constitution. *Science Progress*, 29, No. 114, has an interesting article by Mr. A. J. Mee on "Taste and Chemical Constitution", in which he summarises the theories dependent upon the hypothesis that "taste must be a chemical sense, and must be conditioned . . . by chemical constitution". Physiologically, he points out, the sense of taste is similar to that of sight, but with less capacity for discriminating intensities, subject to large individual differences, and more easily fatigued than most of the other senses. There are five general classes of taste, namely sweet, bitter, salt, sour, and insipid. Acids taste sour, but vary considerably in the strength of solution in which they retain that taste. Taste has been attributed in the past to hydrogen ion concentration, but no quantitative relationship has been proved, and it is generally assumed that it is the combination of the anion and cation that determines the taste of a substance. The mixing of tastes is still not understood, but research has shown that sweet and bitter substances are often closely related chemically. Mr. Mee discusses the chemical possibilities in some detail. The chief difficulty lies in discovering the relationship between the arrangement of the groups in the molecule of the substance and its taste. The personal element, he declares, must be eliminated before the way is clear for research into the subject.

Chromosome Behaviour in Terms of Protein Pattern

By Dr. D. M. Wrinch, Girton College, Cambridge, and Mathematical Institute, Oxford

CHROMOSOMES are molecular aggregates. An ultimate objective, both of cytology and of genetics, must therefore be to interpret their findings in terms of the molecular structure of chromosomes. If, as there seems reason to suppose, chromosomes consist substantially of aggregates of protein molecules in association with nucleic acid, the properties of such aggregates must inevitably determine the behaviour of chromosomes in general, the characteristics of individual chromosomes being attributable to the possession of individual protein patterns.

In view of recent advances in our knowledge of proteins[1], it is reasonable that an attempt should now be made to see how far the properties of chromosomes and the facts of genetics may be brought into relation with certain known facts of protein structure.

To this end a molecular model—however inadequate—must be constructed. The model consists of one or more two-dimensional sheets in the form of a long, worm-like, uni- or multi-molecular surface. The units which lie disposed, possibly helically, along the surface are homologous protein molecules of the classical type[2]—peptide linked amino acids—

. . . -NH-CO-CP-NH-CO-CQ-NH-CO-CR-NH- . . .

put end to end. In consequence, the specification of a chromosome will be in terms of the side chains . . . *P Q R* . . . belonging to molecules consisting of certain numbers of amino acid residues, and, in the most general case of n molecules, will consist of a linear sequence of n linear sequences

$$A_1B_1C_1 \ldots X_1Y_1Z_1A_2B_2C_2 \ldots X_nY_nZ_n.$$

Such an arrangement is in excellent accord with the structure recently proposed for clupein[3], the basic protein of herring sperm, since this structure is specified in terms of a sequence of side chains, namely,

. . . . *M A A M A A M A A* . . . .

with, in some cases,

. . . . *M A A A A M A A M A A A A*;

where *A* represents arginine and *M* some monoimino or monoamino-monocarboxylic acid. The specificity of a given chromosome may be regarded as an expression of its particular protein pattern. (The orderly arrangement of black and white notes on the keyboard of a piano provides a rough picture of what is meant.) Since arginine is known to be the major constituent in sperm of various species, an attractive hypothesis (as a first approximation) is to define chromosomes in such species as various sequences of *M* and *A*. Even if we maintain the ratio of 2 to 2·5 *A* molecules to one *M* molecule, as required by the chemical analysis of clupein, a considerable and presumably sufficient variety of sequences is available.

The end groups of the arginine side chains in the protein molecules[4] are completely ionised for $p\mathrm{H} < 9$ and the four acidic groups in the molecules of nucleic acid[5] for $p\mathrm{H} > 4$, and salt compounds will be formed. In the range pH 4 to pH7, nucleic acid has a variable *zwitterionisch* character, consequent upon the ionisation of the fifth acidic group ($p\mathrm{K} = 6{\cdot}0$) and of the amino groups in cytosine ($p\mathrm{K} = 4{\cdot}2$), in adenine ($p\mathrm{K} = 3{\cdot}7$), and in guanosine ($p\mathrm{K} = 2{\cdot}3$). The degree of ionisation of the end carboxyl and amino groups of the individual polypeptide chains (which in clupein are on the average 28 residues = 98 A. long[3]) is also variable in this range.

Cyclical changes in pH in this range are believed to occur during mitosis[6]: they would entail a cyclical variation in the degree of hydration of the molecular aggregate as a whole, which accords well with the swollen state of the chromosomes in early prophase[7,8], and with the severely dehydrated state of chromosomes at metaphase established by Belar in a classical experiment[9]. By analogy with keratin[10], the molecular aggregate may be regarded as being endowed with considerable powers of contraction, due to a number of different contractile factors. A cyclical change in pH suggests another technique of contraction, which in view of the facts of differential condensation (heteropycnosis)[11,12] is possibly the most important: for the change entails cyclical readjustments in the association of the protein chains with molecules present in the cytoplasm, in particular in the association with the molecules of nucleic acid. The *zwitterionisch* character[13] of molecules appears to provide a key to many cytological problems, notably to those concerned with the geometry[14] and dynamics[8,15] of chromosomes, which have recently been the subject of a number of cytological studies.

The model may also be studied in relation to the other essential properties of chromosome, namely, growth and division. The chromosome here pictured as a cylindrical mosaic or manifold—but with a radius running into thousands of angstroms—may add to its material by the wrapping round of new sheets, each new sheet being laid down over the old mosaic, as in the case of keratin[10]. Alternatively—and more probably—it may grow after the manner of a smectic crystal, such as a film of sodium oleate, where growth consists in other molecules slipping into their places and increasing the area[16]. The incorporation of sufficient new material would then lead to instability, the tendency to division being aggravated by a change in pH which gives the whole aggregate a larger net charge—and the molecular aggregate (now a charged shell) divides after the manner of a charged drop.

Our model is also of significance for genetics. Two chromosomes defined respectively by :—

$$A_1B_1C_1 \ldots X_1Y_1Z_1A_2B_2C_2 \ldots X_nY_nZ_n$$

$$A'_1B'_1C'_1 \ldots X'_1Y'_1Z'_1A'_2B'_2C'_2 \ldots X'_nY'_nZ_n$$

will differ genetically if they differ in one or more members of their sequences. Genetics formally requires of a chromosome that it be specifiable as a sequence *a b c d . . . x y z* which is capable of certain types of behaviour, for example, fusion and fragmentation, represented respectively by :—

$$abcd\ldots p + qrstu\ldots xyz \rightleftharpoons abcd\ldots\ldots pqrstu\ldots\ldots xyz.$$

For the units *a b c* an upper limit of 200–300 A. has been suggested by H. J. Muller and A. A. Prokofyeva[17]. We therefore identify a genetic character with a sequence of n residues: since the length of an amino acid residue[18] is 3·5 A., the upper limit would allow n to be anything up to 86. With this identification,

the phenomena of fusion and fragmentation fall neatly into place on the basis of the classical researches of Fischer, which would translate them into the form :—

$$\ldots\text{-CO-CP-NH}_2 + \text{COOH-CQ-NH-}\ldots \rightleftharpoons \ldots\text{-CO-CP-NH-CO-CQ-NH-}\ldots + \text{H}_2\text{O}.$$

A detailed investigation will be published shortly, offering molecular interpretations of a number of genetic and cytological facts, including those relating to the nature of chromocentres, heterochromatin and euchromatin[19], the behaviour of the spindle attachment[8], the nature of chromomeres and of some of the forces between chromosomes[8]. The fundamental approach to the problem is clearly the study of the molecular structure of chromosomes by X-rays. Pending the necessary technical developments we must pursue our inquiries inductively. The central theme of the work—the chromosome as a crystal structure—gives unity and coherence to the task, the considerable body of knowledge of protein molecules in general, including those of globular type[20], providing a most admirable guide.

Happily, opportunities of testing the hypothesis are not wanting, those rendered possible by the new work on clupein[3] being specially attractive.

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Brood Diseases of Bees

THE eighteenth of the Rothamsted conferences was held at the Experimental Station on May 19, 1934, under the chairmanship of Sir John Russell, and was devoted to papers and discussions on the brood diseases of the hive bee. Its proceedings have now been published under the title of "Brood Diseases of Bees".*

Notwithstanding the extensive researches which have been conducted on foul brood diseases of bees, the present knowledge of the subject is still very incomplete. Practically no scientific work has been done in Great Britain on brood diseases since 1885, and such information that is at present available is derived chiefly from the results of investigations carried out in other countries. The advisability of studying this subject in England has been recognised for some years by the Rothamsted authorities, and the advisory committee connected with the apicultural branch of the Experimental Station strongly urged that action should be taken.

Sir John Russell, in his introduction to the published report on the Conference, explains how the means for carrying out the necessary work was obtained. A decisive move was made by the British Bee Keepers' Association, which secured from its constituent bodies subscriptions enabling it to guarantee a sum of £250 a year for three years. An equivalent amount has been voted by the Agricultural Research Council, and a capital sum of £250, for the special equipment needed, has been obtained through the generosity of private benefactors. Dr. J. C. G. Ledingham, and the managers of the Lister Institute, have offered the use of their laboratories for any special bacteriological work required. The actual investigations started in the present year when Dr. H. L. A. Tarr was appointed in charge of the work. The Conference, it may be added, was called at the outset of the investigations in order to review the whole subject.

In the printed report, Mr. D. Morland contributes an article on the distribution of foul brood diseases in England, which is based on replies received in response to a questionnaire. The information received indicates the need for a full survey of the incidence, varieties and means of control of brood diseases, rather than any feeling that the data obtained is at all complete or that informants were always correct in their diagnoses. Other contributors discuss the historical aspect of our knowledge of brood diseases and the subject of legislation with reference to bee diseases in other countries. The possible benefit to be derived from legislation, as a means of controlling the spread of brood diseases, suggests itself when the success attendant upon such methods in Switzerland, for example, be taken into account. In reviewing the present position of the scientific study of foul brood diseases, Dr. Tarr lays stress upon the confusion that at present exists as regards this subject. American foul brood, European foul brood, sacbrood and rarer infections are individually discussed. The concluding article by Mr. D. Morland is essentially practical and summarises our knowledge with regard to the symptoms, means of prevention and current methods of treatment of the various diseases in question.

The papers contained in this report provide an excellent summary of the present status of the whole subject : they indicate what is already known and

* Rothamsted Conferences, 18 : Brood Diseases of Bees. (Secretary, Rothamsted Experimental Station, Harpenden, Herts.) 1*s.* 6*d.*

where research is most needed. Whereas most investigators agree in ascribing American foul brood to *Bacillus larvæ*, the etiology of European foul brood remains much in doubt, and the problem is further complicated by the presence of 'secondary invaders' which have often been confused with the primary agent responsible for the disease. Whether this primary agent is *Bacillus pluton*, as it is generally regarded to be outside Britain, needs much investigation, and the work is hampered by the fact that there are evident difficulties attending its culture. With advance of bacteriological knowledge of the diseases in question, improved methods of diagnosis and treatment may be expected to result, and the work now being undertaken at Rothamsted is directed towards the solution of these problems. A. D. I.

Sleep and Hypnosis

IN an address on sleep and hypnosis delivered at a meeting of Section J (Psychology) of the British Association at Aberdeen, Dr. William Brown pointed out that although there are marked contrasts between hypnosis and sleep, there is also a close connexion. The muscles in sleep are in a state of relaxation, and in hypnosis in a state of rigidity. In sleep the knee-jerks become less pronounced and eventually disappear : in the hypnotic state, however deep, they remain undiminished. There are other differences ; for example, in sleep the subject is unable to respond to a suggestion to perform a simple act, whereas even in deep hypnosis such obedience is readily forthcoming. But in spite of these contrasts, Dr. Brown holds that there is a close connexion between the two states. Sleep can be induced by hypnotic suggestion even to the cure of some forms of insomnia, and the hypnotic state itself readily passes into a state of sleep. Sleep-walking is a spontaneously occurring phenomenon closely analogous to what is induced in a good hypnotic subject. A person who frequently walks in his sleep is, as a rule, exceptionally easy to hypnotise, and in the hypnotic state the dreams of the somnambulist may be recalled and the abnormal condition often rectified.

In inducing hypnosis, if the subject is instructed to relax and breathe deeply and regularly, the result is a close approximation to normal sleep, although the total state remains one of hypnosis, the knee-jerks being present, and the power to apprehend and react to the suggestions of the hypnotist continuing. In such a mild hypnoidal condition, the subject is unconscious of the outside world, but acutely aware of the hypnotist, and able to concentrate intensely upon certain suggested ideas. In this way, avoiding the unnecessary phenomenon of catalepsy, access may be obtained to some of the deeper levels of nerve function, and therapeutic adjustments can be made.

On the neurological side, the relationship between sleep and hypnosis is probably most accurately given by the theory of I. P. Pavlov, according to which both states involve internal inhibition in the cerebral cortex, spreading to the subcortical centres in the case of the former, and limited to the cortex in the case of the latter.

Mr. R. J. Bartlett reported on association tests with psychotic patients. In free association, complex indicators are progressively exaggerated with increasing mental disability, while, with controlled association, the difference from normality varies considerably, being greatest with opposites. Small but significant correlations were obtained between physicians' estimates and test scores, and there are indications that the work may prove of practical value in securing, for the physician, additional contact with the patient's mental troubles, and, for the patient, renewed contact with his own rational past.

Mechanisms of Cellular Respiration

IN his Croonian Lecture on the "Mechanisms of Cellular Respiration" delivered to the Royal Society on December 13, Prof. D. Keilin, Quick professor of biology and director of the Molteno Institute in the University of Cambridge, described in some detail the part played by cytochrome in the respiratory process. He said that cellular respiration consists essentially of the activation of metabolites by dehydrogenases and their co-ferments : the activated molecules are then oxidised by reacting with a suitable hydrogen acceptor, such as molecular oxygen, cytochrome, Warburg's yellow enzyme, oxidised glutathione, methylene blue or hydrogen peroxide. Of these, cytochrome, the yellow enzyme and glutathione can be re-oxidised by oxygen, thus acting as respiratory catalysts.

The most widely distributed respiratory system in aerobic cells is composed of dehydrogenase-substrate-cytochrome-oxidase-oxygen. Cytochrome is a mixture of three hæmochromogen compounds, with distinct absorption bands. Its reduction is inhibited by removal of metabolites or addition of narcotics : its oxidation is inhibited by poisons like potassium cyanide, hydrogen sulphide or carbon monoxide.

Haas, working in Warburg's laboratory, has recently arrived at the conclusion that the total respiration of starved yeast cells proceeds through cytochrome, as the result of experiments in which he estimated their cytochrome content, oxygen uptake and time of reduction of oxidised cytochrome after addition of potassium cyanide. The yellow enzyme of Warburg is composed of an active pigment group combined with a protein : it acts as a carrier between the activated metabolites and molecular oxygen. The leucoform is easily oxidised by methylene blue and oxygen and requires one molecule of oxygen per molecule of pigment : in the cells of baker's yeast, under aerobic conditions, it is responsible for only 0·5 per cent of the total oxygen uptake.

Certain dehydrogenases, such as xanthine oxidase and uricase, can react directly with oxygen, independently of carriers : both these enzymes are inhibited by potassium cyanide, but not by hydrogen sulphide or carbon monoxide, and both activate their metabolites ; in both systems molecular oxygen is reduced to hydrogen peroxide, which can bring about secondary or coupled oxidations. In the cells of certain bacteria, oxidations can take place anaerobically by reactions between two dehydrogenase systems, one metabolite acting as hydrogen donator and the other as hydrogen acceptor : for example, lactate is oxidised to pyruvate while fumarate is reduced to succinate.

University and Educational Intelligence

BRISTOL.—Dr. MacGregor Skene has been appointed Melville Wills professor of botany in succession to the late Prof. O. V. Darbishire. Dr. Skene, who is a graduate of Aberdeen, went to Bristol as senior lecturer in botany in 1926, and was made reader in that subject in 1929.

EDINBURGH.—At a graduation ceremony on December 14, the degree of D.Sc. was conferred on Mowbray Ritchie for a thesis on reaction kinetics of photochemical and related systems, and on Alexander M. Smith for a thesis on variation in soil acidity, the protein content of oats and the *Aspergillus* method of soil analysis. The degree of Ph.D. was conferred on Alan Mozley (thesis—"The Fresh-Water and Terrestrial Mollusca of Northern Asia"), Margaret F. Ritchie (thesis—"Optical Rotatory Power of Organic Acids and their Derivatives"), George P. Sillitto (thesis—"Comparative Reactivities of Chlorine Atoms on Chlorobenzene"), R. P. Sinha (thesis—"Adsorption of Gases and Water by Coal"), and James S. A. Spreull (thesis—"Microscopic Structure of the Spleen of Domestic Animals").

THE annual meeting of the Mathematical Association will be held at the Institute of Education, London, W.C.1, on January 7–8, when Mr. A. W. Siddons will take the presidency for the year 1935, in succession to Prof. E. H. Neville. The subject of the presidential address will be "The Food of the Gods". The following have been nominated for election as honorary members: Prof. E. Borel, University of Paris; Prof. J. Hadamard, University of Paris; Prof. G. H. Hardy, University of Cambridge; Prof. D. E. Smith, Columbia University; Prof. E. T. Whittaker, University of Edinburgh. Further information can be obtained from C. Pendlebury, 39 Burlington Road, Chiswick, London, W.4.

THE small independent college in America, with its ideal of a 'liberal education', has no longer the unrivalled prestige it enjoyed for generations, but it still counts among the notable formative influences moulding the youth of that country. In *School and Society* of October 20 appear two addresses delivered at the installation of the twelfth president of one of those institutions—Union College, Schenectady, New York. The new president, after enlarging on the unique value of the small college and the dangers that threaten it, suggested that American Governments might well go further along the line of the British Government in providing competitive college scholarships. "If the state," he said, "is to dry up the old wells of philanthropy by confiscatory taxation—and at the present moment this might seem to some no mere hysterical fear—it might support the training of its leaders in just this way, through the subsidy of selected brains". The other address, by Dr. Nicholas Murray Butler, entitled "The Challenge to Education" aimed at rallying the forces of light and leading at a time when there is imminent danger of the submergence of much of the best of the nation's social heritage in a tide of blatant scepticism and disunion, part of the aftermath of the War. The best hope for the future is, he thinks, in the endowment with a liberal education of as many as possible of those who are capable of attaining to it.

Science News a Century Ago

Aurora Borealis seen at Woolwich

On December 23, 1834, William Sturgeon sent to the editors of the *Philosophical Magazine* an account of an aurora he had seen the previous evening. "A beautiful Aurora Borealis," he said, "was seen from this place last night. I was on Woolwich Common when I first saw it, then exactly six o'clock. It consisted of several groups of vertical beams of pale yellowish light on both sides of the north star, extending nearly to equal distances in the western and eastern directions. These beams presented the strongest light at their bases, and grew gradually fainter, to their superior extremities, here they softened and gently glided into the most attenuated light and were lost at various altitudes some of which were near to the zenith. . . . During the display of the fine streamers which first presented themselves about five minutes past six I hurried home to adjust a magnetic needle. It was about half past six before I had my magnetic apparatus fit for observation and the splendour of the aurora had now passed its meridian. I diligently watched the needle and the aurora until half past ten, but observed nothing in the motions of the former that could possibly be attributed to the influence of the latter."

Death of Malthus, December 29, 1834

The Rev. Thomas R. Malthus, the well-known writer on population problems, died at Bath on December 29, 1834. He was born on February 14, 1766, at the Rookery, near Dorking, then the property and home of his father. Educated privately in the first instance, Malthus entered Jesus College, Cambridge, in 1785, graduating ninth wrangler, and becoming in 1797 a fellow of his College. He was ordained in the Church of England, and for a time held a small living in Surrey. In 1805 Malthus was appointed professor of history and political economy at Haileybury College, Hertfordshire, the training centre for cadets of the East India Company. Here, throughout his life, he was able to pursue his researches upon the economic structure and implications of social life. Malthus joined the Statistical Society on its foundation in 1834; already, in 1819, he had been elected a fellow of the Royal Society, and, in that year, signed the charter book. In 1798 Malthus published his views in a work entitled, "An Essay on the Principle of Population as it affects the future Improvement of Society, with remarks on the Speculations of Mr. Godwin, M. Condorcet, and other Writers". Revised and enlarged editions of the treatise were the subject of his facile pen down to 1826. A passage that Darwin wrote in his autobiography ("Life") may be recalled here: "In October 1838 I happened to read for amusement 'Malthus on Population', and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species." Notwithstanding that much censure and calumny followed his published opinions, Malthus uniformly maintained composure and toleration, traits which were inherent in his character.

Societies and Academies

DUBLIN

Royal Irish Academy. J. J. NOLAN : A method for counting atmospheric ions and determining their mobility. A simple method is described by which accurate counts of atmospheric small ions may be made.

PARIS

Academy of Sciences, November 19 (*C.R.*, 199, 1077–1164). MARIN MOLLIARD and ALBERT CRÉPIN : The characters presented by green plants which develop in air enriched with carbon dioxide. A description, with reproductions of photographs, of the effects of atmospheres containing 0·5, 2 and 10 per cent of carbon dioxide on the radish. MAURICE GIGNOUX and LÉON MORET : The stratigraphy of the external edge of the Flysch zone of the Embrunais, between the Durance and the Drac (Piolit and Autanes massifs, Hautes-Alpes). E. MATHIAS : The idea of impurity in naked globular lightning. HANS SCHWERDTFEGER : Remarks on matrices with linear forms. D. PEREPELKINE : The directions of curvature of a Vm in Rn. M. HAIMOVICI : Some types of Finsler metrics. P. VINCENSINI : Deformable cyclic systems. ALBERT TOUSSAINT : Contribution to the study of the ground interaction for supporting wings. ROGER DUCHÊNE and JULES VERDIER : Forces resulting from knocking in (internal combustion) motors. Studies on the bouncing pin knockmeter. GEORGES DURAND : The application of the mass-luminosity relation to the calculation of the orbital elements of the spectroscopic double stars. NY TSI-ZE and TSIEN LING-CHAO : The laws of the disengagement of electricity by torsion in quartz crystals. CH. FABRY : Remarks on the preceding communication. Reference to the work of E. P. Tawil on the same subject. EDMOND ROUELLE : The transitory regimes produced on closing an oscillating circuit with an iron nucleus. G. KRAVTZOFF : The cathodic behaviour of the organic salts of copper. Study of the different factors. RENÉ LUCAS : The phenomena of optical mirage due to elastic waves. RENE FREYMANN and ARTHUR STIEBER : The effect of temperature and of visible and infra-red radiations on the electrical resistance of boron. The results of Weinstraub on the rapid variation of the electrical resistance of boron with temperature are confirmed. The changes in the resistance of boron when exposed to infra-red rays can be utilised for detecting radiation between 0·5μ and 0·85μ. GEORGES DÉJARDIN and MLLE. R. SCHWÉGLER : The luminescence excited by rolling mercury in a glass bulb containing impure neon under low pressure. Study of spectrograms obtained with this light source shows that, excluding known mercury lines, the spectrum is very similar to that of the aurora. Nearly all the lines can be attributed to either the atom or molecule of nitrogen. FRÉDÉRIC DIÉNERT and FERNAND VILLEMAINE : Contribution to the study of photo-chemical reactions. The action of phosphorous and hypophosphorous acids on uranyl salts. Uranyl salts are precipitated from acid solutions by sodium hypophosphite in sunlight : there is no apparent reaction in the dark. EDOUARD RENCKER : The dilatometric study of some ternary (soda, silica, alumina) glasses. FRANÇOIS CANAC : Study of the topography of certain surfaces from their coefficient of light diffusion. Application to the study of corrosion. WILFRIED HELLER and MICHAEL POLANYI : Quantitative studies of the reactions of atoms. IVAN PEYCHÈS : The Raman spectrum of tartaric acid and of tartrates in solution in water. Diagrams of the Raman spectra of tartaric acid, ethyl tartrate and six alkaline tartrates are reproduced, and the data briefly discussed. EUGÈNE DARMOIS and YEU KI HENG : The measurement of the strength of acids. A method is suggested based on the change in the rotatory power of solutions of ammonium tetramolybdate produced by the addition of acid. By this method, perchloric acid is stronger than benzenesulphonic acid. MME. SIMONNE ALLARD : The magnetic properties of a free radical, xanthyl-α-naphthylmethyl. From the measurement of the magnetic susceptibilities of solutions of dixanthyl-dinaphthylethane, it is deduced that 78–94 per cent is dissociated into the free radicle. This result is in agreement with the cryoscopic measurements of Gomberg. LÉON PIAUX : The Raman spectrum of some derivatives of cyclopentene. The synthesis of Δ.1-benzylcyclopentene. MLLE. BLANCHE GREDY : 3-cyclopentyl-1-propyne and some of its derivatives. Six new compounds are described with details of their Raman spectra. GEORGES DARZENS and ANDRÉ LÉVY : A new general method for the synthesis of tetrahydronaphthalenic acids and of naphthalene hydrocarbons. C. STANFIELD HITCHEN and RENÉ VAN AUBEL : The composition and age of crystalline uraninite from Katanga. From the results of spectrum analysis, it is concluded that this uraninite is a primary hydrothermal mineral. The lead–uranium ratio is 0·0863. PAUL FALLOT, LÉON MORET and EDOUARD ROCH : The Lias series of the Skoura country (Haut-Atlas marocain). JACQUES FROMAGET : The Trias in the Haut-Laos synclinal. JOSEPH BLAYAC and RODOLPHE BÖHM : A notable extension of the Ordovician in the eastern part of the Montagne Noire. MARCEL SOLIGNAC : Geological and hydrological results of No. 3 boring at Ben Gardane (Extrême-Sud-Tunisien). J. COULOMB and G. GRENET : The theory of seismographs with electromagnetic magnification. MLLE. MADELEINE FRIANT : The primitive type of the upper molars in rodents. KENNETH SMITH and JEAN DUFRENOY : The *Y*- virus of the Solanaceæ. The *Y*- virus tends to slow down the synthesis of the complexes forming the cytoplasm and hence to cause the accumulation of amino-acids. A. JUILLET and R. ZITTI : The seasonal variations of hydrocyanic acid in *Molinia cærulea*. AUG. CHEVALIER : Preliminary sketch of the vegetation of the Cape Verde islands. J. BOUGET : The culture of potatoes from seed at Bagnères-de-Bigorre (560 metres). G. LEMÉE : The beech association in the Perche and the north-west of France. PHILIPPE JOYET-LAVERGNE : A new theory on the mechanism of intracellular oxido-reductions. E. GRYNFELTT : The modifications of the chondriome of the cells of the Flexner-Jobling tumour of albino rats in the course of their evolution.

CAPE TOWN

Royal Society of South Africa, October 17. F. R. C. REED : A new lamellibranch from the upper Dwyka beds of South-West Africa. S. HONIKMAN, H. A. SHAPIRO and H. ZWARENSTEIN : Variations in the ovarian response of *Xenopus* to the gonadokinetic principle of the anterior pituitary (1). Anterior pituitary extract assayed on frogs in July gave 263 units per gm. original tissue. A similar assay in October gave 77 units per gm. In July the ovary – body weight ratio was 110, in October, 80. The potencies of extracts from different batches of anterior

pituitaries prepared at the same time and assayed on animals from the same stock varies considerably. It would be premature to conclude that the correlation between the ovary – body weight and the number of units per gm. observed above is a true correlation.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 5). I. P. NATANSON: Note on the convergence of singular integrals. G. FICHTENHOLZ and L. KANTOROVICH: Some theorems on linear functionals. P. RACHEVSKIJ: The infinitesimal structure of the geodesic lines in two dimensions, considered with the approximation of the fourth order. G. GUREVITCH: (1) Some arithmetical invariants of a trivector and of a cubical shape. (2) Reduction of a trivector to a canonical form in a special case. E. BRUMBERG and S. VAVILOV: Statistical structure of the field of interference. A. ANSELM: Contribution to the theory of the surface ionisation of heated metals. N. FUCHS: Activation energy by evaporation and condensation. A. SOKOLSKIJ: Absolute method of determining the coefficients of viscosity in liquids. N. KALITIN: Diurnal and annual period of the long-wave solar radiation in the infra-red radiation is less than that in the case of total radiation, because of the effect of water vapour in the atmosphere. B. TARUSOV: Dielectric constant of muscle. The high value of the dielectric constant in a living muscle is probably connected with the presence of free salts, and changes with variations in their quantity. M. K. GRODZOVSKIJ and Z. TCHUCHANOV: Gasification of solid fuel. N. TAGEJEVA, S. ZEITLIN and A. MOROSOVA: Boron content of natural waters. Boron is a characteristic component of oil-well waters, probably connected with their geochemical history. J. TOLMACHEV and A. FILIPPOV: Presence of Rb, Be, Ga and Sr in nephelines. V. CHLOPIN: Geochemistry of helium. N. GORNOSTAEV: Geochemistry and tectonics of the gold quartz veins of the Soviet mine in the North Yenisseisky taiga. P. ZHIVAGO, B. MOROZOV and A. IVANITSKAJA: Influence of hypotony on cell division in the tissue cultures of embryonic heart. A. CHARIT and N. CHAUSTOV: Flavines and their determination in animal tissues. L. VARDANIANZ: Upper Jurassic orogenetic phases of the Caucasus. A. NIKIFOROVA: Contribution to the stratigraphy of the Upper Palæozoic of the north-eastern outskirts of the Great Donetz basin. A. TARANEC: A short review of the fishes of the genus *Gymnogobius*, with a description of one new species and notes on some related genera.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. B. MANIÀ: The differential equations dependent on a curve. M. VILLA: The theory of hyper-algebraic hyper-surfaces. L. TOSCANO: The integration of recurrent successions of the second order, linear and homogeneous (2). C. SEVERINI: The double series of orthogonal and normal functions (2). A. ROSENBLATT: The equations to the partial derivatives of the parabolic type with two independent variables. L. PINCHERLE: The natural width of X-ray lines. An attempt is made to obtain theoretical justification for the results of recent measurements of the width of X-ray spectral lines on the basis of quantum mechanics. It is found that the natural width of the lines, taking account only of the probability of passage with emission of light, is in accord with the experimental data only for transitions of deep electrons of very heavy elements. In other cases, quantum jumps without radiation (Auger effect) must be taken into consideration; the influence of these suffices to explain satisfactorily the experimental data. U. FANO: The calculation of optical terms, in particular the ionisation potentials of bivalent metals, by means of Fermi's statistical potential. G. RACAH: The so-called electric moment of the electron. G. SCAGLIARINI and F. MONFORTE: The reaction between sodium nitritopentacyanide and alkali sulphides (4). The final product of the interaction of sodium nitropentacyanide and excess of potassium sulphide is an alkali sulphonitroprusside. E. PARISI and G. DE VITO: Contribution to the knowledge of the maturation of cheese. (1) Proteases, diketopiperazine and proline peptides. Ripe cheeses are found to contain compounds resistant to proteases, such as proline peptides and diketopiperazine, which have not hitherto been observed in cheese. The conclusion is drawn that the extent to which the casein of cheese undergoes degradation is closely related to the proportion of proline products present. GISELDA SERRA: Observations on the masticatory apparatus of the genus *Orthopsis*. G. MONTALENTI: Experimental parthenogenesis of the egg of the lamprey. C. GUARESCHI: Processes of regeneration and their limits in experiments on the centrifugation of the insect chrysalis. Centrifugal force acts on insect chrysalides as a disturbance of the metamorphic processes, tending to arrest or retard these according to the intensity and duration of the force applied and to the constitutional resistance of the individual. GIUSEPPINA DRAGONE-TESTI: Action of certain salts on the germination of embryos of grain outside the seeds. When added to Knop's solution, on which grain embryos are grown, various salts, particularly borax and zinc sulphate, exert a stimulating effect on the growth of the seedlings.

SYDNEY

Royal Society of New South Wales, October 3. A. H. VOISEY: The physiography of the middle north coast district of New South Wales. The main features are: (1) the dissected New England highlands, (2) an intermediate area of broad valleys in which the streams are entrenched, (3) coastal plains of accumulation with inliers of older rock, and (4) a coast-line of long curving beaches between rocky headlands. The coastal plain is particularly wide around the Macleay River, where the rocks eroded have been soft sandstones and tuffs. Submergence to the extent of at least 70 ft. is proved, and a small emergence is held to be responsible for rock-platforms, raised beaches, land-tied islands and other phenomena. There is strong evidence that this emergence has occurred during the period of human occupation. G. J. BURROWS: Some hydroxy salts of secondary and tertiary arsines. Although tertiary arsines are oxidised to arsine oxides or dihydroxy arsines when treated with permanganate or hydrogen peroxide, the mechanism of oxidation by moist atmospheric oxygen appears to be different. Thus a specimen of phenyl dimethyl arsine, on prolonged exposure to the air, was partly converted to phenyl methyl arsinic acid. Arsine oxides and arsinic acids combine with mineral acids to give stable crystalline salts with characteristic melting points. L. W. O. MARTIN: A theory of association. There are two theories of association. The dipole theory is found to be

unsatisfactory, and not in accordance with many observed facts. A development of Sidgwick's theory of chemical association is made, and a rule deduced giving conditions for such association. When two atoms of the same element can have a normal covalent and a co-ordinate electron pair bond with the same atom, and if quantum numbers n and l are the same for both electron pairs, association follows, the association being stabilised by quantum mechanical resonance under certain conditions. HF, H_2O, HCl, ketones, oximes, carboxylic acids, esters, etc., are shown to fit in with the theory. A. R. PENFOLD, G. R. RAMAGE and J. L. SIMONSEN: The essential oil of *Calythrix tetragona*, var. 'A'. The leaves and terminal branchlets yield 0·7–1 per cent of an essential oil, the principal constituents of which are *d*-*a*-pinene, *d*-citronellol, *d*-citronellyl formate and the methyl esters of geranic and probably citronellic acids, the ester fraction comprising 60–70 per cent. This is the first natural occurrence of geranic acid which has been recorded.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 539–564, Oct. 15). R. H. SCIOBERETI: On the determination of the geocentric distance in the Laplace-Leuschner direct method for parabolic orbits. H. K. BENSON and A. M. PARTANSKY: The rate and extent of anaerobic decomposition of sulphite waste liquor by bacteria of sea-water mud. Liquor from a works manufacturing paper pulp by the acid sulphite process was used. Temperature of incubation and dilution of liquor governed rate of fermentation but did not affect extent of decomposition. 85 per cent of the reducing sugars was destroyed. The reduction products, methane and hydrogen sulphide, were preferentially formed while sulphide was available; the oxidation product was carbon dioxide. It is stated that the evolved gases, based on the yield with fermentation at 36° C., had a heating value of 649 B.T.U. per cubic foot. J. L. WALSH: Note on the location of the critical points of harmonic functions. E. D. GOLDSMITH: Correlation in planarian regeneration. Planarians were made double-headed by longitudinal splitting. Removal of one head may then be followed by complete, retarded or no regeneration of the head. Failure of regeneration is correlated with the presence of the remaining head. Frequency of regeneration was greatest in a zone lying between levels just posterior to the eyes and anterior to the pharynx. The effectiveness of this region is possibly correlated with high formative cell number and high (SH) content. F. B. SUMNER: Does 'protective coloration' protect? Results of some experiments with fishes and birds. Numbers of mosquito-fish (*Gambusia patruelis*) were placed in two cement tanks, one painted white, the other black. After seven or eight weeks, equal numbers of black-adapted and white-adapted fish were removed and placed in a whitish coloured tank and two Galapagos penguins were released in the tank to hunt and eat them. A similar experiment was tried in a black tank, and the interval between release of fish and birds was varied. Of the fish consumed in the whitish tank, 61 per cent were 'blacks', 38 per cent were 'whites' and 1 per cent unidentifiable; of those consumed in the black tank, 27 per cent were 'blacks' and 73 per cent were 'whites'. Hence fish that harmonise in shade with their immediate surroundings are less likely to be eaten by certain birds; coloration here has a definite survival value.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, December 23

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. Isabella Gordon: "Crustacea of the Deep Sea".*

Thursday, December 27

ROYAL INSTITUTION, at 3.—Prof. W. L. Bragg: "Electricity" (Christmas Juvenile Lectures. Succeeding lectures on December 29, January 1, 3, 5 and 8).

Official Publications Received

GREAT BRITAIN AND IRELAND

The National Smoke Abatement Society. Fifth Annual Report, 1934–5. Pp. 28. The Smokeless Home. Pp. 12. (Manchester: National Smoke Abatement Society.)

The National Institute of Industrial Psychology. Report 5: An Account of the Research Work carried out by the National Institute of Industrial Psychology during the Years 1921–34. Pp. 37. (London: National Institute of Industrial Psychology.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1603 (Ae. Tech. 805): Lift and Drag of a Wing Spanning a Free Jet. By H. Glauert. Pp. 8+1 plate. 6*d*. net. No. 1611 (A. 142b): The E.M.F. between Metals in Seawater. By J. W. Willstrop. Pp. 10+1 plate. 9*d*. net. No. 1614 (T. 3404): Abstract—Statistical Measurements of Turbulence in the Flow of Air through a Pipe. By Dr. H. C. H. Townend. Pp. 2. 2*d*. net. No. 1616 (Strut. 182): Buckling of a Linked Beam having a Strength in Flexure and Shear. By R. A. Fairthorne. Pp. 6+1 plate. 6*d*. net. (London: H.M. Stationery Office.)

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