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Racial Character and Criminal Responsibility

IT was evident from the moment of the arrest of Paul Gorguloff after the assassination in May last of the President of the French Republic, that the trial would be one in which the expert evidence of the alienist might be expected to have the last word. In the event, owing to the line taken by the prosecution, the case is likely to be of greater significance in relation to fields of scientific research other than morbid psychology. The crime was of a type with which the world has been only too familiar in the last half-century or so. The assassination on Sept. 10, 1898, of the ill-fated Empress Elizabeth of Austria, blameless and universally beloved, will mark for all time the futility and tragedy of such crimes, in which the choice of victim is determined solely by social pre-eminence and the assassin has no specific personal grievance, but is dominated by an overwhelming and violently perverted sense of social injustice, directed impartially against any and all in authority.

Nihilism is no longer in vogue as a mode of political expression. Its place has been taken by other 'isms', which claim for themselves a more consistently grounded philosophy, but, it may be said incidentally, have a more far-reaching and devastating effect, even if their aim be ostensibly constructive. The individual who by assassinating the ruler of a country, usually not his own, seeks to pave the way to the regeneration of the world—Gorguloff at his trial acclaimed himself as an "apostle"—is now something of a political anachronism. The assessor of his criminality is no longer the statesman, nor the touchstone of his crime the stability of the social order. He has become merely a subject for the alienist.

A defence of insanity in a legal trial places the prosecution in a position of considerable embarrassment. Recent controversy in British medical jurisprudence has been an indication of the difficulties which are experienced in fixing the degree of criminal responsibility in such cases. For, it must be remembered, the legal issue is not insanity *per se*, but responsibility. When the crime is political the difficulties of arriving at the state of mind of the accused at the moment of the criminal act may be enormously increased by prejudice.

Political crime which goes to extremes is, fortunately, rare in Great Britain, and the common-sense view, somewhat phlegmatic, of the British public towards hyper-enthusiastic reformers, as well as the notoriously impartial attitude of judges, law officers,

and courts, have a modifying effect on the heat of political controversy. On the Continent, however, the temper of the public and the atmosphere of the courts, which, as representing the State, are vindicatory rather than judicial, contrive to imbue cases of political crime with a more vital quality in their relation to the everyday life of the average citizen; while the more aggressive methods of political extremists there have too often justified the apprehensions with which the logical consequences of their doctrines are regarded. Expressions of opinion, which in Great Britain would be thought the mere vapourings of a doctrinaire, in France or Spain, for example, will be accepted as a prelude to action of a corresponding violence.

If it is true logically, as well as legally, that it is impossible to indict a whole nation, it is scarcely less true that it cannot be confined to the limits of a generalisation on its psychic characters. Yet in the Dreyfus case, the condemnation of an officer suspected of betraying official secrets to a foreign power, which appeared to the world at large as more than probably a miscarriage of justice, was an almost instinctive reaction of virtually a whole people, which saw itself already defenceless and outmanœuvred, and the overwhelming victory of an enemy force *fait accompli*. A racial capacity for logic may, it seems, readily develop hysteria. On the other hand, Italy's realism grapples drastically with facts as they are. Its methods of attacking social and political problems leave no place for aspirations or theory, unless officially approved. Hence the secret society. In Germany an ideal of pan-Germanic sentiment, in which its youth is sedulously trained, is supreme, however parties may differ as to the best means of its attainment. Here are samples, taken not quite at random perhaps, but none the less significant, of the manner in which different peoples are dominated by psychic constitution in their reaction to a political crisis, and the attitude of mind with which they may be expected to view an act committed for political reasons and with a background of political theory, such as was the assassination of the French President.

It may seem that these speculations on the effect of racial character as a factor in politics have led us rather far from the function of the alienist as the assessor of criminal responsibility. This might be so, were it not for the argument put forward by the prosecution in the trial of Gorguloff.

As was to be expected, the defence entered a plea of insanity, and it is significant of the almost academic method of approach that its principal witness, Dr. Logre, made the admission, which might well have been damaging in certain contingencies, that he personally had not examined the accused. He maintained, however, that the report of Gorguloff's examination showed that he was a border-line case, neither completely responsible nor completely irresponsible. He summarised the mentality of the accused, in what was virtually a characterisation of a type, by saying that he would have certified him as showing " lack of the critical spirit and the sense of responsibility, tendency to paranoia and morbid ideas, megalomania, persecution mania, and the possession of an idea that he had a mission to fulfil, believing himself to be not the saviour of his country alone but of the whole world ". His colleagues, he said, had not taken into account the drama going on in the spirit of the accused man. Gorguloff, who had been consistently incoherent in his frequent interruptions throughout the trial, especially when evidence had been given of his actions as torturer and member of the Cheka at Rostoff, here accepted the doctor's interpretation of his mentality with emotion, declaring with sobs that the doctor understood his soul and that he could now die like an apostle. The last expert witness for the defence was more concise than Dr. Logre. The case, in his opinion, was simple: the prisoner undoubtedly suffered from paranoia, megalomania, and a persecution complex—a case in which one had to be on the look-out for tragedy.

It has seemed desirable to outline the defence out of its proper order so that the remarkable line taken by the prosecution's expert witnesses may be fully appreciated. It is to be noted that they, or at any rate the most important of them, Dr. Genil-Perrin, insisted that no interference or hint had been received from the defence. It is evident, however, that they had anticipated the defence, as, indeed, any expert was bound to do, and that their examination of Gorguloff was directed, perhaps almost unconsciously, to meeting the course it was presumed it would take by finding the basis of an argument which would be conclusive, in the eyes of the court, in proving his sanity.

The line of argument developed by Dr. Genil-Perrin was that Gorguloff was a native of the Caucasus, " a country where the people lived among myth and legend ", and belonged to a different and " perhaps ill-assimilated civilisation "; while the atmosphere of terrorist Russia may have predisposed him to acts of violence. He was, therefore, to be regarded as responsible. In other words, the witness's contention was that in assessing the degree of responsibility in an apparently abnormal mentality, race and culture must be taken into account.

This is by no means the first occasion on which anthropology and psychology have been made to subserve political ends, as they undoubtedly have in this trial. The applause which greeted the condemnation of Gorguloff to be guillotined in a public place is a clear indication of the temper of the French public, justified though it may be by the character of the crime. In like manner, public opinion in the United States was fortified in the post-War discussions of the immigration quotas by arguments based on the alleged superior intellectual, moral, and social qualities of the Nordic stock. Anthropologists themselves consistently urge that culture and race must be taken into account by a British administration in the Dependencies, which has to deal with acts of the native population, such as the punishment of a witch by death, which in a civilised community may be crimes but in the native code are an observance of tribal custom. The cases are scarcely parallel. Even a negro who migrates to, and resides in, a civilised community, is expected to conform to the civil and criminal code or pay the penalty. The law in a civilised community cannot be tempered, as things are at present, in accordance with conventions and standards other than its own, even though these latter are coloured by a specific and individual racial temperament.

On the other hand, it must be admitted that there is a growing tendency to recognise that in a number of questions, especially of a sociological import, racial characters, racial temperament, and racial peculiarities must be taken into account. Much sociological discussion has been vitiated by neglect of these factors ; but prolonged and intensive research is necessary before anything like an adequate scientific precision is attainable in evaluating them. The physical characters and attributes of man can be, and have been, observed and recorded as mathematical units ; they can be classified, tabulated, and made the subject of statistical analysis. The anthropologist and the psychologist have yet to produce in combination a technique for dealing with racial mental characters. Racial characteristics, such as those quoted above, however closely their analysis may be based on deductions from the culture and past history of a people, are at present too much a matter of individual judgment ; and in any event they cannot be applied to individual cases with sufficient precision to afford a basis for scientifically sound argument. The trial of Gorguloff and the precedent it affords for the application of an unsound, pseudo-scientific method should serve to stimulate research in a field in which it is much needed.

Great Adventures in Astronomy

Signals from the Stars. By George Ellery Hale. Pp. xx + 138. (London: Charles Scribner's Sons, 1932.) 7*s.* 6*d.* net.

"ASTRONOMERS, like other men," writes Prof. Hale, "spend most of their lives in hard and often tedious routine work. They are, however, sometimes fortunate enough to take part in a great adventure" ; and the great adventure he now describes is the building of the 200-inch telescope. This is the subject of his last chapter, but in fact the whole book forms an exciting story of a series of adventures. Although it is named "Signals from the Stars", its main concern is with our astronomical receiving sets on earth, and how we may still further improve them, so as to interpret the signals better and reach more and more distant stations. Thus it differs from most popular books on astronomy, and while it will interest professional astronomers and also the general reader, its greatest value probably lies in the stimulating appeal it will make to the amateur astronomer.

The excellent and numerous illustrations also include something unusual, for in addition to very beautiful photographs of sun and stars, there are delightful drawings by Russell Porter of astronomers at work, and of instruments and buildings, some of which already exist on earth, but others only in the minds of their designers.

When the writer of this review visited Mount Wilson in 1906, it was a Solar Physics Observatory only ; but Prof. Hale explained that the sun, our nearest star, was the first stage in his plans for exploring the universe. Designs for the tower telescope were being eagerly discussed, and a circle pencilled on the wall to show how large it was going to be was all that then existed of the 100-inch telescope.

The 100-inch was a tremendous undertaking, and it has been fully justified. This, with the camera, has resolved a nebula into stars ; this, with the interferometer, has measured stellar diameters ; this, with the spectrograph, has revealed the swiftly receding motions of very distant nebulæ. An eminently satisfactory illustration shows nebular spectra, enlarged and widened from the originals (only $\frac{1}{8}$ in. long), and we see clearly the displacements of the *H* and *K* bands, astonishingly large and increasing with distance, from which the nebular motions are deduced. These spectra were made possible by the invention of a special type of camera lens far faster than any used in moving-picture work.

A sketch of the 100-inch mirror being prepared for re-silvering gives one a shock for a moment, until one realises that the large hammers with which it is apparently being hacked to pieces are in reality swabs for cleaning.

The next great adventure was Prof. Hale's invention of the spectrohelioscope, which has been fully described in NATURE and elsewhere, and is in use at the Royal Observatory, Greenwich. By means of the simple and cheap form which he has recently designed, he hopes to enlist many amateurs all over the world, so that the sun can never escape prying eyes, and someone may always be on the watch somewhere for a brilliant eruption like that caught by Dr. Royds with the Kodaikanal spectroheliograph, and shown on p. 79. (By some oversight, the wrong date has been given in the caption, although Feb. 22, 1926, is correctly given in the text on p. 74.) A plan of the helioscope, with an eager young astronomer gazing through the oscillating slit, is given on p. 54. There is always something of interest on the sun, but one special importance of these eruptions on the disc is, of course, their connexion with auroræ and magnetic storms on the earth.

Neither the method of construction nor even the material of the 200-inch mirror has yet been finally decided upon, and it is interesting to read of the various suggestions and experiments which have been made; but it seems certain that the focal length will be very short, in order to obtain an intense concentration of light, and a specially designed correcting lens will enlarge the area of sharp definition. The mounting is also still under discussion, but an illustration shows a design which may probably be adopted. Prof. Hale is convinced that the main optical and engineering problems have been solved, and that the mirror will have ten times the space-penetrating power of the 100-inch.

All the auxiliary apparatus have to be considered also, and practical astronomers will warmly agree that these should be designed and constructed under the personal supervision of those who use them, and should be constantly improved in the light of new discoveries. For these Mount Wilson is always on the watch, even when they are made for quite different purposes, with no thought of service to astronomy. New dyes may be useful for sensitising photographic plates, new alloys for making mirrors or gratings, and improvements in vacuum tubes or electromagnets may aid in astrophysical laboratories: in fact, "almost any discovery may help us directly or indirectly". The Carl Zeiss Company recently discovered that a temperature of nearly 9000° can be obtained by focusing the sun's rays with a searchlight mirror; and now a large 'solar furnace' is being constructed in Pasadena. It will vaporise metals by concentrated sunlight, and these will then be studied with a spectrograph.

Tests are still being carried out to determine the best site for the new telescope, but the conditions and results on Mount Wilson are considered so good, and it is so important that the instrument should be within convenient reach of Pasadena, that some neighbouring mountain site will probably be chosen.

Physicists, chemists, engineers, manufacturers, captains of industry, all are sharing in the great adventure with their discoveries, advice, and financial supplies; and help is gratefully acknowledged not only from Americans but also from experts in Great Britain and other parts of the world. The author only omits to mention that this willing co-operation, and the wonderful system of great laboratories and machine-shops in Padasena working in connexion with the observatory on Mount Wilson, are mainly due to his own boundless enthusiasm and his power to kindle enthusiasm in others. In his final pages he answers the old question, *Cui bono?* by showing that astronomy has freed mankind from superstitious fear, and that it is our duty and our advantage to discover and obey natural laws. But beyond this, in spite of the quiet restraint of the writing, there shines throughout this book his consciousness of the sheer joy in exploring for no utilitarian purpose, and the enlarging of mind and spirit which is the glory of science, and the breaking down of barriers between race and class which comes with this age-long and world-wide co-operation to "push back the hampering boundaries of the universe".

M. A. EVERSHED.

Echoes of Ancestry

Children who Run on all Fours: and other Animal-like Behaviors in the Human Child. By Dr. Aleš Hrdlička. Pp. xx + 418. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 25*s.* net.

SOME thirty years ago, Dr. Hrdlička, travelling in Mexico with Carl Lumholtz, saw an Indian child, well advanced in his second year, who ran about on all fours with hands and feet flat on the ground, knees slightly bent, body not far from the horizontal, and the head nearly in a line with the body. He was much struck by this unusual quadrupoid type of locomotion, very different from the

young child's usual creeping, and obviously suggestive of the walking of gorilla, chimpanzee, and orang utan, when these apes are on all fours and not trying to be bipedal. There is this difference, however, that these apes rest their fore weight on their knuckles, and that the orang rests its hind weight on the outer edge of its foot.

Hrdlička began to search for other examples of quadrupoid infants, and he has been gradually rewarded by finding 387 cases, 369 white and 18 coloured. He has also collected a number of references to this unusual mode of progression, but few of these seem to us to be of more than bibliographical interest, most of them being very vague in their description of what the actual movements were. Of Hrdlička's cases, 331 are more or less satisfactory, but the number is relatively small for the time given to collecting, and indicates that running about on all fours is not of frequent occurrence.

The phrase 'on all fours' is often colloquially applied to children levering themselves along the nursery floor on their hands and knees, or in some modification of creeping and crawling; but Hrdlička rightly restricts it to those cases where the hands and feet are pressed more or less flat on the ground, while the knees are off it. It is a kind of locomotion comparable to that of a bear or some other plantigrade mammal going on all fours. One must not, of course, press the conformity to the defined type too hard, for the phenomenon is a variable variation and has different degrees of expression. Thus the hands are occasionally flexed; in rare cases there may even be a use of the knuckles; or the anterior contact with the ground may be restricted to the fingers. Similarly, the part of the foot behind the toes may be off the ground, especially when the child is putting on speed. There are many oscillations within the variation; yet there are few, if any, of the photographs submitted that could be mistaken for a moment for the common 'hands and knees' progression. It is interesting to notice that the 'all fours' method may precede the 'hands and knees' method, or succeed it, or alternate with it; but if it occurs at all, it is usually the only (recorded) way of moving before the child begins to toddle.

The 'all fours' children are almost always vigorous in body and mind; they move with striking rapidity and show more than average power of balance; after becoming bipedal they may occasionally return to the quadrupedal method, which is for a while quicker than toddling; in a few cases the habit may be prolonged to the age of five years, or even longer; in three cases the habit was not exhibited until after the erect position had been assumed. The earliest reported age at which the practice began was five months; the latest was fourteen months in a girl, four years in a boy; the average duration of the quadrupoid walk was about four months in both sexes.

In the three hundred or so recorded cases the habit was more frequent in boys than in girls; it appears to be commoner in the first child of the family than in others; but the author is well aware that the number of cases must be greatly increased before generalisations can be regarded as satisfactory. It is certain, however, that the variation is in no way pathological. Nor has it any consequences that are not beneficial. Perhaps it will turn out to be a much commoner phenomenon than is usually supposed. Clear-cut instances should be reported, with photographs, to Dr. Aleš Hrdlička, Smithsonian Institution, Washington, D.C.

The question arises as to the nature of this divergence from the usual modes of locomotion in babies before they begin to be bipedal. But the answer must remain to some extent a matter of opinion until the data are more numerous. Hrdlička regards it as an individual recapitulation of a pre-human mode of progression, such as is seen in gorilla, chimpanzee, and orang utan, with the differences already noted, or in baboons and monkeys, where the hands and feet are planted more or less flat on the ground.

The difficulty is the relatively rare manifestation of the peculiarity, so far as we know, for its expression is certainly not part of a normal ontogenetic recapitulation of a phylogenetic stage. It seems to be casual. The author is disinclined to regard it as a reversion or atavism in the strict sense, that is, as due to the reactivation of a hereditary factor which is normally dormant. When one thinks of it, it is a far cry back to a plantigrade primate ancestry, and the 'all fours' method is itself, as we have mentioned, somewhat variable in its expression. The author concludes that it is a weakened but apparently still continued inheritance from the pre-human past, perhaps of universal occurrence as a predisposition, but manifesting itself only occasionally and irregularly when the conditions are favourable. This last point should be more consistently kept in mind, that features in an inheritance may not find expression unless "freed for a time from inhibitive factors or incidentally strengthened".

We should ourselves regard the 'all fours' progression as an individual germinal variation in a

habit which is well known to be variable. The actual somatic expression of the variation is defined by imperfectly understood laws of growth and functioning, which are themselves determined by the hereditary nature of the developing material. But in divergent as in normal expressions of the developing material, much may depend on the liberating stimuli which individual nurture affords.

The bulk of the book (pp. 97-143) is occupied with the reports of the individual cases. "Much cry and little wool", it may be said, but we cannot agree. We think the author has done well to make the most of a picturesque human variation; but we wish that his disciplined anthropological experience had had 3000, not 300, cases to work with. We also wish that he had been able to say a little more in regard to the very interesting similar phenomena in children, namely, those activities that look like recapitulations or rehabilitations of ancestral features. Thus many children have a strongly defined predisposition to climb trees, which may be subtly linked back to man's arboreal apprenticeship, of which his body retains many marks, as has been indicated in detail by R. Anthony and by F. Wood Jones. Also very familiar is the prehensility of the toes in many young children, who will lift a pencil or the like with their toes to their hands or to their mouth. These are but examples of what is well known. There is still much to be discovered in regard to the way in which the past lives on in the present.

Adsorption Data

The Sorption of Gases and Vapours by Solids. By Prof. J. W. McBain. (Twentieth-Century Chemistry, 4.) Pp. xii + 577. (London: George Routledge and Sons, Ltd., 1931.) 25*s.* net.

RECENTLY it has been stated that on the average a paper on adsorption appears every day in the year. Prof. J. W. McBain's volume is a masterpiece of collection, codification, and classification of such data. It is divided into three parts, the introductory section, the experimental data, and the hypotheses and theories of sorption.

The second section (pp. 33-426), which is certainly the most complete compilation on the subject ever published, includes not only a very comprehensive survey of the literature on sorption by charcoal and other porous rigid systems, but also an account of the work carried out on metals, cellulose, and non-rigid gels. The section is not only singularly complete, but also extremely interesting to read, as the author has from time to time inserted personal comments and criticism. It is, on the other hand, not so satisfactory if regarded as an introduction to the third section, which includes the theories of adsorption. The reviewer has found it very difficult 'to see the wood for the trees'. To take only two examples. We know with some degree of certainty that practically all cases of adsorption are accompanied by a penetration of the gas or vapour into the interior of the solid by processes which may include space-lattice diffusion, persorption through molecular sieves, intergranular diffusion and capillary penetration, and it is indeed to Prof. McBain himself that we are largely indebted for a proper appreciation of the importance of this phenomenon. Again, from the work of Dewar on the oxygen charcoal system, of Ostwald and Langmuir on the system $CaO - CO_2$, it was clear that at least two states of adsorption existed. The work of Benton and of Nikitin has revealed another state, the existence of which has been confirmed by the more recent work of H. S. Taylor and of Garner. These three types of adsorption, sometimes termed Van der Waals' adsorption, activated adsorption, and chemi-adsorption respectively, all exhibit their own peculiar characteristics, and examples of all three types can indeed occur in certain systems when taken over a sufficiently wide range of temperature. Whilst the actual facts are presented to the reader, a dissection of the data by Prof. McBain, or even an arrangement of the data in such a manner so as to exemplify those points, would provide a reader with a valuable introduction to the theoretical section.

In the theoretical section, the author subjects the hypothesis of adsorption in multimolecular layers to a somewhat detailed analysis, concluding that Langmuir's hypothesis of monomolecular adsorption is adequate to fit all the data which have been established with sufficient degree of certainty. The discussion on the more recent developments of Langmuir's original hypothesis, such as surface mobility and the necessity for energies of activation after 'primary' adsorption, is particularly interesting. More might have been included in the section on active patches and promoters, on the importance of lattice spacing as distinct from isolated atoms or configuration as factors in reaction at or with a surface.

The volume is full of most interesting information clearly presented, and can certainly be recommended to all those who are interested in the phenomena of sorption. ERIC K. RIDEAL.

Short Reviews

Bacteriological Control of Milk : a Practical Guide for Media Preparation and Milk Testing. By A. G. House. Pp. vii + 59. (Reading : The National Institute for Research in Dairying, 1931.) 3*s.* 6*d.*

THIS practical little book contains much useful information on routine bacteriological testing of milk samples. The section on sterilisation is admirable, though it is rather surprising that electrical apparatus, particularly for hot air sterilisation, is not mentioned. Media-making is an art in which precise details always vary according to the experience of the particular technician practising it. To the present reviewer, Mr. House's technique seems in several directions over-elaborate. To mention only one point: in filling media into test tubes, pouring through a small funnel is simpler than the use of a previously sterilised syphon apparatus.

The obsolete titration method of standardising media is described, as well as the *p*H method. It is stated that media can be sufficiently cleared by steaming, but where final sterilisation is done in the autoclave there will be further precipitation, and a preliminary autoclaving is therefore better practice. However, no two technicians will ever agree on such points, or be induced to depart from their favourite methods.

The directions for the actual testing and for the collection and transmission of samples are clearly given. Lactose bile-salt cultures should surely be incubated for three days rather than 48 hours before being regarded as ' negative '. Mr. House very properly relegates the reductase test to its true position as a rough sorting test only. Useful lists of apparatus and equipment are given in an appendix. R. F. H.

The Keys of Power : a Study of Indian Ritual and Belief. By J. Abbott. Pp. xi + 560. (London : Methuen and Co., Ltd., 1932.) 21*s.* net.

MR. ABBOTT is concerned neither with the religion of the Prophet nor with the animistic concepts of Hinduism, but deals only with the far older underlying belief in a universal supernatural cosmic power which lies behind phenomena and has determined the ritual and practice of the natives of India from time immemorial. Unfortunately, the conservatism of India, which has preserved this ritual unchanged for so long, is not now operative in every department of human activity. Mr. Abbott has to record that the traditional customs, for example, of agriculture, are rapidly passing away. He himself in the last decade has witnessed, in the Deccan, customs discarded by the younger generation and left to the older to preserve ; while in Gujerat and Sind the changes have been great. The anthropologist, therefore, will be all the more grateful to him for his assiduity in collecting the large amount of detailed information recorded in this book relating to the manifestation of ' power ', or ' mana ', as accepted by Mahommedan and Hindu alike, and the ritual which this belief entails in every department and almost in every act of daily life. An important chapter deals with totemism and the ' Devak ', in which the author discusses and dissents from accepted views.

The Supply of Water. By T. H. P. Veal. Pp. viii + 242 + 22 plates. (London : Chapman and Hall, Ltd., 1931.) 15*s.* net.

THIS book is best described as a compact manual for the student, covering such matters as are involved in the design and execution of water works undertakings, namely, sources of supply, measurement of rainfall and flow in pipes and open channels, construction of dams and reservoirs, conduits, mains and their fittings, filtration, and the fundamental principles of chemical analysis. The treatment is commendably clear and succinct, though perhaps slightly sketchy in places, but sufficient for the acquirement of a general knowledge of the subject. Bibliographies are given at the end of each chapter. The list of works cited is good, but by no means exhaustive. A number of plates are included among the illustrations showing types of appliances used in connexion with water-supply services : these have been furnished by firms of manufacturers specialising in this class of work. B. C.

Insect Pests of Farm, Garden and Orchard. By Prof. E. Dwight Sanderson. Third edition, revised and enlarged by Prof. L. M. Peairs. Pp. vii + 568. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1931.) 13*s.* net.

WE welcome the appearance of the third edition of this standard book, which has justly enjoyed popularity as being one of the best manuals dealing with North American agricultural pests. It is similar in general arrangement to its forerunners and contains about the same amount of subject matter, but, owing to the larger page employed, the total number of pages is considerably reduced. Only a few of the articles written by Prof. Dwight Sanderson in the first edition remain more or less unaltered. For the rest, the book has been largely rewritten by Prof. L. M. Peairs, who has embodied the results of recent investigations and included a number of new illustrations. As stated in the preface, the edition is properly that of Prof. Peairs, although the name of the original author is retained.

The Story of Science. By David Dietz. Pp. xvii + 387 + 31 plates. (London : George Allen and Unwin, Ltd., 1932.) 10*s.* 6*d.* net.

AN amazing amount of matter is crowded into this very useful book for the general reader who wishes to follow the complex development of science. Beginning with a short survey of astronomy, the author goes on to discuss the origin and structure of the earth. An interesting chapter on the " Story of the Atom " follows ; and the book closes with an outline of the problems connected with life. Occasional historical remarks enhance the interest of the book, which is not controversial in character, and aims at presenting a simple but complete picture of present-day scientific knowledge. T. G.

The Scope and Needs of Medical Research*

By Sir WALTER M. FLETCHER, K.B.E., C.B., F.R.S.

IN this outline I have tried to show the wide sweep and scope of the group of studies properly called medical research. In spite of the widely scattered fields over which it ranges, this work is joined in an organic unity because it has ultimate reference always to the nature and the needs of the living human body. At almost every point will be found interrelations between one part of the work and another, and between the various groups of workers in this extended army. While it is served of course by the medical sciences, physiology, pathology, bacteriology, it calls in increasing degree for intensive studies in the more primary sciences of chemistry and physics. Medicine, in fact, using the word in a wide sense, is already being served by a great army of workers, of which a large and increasing number may have no medical degrees and no direct relation to the medical profession.

When the Medical Research Council began its work eighteen years ago, then, and indeed for some years later, rickets was regarded by many of the best authorities in Europe as a chronic infective disease of which the infective agent was unidentified. It was called on the Continent the 'English disease' because it was first described in England and because of its abundance in our smoky cities. The disease consists most prominently in the failure of the calcifying process that gives hardness and strength to the bones and to the teeth, and the rickety child is stunted, deformed and enfeebled in various degrees. Before the War it was estimated that in our cities at least one child in every three had obvious signs of rickets. Dr. Mellanby discovered, by laborious experimental work, that rickets is simply a deficiency disease due to the lack in the food of a particular constituent, now called vitamin D. The proper supply of this prevented rickets or rapidly cured rickets already present. Familiar now as this is, even to laymen, it was greeted at first and for some years by much scepticism in many medical circles.

This discovery has led to a remarkable series of developments. It had been found that sunshine upon the body also prevented or cured rickets, that it was the short ultra-violet rays that had this action, and that it could also be produced by artificial light. But these rays cannot penetrate more than a tiny thickness of skin, and their action must therefore be upon something at or very near the surface. Were the rays producing vitamin D from something on the skin surface? The vitamin was known to be associated with fats; it was an obvious guess that the light might produce it from the protective grease secreted upon the skin surface. A chief constituent of this is a fat called cholesterol. A loud 'cry' from what had now become an international pack of hounds announced that this was the right line and that irradiation of cholesterol gave vitamin D. But almost at once a more sagacious 'hound' (if I may continue that impertinent metaphor for Dr. Rosenheim at the National Institute for Medical Research) found with Mr. T. A. Webster that it was not cholesterol itself that gave this result but a related substance, present with it in much smaller quantities. This, after exchange of results and ideas with Prof. A. Windaus of Göttingen, was identified as a sterol called ergosterol, previously known only as the characteristic sterol of certain fungi and of yeast.

Now the problem became one for intensive study by physicists, organic chemists and biologists working in intimate collaboration. A team of this kind, working under the general leadership of Dr. R. B. Bourdillon at the National Institute for Medical Research, obtained a crystalline substance of very high antirachitic activity by the physical process of distillation in a high vacuum; and another team under Prof. Windaus, in Germany, obtained a very similar substance by a selective chemical reaction. Both of these, however, proved to be compounds of the vitamin with inert substances; and Dr. R. K. Callow, of the National Institute group, found a method of separating the vitamin from either as a crystalline ester, from which the pure vitamin can be liberated. It proves to be itself a sterol, differing from the parent ergosterol only in a detail of the structural arrangement of its atoms, and it has been given the chemical name 'calciferol'. In pure form this has almost incredible biological potency. A single ounce of it would suffice to give a full daily ration for a million growing children.

It is to be noted that this devotion of physicists and chemists to a medical problem has done more than assist medical knowledge. It has yielded additions to both physical and chemical methods. A new form of photoelectric microphotometer which multiplied five-fold the speed of observations was produced in its course, together with a new type of spectrograph. Important new contributions have been made and are still being made to our knowledge of the pure chemistry of the group of sterol compounds. In deciding between alternative possibilities of structure for these complex molecules, the chemist is becoming more and more dependent on the physicist for measurements made by the methods of X-ray analysis.

Now this progressive work, interesting as it is, is not only a clever physico-chemical exploration of academic interest. The results of this intensive laboratory work take on at once a direct bearing upon the practical needs of the community. Accurate knowledge of the vitamin allows adequate standardisation of its amount in different foodstuffs, in terms of a fixed standard of reference. Its artificial production, moreover, brings into action, or should bring into action, the medical administrator, who should be concerned to see that so long as social or economic factors maintain, as they do, an effective shortage of the natural sources of the vitamin among our city populations, a supply

* Continued from p. 192.

of it by means of the new methods we now have at command shall be made available for every growing child and every child-bearing mother in the country.

There still remains for study the attractive physico-chemical problem of how it is exactly that this calciferol molecule exerts its special influence upon the living cells of the intestinal walls and exactly why, without it, they cannot do their work of effecting the passage of calcium salts into the blood from the food but not back again. Of this we now know almost nothing. Here our task is to attempt further steps towards better knowledge of the mysterious microcosm of the living cell substance.

Other fascinating vistas are in sight. Only in the last few weeks workers in the physico-chemical laboratory at Cambridge have found some evidence that the action of particular wave-lengths of light in developing vitamin D from its precursor substance may not be, as we had been thinking, an isolated phenomenon. They have obtained some indications that, just as for this, so in the case of two other vitamins—each in its own way indispensable for animal life—particular wave-lengths of light may produce the vitamin from its precursor while other wave-lengths close to them destroy it. What we know already of the chemistry of the vitamins having these special relationships to light shows that they belong to widely different types of chemical compounds. If the indications just given should be confirmed, it will seem to be, so to speak, more than a mere coincidence that in two or three different directions at least the animal cell has come to be vitally dependent upon different individual chemical substances, of which each has these remarkable photochemical properties. We should have to consider that we have here perhaps taken our first step towards knowledge of a phase of evolutionary development that has not been dreamed of hitherto, a development made manifest in a highly specialised and detailed adaptation of living matter to its age-long environment of light.

In quite another direction, the growing demands of medical research for intensive physico-chemical studies may be illustrated. Among the varieties of parasitic life that infest the animal body, I mentioned the so-called viruses that cause devastating diseases in man, in animals, and in plants. The loss they cause in life and in money has a magnitude almost beyond calculation. They cause smallpox, measles, infantile paralysis, and many other diseases in man. They cause foot-and-mouth disease of cattle, swine fever, fowl-pox, and other devastating plagues in animals. They cause ruinous diseases in vegetable crops of many kinds, from potatoes in Great Britain to bananas in the tropics. They are called 'viruses' at present because that commits us to no decision as to their nature. What do we know about them? In a fluid containing them they can be shown to be freely suspended and particulate bodies, for the fluid can be freed from them by rapidly spinning it in a tube so that the particles are driven to one end of it. The bacteria themselves vary widely in size as animals do. None of them can be seen with the unaided eye, and taking the largest as enlarged to the size of a horse the smallest would then be represented by a mouse—and would be near the extreme limit of our highest powers of direct microscopic vision. The viruses are so small, however, that they pass through porcelain filters that retain all bacteria, and they are just upon or beyond the border-line of direct vision by ordinary microscopic means.

Here again medical research has had to call for the intensive application of new physical methods of study. By using the shorter wave-lengths of ultra-violet light the limits of clear microscopic vision can be extended, though this involves using quartz instead of glass throughout the optical apparatus, and obtaining photographic images instead of using direct vision by the eye. It is desirable to photograph the virus bodies in their natural state undisturbed by chemical agents or by stains which by coating their surface alter their apparent size. These methods are already being successfully applied at the National Institute for Medical Research by Mr. J. E. Barnard, who has been foremost in developing them. Another physical problem has been to devise suitable filters with apertures of known size and uniformity so that the different viruses may be graded in order of magnitude and the work of separating them in the laboratory made constant and accurate. This problem has been largely solved already by Dr. W. J. Elford, also at the National Institute, who has found how to produce accurately graded and uniform filters by making collodion films under precisely controlled conditions.

Many of the known viruses have already been arranged in an order of size, and the results gained by optical and filtering methods, which are constant, agree closely where they can be compared. They show that the viruses vary in size nearly as widely as the bacteria do. The largest are close in size to the smallest bacteria, and they descend to the virus of foot-and-mouth disease, of which the particles are little larger than the colloidal aggregates of oxyhæmoglobin in solution. There is probably not room in each particle for more than two or three hundred protein molecules. They can be present in immense number, and yet very few of them are enough to carry full potency. The fluid from a case of foot-and-mouth disease can be diluted ten million times and yet be potent to reproduce the disease.

There are many reasons for considering the viruses to be the smallest forms of life and for allowing them to be living organisms. But there are many unsolved difficulties here. The particles are far smaller than the simplest living cells which have hitherto been regarded as the smallest organisations of living matter endowed with specific character and the power of self-production. It is not certain that a virus can multiply outside a living animal or plant cell: inside it they may multiply with such rapidity as to make it tempting to think that the new particles are being formed not by the growth and a doubling subdivision of their

own substance, but directly, and by some more rapid transformation of matter, out of the substance itself of the living cell containing them. In other words, it may perhaps be as true to say that the disease causes the virus as that the virus causes the disease.

Here again we notice how great is the intellectual interest offered to the physico-chemical student, quite apart from any incentive given by the gigantic practical benefits that will certainly be the reward of successful work in this field. It may be that in the study of these minute forms we are destined to find new clues to some of the most fundamental properties of living matter, and to express them in terms of physics and chemistry. It is perhaps just as likely that we may find ourselves able instead only to express physics and chemistry at this point in terms of life.

It is obviously most urgently desirable that we should increase our knowledge of these tiny forms and the laws of their behaviour as rapidly and fully as possible, if only with the direct utilitarian object of protecting the life and property they attack upon such an immense scale. We have to remember, too, that beyond a doubt some forms at least of malignant disease can be propagated by minute particles of matter which have all the known characters of the viruses. That being so, it is hard not to believe that the right clue to the problem of cancer lies here, and it is in fact being devotedly pursued from that point of view.

I might give many other examples of the great refinements now attained in many directions of biological and medical work. For study of the electrical changes in rapid muscular movement, the physiologist Einthoven introduced the string galvanometer which has been so useful in the hands of Sir Thomas Lewis and others in recording and analysing the successive events in the beat of the heart, normal or disordered. This instrument has passed as a contribution from biology to the regular uses of the physical laboratory. New devices of amplification by the physicists, on the other hand, have allowed Dr. Matthews at Cambridge to follow and measure the curve of electric change due to the passage of an impulse along a single nerve fibre, while Dr. E. D. Adrian there obtains an audible record by a loud-speaker of the impulse, for example, which passes along the optic nerve of a fish when a brief shadow flits across its retina. Prof. A. V. Hill follows the course of the heat changes due to the train of transient and minute chemical changes in nerve fibres that propagate the nervous impulse and measures them with an accuracy expressed in millionths of a temperature degree. The biologist, if given two samples of crystallised egg albumen from the eggs of a duck and hen respectively, can tell, by means of a biological test, which of them comes from which bird with great rapidity and certainty, though the detection depends on a subtle difference of molecular pattern far beyond the reach of any analysis by the chemist. Dr. Todd, at the National Institute at Hampstead, again, has shown that the interactions of the blood between fowl and fowl can be so used as to enable the biologist if he desires it to identify any given hen and its family from any other hen in the world. No organic chemist has ever dreamed of performing in such subtlety as that.

Medical progress, however, is greatly hampered by various circumstances that keep from its services many of the able men who are best fitted to enjoy giving their life-work to advancing it.

One of the most serious of these is the unfortunate and harmful tendency both in the schools and in the universities to segregate physicists and chemists on one hand from biologists on the other. At the schools this is largely the result of the scholarship system. It is found easier to cram clever boys along narrow specialist lines in physics and chemistry for scholarships at the universities, while the universities have never taken effective action so to use the scholarship system as to secure a well-balanced scientific education for scholarship candidates. The result is twofold. The cleverer boys are diverted from biology, while the biologists, if any, must give up proper training in the physical subjects and themselves specialise narrowly if they are to have any chance of scholarship success. The system of university examinations at both Oxford and Cambridge encourages still further this segregation of the sciences, and at Cambridge changes in regulations during the last twenty years have made the position worse rather than better. These are not only personal views drawn from my own experience; the same opinions have been strongly expressed by Lord Chelmsford's Committee, appointed in 1930 by the Prime Minister to consider the obstacles which stand in the way of the education and supply of biologists for work in Great Britain and overseas.*

I must not enter further upon this educational question now. I want only to urge here that the general cause of medical research suffers greatly from the present wide and unnecessary divorce, during the earliest stages of education and onwards, between those taught on the physical side and those upon the biological side. It is wholly indefensible on any ground that schoolboys and undergraduates who have special aptitudes for physical inquiry should be confined by a faulty system to the study of non-living matter only. The problems of the living cell are at least as attractive to a keen mind as those of non-living matter, and they demand perhaps greater rather than less manipulative and analytical skill, because of the instability of the living substance that is studied.

Medicine has always been the mother of sciences, and we may remember that it was from the body of medicine, namely from the schools of physiology, and not from schools of organic chemistry, that biochemistry was born and developed as an organised university discipline. It has been found indeed as the result of experience that the man trained narrowly in organic chemistry does not in general make the best biochemist. Without earlier acquaintance with the problems of living things, he

* Report of the Committee upon Education and Supply of Biologists. H.M. Stationery Office Publications, 63-75, 1932. Price 1*s*.

is less likely to break new ground than the biologist starting far behind him in purely chemical equipment. There is pressing need now for a parallel development of bio-physics, not necessarily, or even desirably, as a separate discipline, but by a breaking down of the present artificial educational barriers between physics and physiology, barriers so unworthy of the Greek spirit of which those very names remind us.

I must not stay to speak of still another set of conditions that handicap medical progress. Of those biologists who pass on to hospital work and the study of disease as such, many who are among the fittest to make new knowledge in the sphere of clinical medicine are tempted to turn aside from the arduous path of new investigation, either because of the absorbing human interest of professional work or again because of their financial needs or desires.

The mastery over non-living matter which physical science has given us has transformed all the conditions of human life within a century, but the conveniences offered by improved transport and improved communications have brought only superficial changes, and it is doubtful whether they have done on the whole greater service or disservice to the happiness and well-being of mankind. Our improved powers of producing wealth, as the whole world is now observing, seem already to have outrun lamentably our powers either of wisely using or even of retaining it. It is better mastery over living matter, and the improvement of the bodily and mental powers of man, that are needed for the real betterment and enrichment of the race. By powers of a kind that we are already in process of gaining by medical research we may hope to transform human life in ways almost unimagined now and to make a new world indeed.

Without entering into dreams of the far future we know that here and now the campaign of medical research is improving our estate. Its progress and success have immediate interest for all of us and the highest claims upon the goodwill of all mankind. It is a campaign to diminish pain, to lessen the waste of human effort and human life, and to enrich and enlarge the powers of the human body and mind.

York Meeting of the British Association

THE full programme of the York meeting of the British Association is approaching completion, and should be in the hands of members very shortly. A change of practice has been instituted with the view of economy and greater convenience. The "Programme and Daily Timetable" will embody the usual features both of the Association's list of transactions and of the so-called local programme formerly issued by the authorities at the place of meeting. Between these two publications there was always a measure of overlapping; moreover, the local programme was never in the hands of members until their arrival at the meeting. Now, following the practice initiated at last year's centenary meeting, when the whole organisation was centred at Burlington House, it becomes possible to place fuller advance information in the hands of members whose intention to attend, and postal addresses, are known.

Another and still more important change of practice with the same objects is initiated this year. It had become the custom, as is well known, for local committees to prepare handbooks for the successive places of meeting. Some of these have become standard reference-books of material value; on the other hand, the series followed no definite plan, and these books, again, were issued only at the meeting, and were sometimes very costly to produce. It is known that they did not always receive from members the attention they deserved: there is a case on record of a copy of the local handbook being seen on a second-hand bookstall in the place of meeting almost immediately after its issue. For the present year, a short "Scientific Survey of York and District" has been prepared by recognised authorities through the London office, with the collaboration of the appropriate sectional officers and the York executive. This also will be issued, so far as possible, to members in advance, and they will thus have the opportunity of priming themselves with information about the locality before they visit it. It is intended afterwards to include this "Survey" in the Annual Report, and if the present issue is found to form a satisfactory model, there will gradually accumulate, as the Association meets in successive centres, a systematic series of local scientific studies.

In these directions, at least, the Association has travelled far from the practice of twenty years ago, when the meeting was announced by a single leaflet, and members were left to find all other information at the meeting itself. Certainly the Association has become more businesslike (if the epithet may be permitted) in the formulation and announcement of its programmes. The main lines of the sectional transactions are laid down at the joint meeting of the organising sectional committees in January. The value of this meeting, which was initiated at the instance of the former general treasurer, the late Dr. E. H. Griffiths, has been, from the point of view of administration, immense, and it is believed to be the general opinion that it offers a most useful occasion for the really hard labourers in the Association's vineyard to keep in personal touch during the interval between the annual meetings.

As a result, the principal features of the meeting were known in broad outline when the "Preliminary Programme" was issued and noticed in NATURE for April 30, p. 642. Not many important corrections are made. The title of Lord Rothschild's presidential address to Section D (Zoology), not then announced, is now known to be "The Pioneer Work of the Systematist". The evening discourses by Sir Arthur Hill and Mr. C. C. Paterson have been transferred from the Exhibition Hall, which is found unsuitable for lanterns and demonstrations, to the less commodious but more

intimate Co-operative Hall, where, to obviate overcrowding, special tickets will be required (an unusual practice, which members are asked to note). The discussion on the university movement in Yorkshire, originally announced provisionally in Section L (Education), will not take place. For the rest, the full programme in no way falls below its predecessors in general interest. As compared with the York meetings of 1881 and 1906 (and indeed with later meetings) there is to be observed the widening of the tendency of sections to lay out their programmes and group their communications under definite broad headings. This is a movement appreciated by the informed public which it is one of the functions of the Association to address: the method gives a clear view, from year to year, of directions in which the main lines of scientific advancement are being laid down; and if the Association should be tending to leave the highly specialised individual communication to other more specialised media (and probably, on balance, there is such a tendency), the meetings should not on that account become less valuable to scientific workers. As occasions for personal contacts, these meetings are unique. To take a single illustration from the present programme, it is difficult to imagine another organisation which would give opportunity for a joint discussion of common problems between physicists and psychologists.

In the previous article on the York meeting in these pages, it was stated that many points of interest in the neighbourhood would be visited, and that no locality is richer in them. The full programme bears out this statement. In York itself there are all the antiquarian interests of the city. There are the cocoa and chocolate works of Messrs. Rowntree and Messrs. Terry, at both of which special receptions are being arranged. There are the museum, the carriage works, and the signalling school of the London and North Eastern Railway, the scientific instrument works of Messrs. Cooke, Troughton and Sims, and glass, aircraft, electrical, and other works. Taking a radius from York to the east coast, Hull, Leeds, and the Pennines, there are geological, botanical, zoological, archæological, industrial, and educational interests of the widest variety, of which the various sections which arrange their own excursions will take full advantage. The general excursions, mainly, as usual, on the Saturday, will combine railway and road travel in a manner not without significance when these methods of transport are elsewhere so strongly in opposition; there will also be occasions for relaxation on the River Ouse.

It might have been feared—indeed, it was feared—that the difficulties of the present time might react unfavourably on the attendance at the meeting. It is never known until the meeting itself what amount of local support by way of membership will be forthcoming: it is to be hoped that it will be ample at York. But so far as concerns the attendance of visiting members, as registered from day to day in the London office, there is no evidence of any enforced diminution of interest.

Lastly, these same difficulties, as suggested at the beginning of this article, have dictated economy in the working of the meeting. Traditions expensive to maintain had been handed on from one locality which entertained the Association to the next. The Council was instructed by the General Committee at the centenary meeting last year to review the cost of meetings falling upon local funds, and to suggest measures for its reduction. This has been done. The steps taken in co-operation with the York executive will not affect the Association's own funds in the direction of saving—they may, indeed, have a contrary result. But they will render the Association this year, and, it is to be hoped, in future, a less exacting guest than it used to be, and that without any diminution in the scientific value of its proceedings.

Obituary

SIR RICHARD THRELFALL, G.B.E., F.R.S.

NO one who knew Threlfall is likely to forget him: his robust personality, his bonhomie, his humour, his gift of vivid expression, his energy, his driving force, his power of telling a good story and of making a good speech, together with his massive frame, made an impression not easily effaced. Those who knew him most intimately knew that besides all this he was the staunchest and most helpful of friends, one on whose help they could rely in good times or bad, and whose death has taken from them a prop on which they had often leaned.

Threlfall was born at Hollowforth, a village near Preston, on Aug. 14, 1861, and in due time went to Clifton. Here his tastes soon became apparent; explosives were his first love, and legends about his adventures in practical chemistry still float about; one of these is that he conceived the idea of felling trees by the aid of dynamite and tried it on a young fir tree just outside the school, with the result that the tree was shot through the window of the school laboratory. Once when he was working at home during the Easter holidays, in a small laboratory which his father had fitted up, he had an explosion which blew off the third and little finger of his left hand and a good deal of the hand at the back of them, as well as the top joints of the right thumb and index finger. It was characteristic of him that before being driven into Preston to have his wounds dressed, he asked his mother to get a piece of wood and put it between his teeth so as to keep his mouth open. He said if he did get lockjaw he was not going to be starved to death as well. In spite of the loss of half his fingers he became one of the best manipulators and glass-blowers of his time, and wrote a book on laboratory arts. He was in the Rugby XV. at Clifton, and also shot for the School.

He left Clifton in 1880 and entered Caius College,

Cambridge, where he had won an entrance scholarship. Among the scholars of Caius in his time were many who attained great distinction, including Sir Charles Sherrington; the regius professor of civil law at Cambridge; and the Master of Emmanuel College. He took a 1st class in Part I. of the Natural Sciences Tripos in 1882, and again he was in distinguished company, for with him were Adami, Bateson, H. H. Head, Harker, Harmer, and Shipley, who all, like himself, became fellows of the Royal Society. Between the first and second parts of the Tripos he spent a semester at the University of Strassburg and worked under Profs. Fittig and Kundt. It was about this time that he constructed an automatic microtome. The history of this discovery is given in *Biological Reviews* of October 1930.

In 1884, Threlfall took a first-class in Part II. of the Natural Sciences Tripos. He was very prominent in undergraduate life, and played twice in the Rugby XV. against Oxford. In those days a 'blue' was not given in Cambridge for Rugby football, though it was in Oxford. The Rugby team was naturally up in arms, and said that if the 'blue' was not given to them they would take it for themselves. This brought all the wigs on the green, and in 1885 a meeting to which all members of the University were admitted was held at the rooms of the Union Society. The room was so crowded for some time before the proceedings began that when Threlfall, on whom the hopes of the Rugby supporters rested, arrived, he could not get beyond the crowd at the back of the hall, and had to be held up by some friends while he made his speech. The speakers before him delivered carefully prepared speeches which smelt very much of the lamp and left the audience quite cold. When he got up and jerked out from his uncomfortable stance one short sentence after another, full of good sense, good humour, and good jokes, he soon had the house rocking with laughter, and put the issue beyond doubt. I never heard a speech which had so much influence on the division. About this time he was Hercules in the "Birds" of Aristophanes, the second Greek play produced at Cambridge, and certainly looked the part.

Threlfall had worked at the Cavendish Laboratory while an undergraduate, and after taking his degree began systematic research work. He and I collaborated in some investigations, and I soon realised his quite exceptional skill as an experimenter. He was a demonstrator in the Laboratory for a short time, but left Cambridge in 1886 to take up the professorship of physics in the University of Sydney. When he arrived at the University and asked where the Physical Laboratory was, he was told there was no laboratory. Then he said he was going back to England, as he was not going to be a professor of physics without a laboratory; so they took him over the building and showed him a room here and another room there which might perhaps be spared to make the laboratory. When he said he was not going to have a laboratory of that kind, they offered to try to get the funds from the Government, but for a long time nothing materialised.

Threlfall had in the meantime become very friendly with the Prime Minister, and kept pressing upon him the claims of the laboratory, without any immediate result. One night, however, the Prime Minister came up to him at the club and said, "Dick, I have done the square thing by you at last. I've put your laboratory on the estimates. We've just been beaten on a division, and are resigning to-morrow, so that the other fellows will have to pay." The other fellows did pay, and Threlfall got a laboratory which at the time it was completed was at least as good as any in the world.

He had many amusing experiences in Australia. Once when he and the professor of geology were travelling together, they were surprised, when they arrived at a small town, to be welcomed by a band which struck up "See the conquering hero comes". The geologist said, the people here have evidently got some mine they want to boom, and are doing this to induce me to give them a good report. This seemed reasonable, but when they got to close quarters, it turned out that the people had mistaken Threlfall for Donald Dinnie, a famous Scotch athlete, who for many years had been the 'star' performer at Highland gatherings and could 'toss the caber' farther than anyone else had ever tossed it, and was at this time touring New South Wales. The geologist asked who they thought he was, and they said they thought he was the man who went round with the hat after the performance.

As soon as the laboratory was finished, Threlfall began to experiment, and many important researches by himself, his colleagues, and pupils were made during his tenure of the professorship. I hope at another time to give a detailed account of his contributions to physics, but I shall now confine myself to personal reminiscences. I may mention here, however, his experiments made on quite an engineering scale on the velocity of transmission of violent explosions through sea-water, and the work he did as chairman of the N.S.W. Royal Commission on the causes of the spontaneous combustion of coal in ships.

In addition to his more conventional duties, Threlfall played in the Rugby XV. of the University of Sydney.

Threlfall returned to England in 1899 and joined the well-known chemical manufacturing firm of Albright and Wilson at Oldbury, near Birmingham, the largest producers of phosphorus in England. The knowledge of phosphorus and its properties which Threlfall acquired at Oldbury were of vital importance to the country when War broke out. In 1905 he was elected an honorary fellow of Caius College, on the same day as Sir Charles Sherrington. He had been elected a fellow of the Royal Society in 1899.

Threlfall's qualities first found opportunities for their full development during the War. He threw himself with the greatest ardour into the work of applying chemistry to the needs of the Army, Navy, and Air Force. His qualifications for this were unique; he knew chemistry from the point of view of the manufacturer as well as of the professor, and

he had at the works at Oldbury great facilities for carrying out experiments on a large scale with the least possible delay. His powers of work, his ability to get results quickly, his energy and enthusiasm were quite extraordinary. He served on the Board of Invention and Research under Lord Fisher, on the Advisory Council for Scientific and Industrial Research, on the Trench Warfare Committee, and devoted practically all his time to work for the nation. I was on the Central Committee of the Board of Invention and know what he did for that Board alone. The committee met every week, and more often than not we had a report from him on some question that we had asked him to investigate, or gave him a new problem on which we wished for a report. His development of smoke screen and the tracer bullet were of vital importance in the War. For these services he was made K.B.E. in 1917 and G.B.E. in 1927, and never were these honours better earned.

After the War, Threlfall continued to spend a very large amount of time and work on the affairs of the Department of Scientific and Industrial Research, of which his great friend Sir William McCormack was chairman. He succeeded Sir George Beilby as chairman of the Fuel Research Board, and in 1919 went on a mission for the department to Japan. He also, after the War, spent a good deal of time and money on experiments on the effect of great pressure on carbon, as Moissan claimed to have produced diamonds in this way. Sir Charles Parsons was also about this time working by a method of his own on the same subject; neither were successful in producing diamonds, and they came independently to the conclusion, which I believe is now generally accepted, that Moissan was mistaken in the interpretation of his results. Threlfall also took up again a research which he had commenced when in Australia, that of measuring the variation of gravity at different places by means of a quartz torsion-balance.

Threlfall's published papers, good as they are, give a very inadequate idea of the amount or importance of his work, the most important part of which was done for the War or for the application of science to industry. This was known to few, and no account of it appeared in scientific papers; it is to be hoped that steps will be taken to keep it in remembrance.

He was nearly as keen about his amusements as about his work; he was fond of shooting and fishing, and was a good shot with both gun and rifle and an excellent fisherman. He was also the most sociable and 'clubbable' of men: he thoroughly enjoyed the meetings of the Royal Society Club, the Old Boys' dinners at Caius College, the Cavendish Laboratory dinner, or a dinner with a friend or two at the Athenæum; he enjoyed the dinner itself as well as the company. He was an excellent after-dinner speaker; his strong personality came out in this as in everything he did, and his speeches had a freshness and vigour all his own.

In April 1930 he had a serious illness, and though he recovered sufficiently to get about again, his health gradually declined, and on July 10 he died at his house in Edgbaston. He married in 1890, when he was professor at the University of Sydney, Evelyn Agnes, daughter of John Forster Baird of Bowmont Hill, Northumberland. Lady Threlfall died in 1929, leaving four sons and two daughters.

J. J. T.

I FIRST met Sir Richard Threlfall during the War, when he came to witness trials of his phosphorus smoke bombs. During the last year of the War I was in close touch with him, as he was busily engaged on other experimental work of importance to the Air Force, and frequently visited Col. Bertram Hopkinson, who was then in charge of experimental and research work for the Air Force. He was a great friend of Bertram Hopkinson; he had also been an intimate friend of his father, John Hopkinson. He often spoke to me about them in later years, and evidently held them in affectionate memory.

The particular work of Threlfall's with which I was then officially connected exhibited all his great powers of experimental skill, resource, and persistence. His persistence in research work was one of Threlfall's most marked characteristics. He never knew when he was beaten; he hated to acknowledge defeat in the laboratory. From a commercial point of view perhaps this was occasionally a fault, but on balance it must have paid hand over fist. When engaged on a problem, he would work long hours at night in his laboratory at home, tireless in the pursuit of his end. A remark in his paper on "The Electrolysis of Molten Zinc Chloride" (*J. Soc. Chem. Ind.*, July 1929) indicates his constant attitude to research. After referring to the formidable experimental difficulties he would have to encounter, he says, "However, in the end I decided that such difficulties as might arise could probably be overcome by steady work and engineering". They were.

Threlfall afterwards referred to this work as his most complete and finished investigation. It occupied, on and off, a period of eleven years, but unfortunately its commercial application was first prevented by the War, and afterwards rendered inadvisable by reason of other developments. However, this commercial failure had its bright side for other people, for it set him free to publish an account of the work on the occasion of the award to him of the Gold Medal of the Society of Chemical Industry in 1929. The account is necessarily brief; but it is written clearly and forcefully, and gives the reader a good idea of the magnitude of the problem, and of the skill and wide knowledge of the investigator.

The details of most of Threlfall's industrial work must necessarily remain confidential, but a brief reference to the chief items will indicate its scope. In addition to his researches on the electrolysis of fused zinc chloride, he worked out processes for the electro-chemical production of sodium chlorate, and ammonium persulphate, which were successfully operated on a large scale. He was also responsible for the substantial improvement of electric furnaces for the production of white phosphorus,

and for the erection of a station at Oldbury for the generation of electricity on a large scale from gas-engines. In the course of some of this work he was led to investigate the flow of gases in pipes, an account of which he afterwards published. He also devised a characteristic method for determining the efficiency of electric generators by air calorimetry, which gave rise to considerable discussion and interest among electrical engineers at the time (1903). His remaining industrial work included the development of processes for the manufacture of carbon tetrachloride and carbon disulphide, the production of ferro-chrome, and of some of the rare metals.

In my view, which I feel sure will be shared by all who knew something of his work, Threlfall was one of the greatest of electro-chemists. It was a subject which exercised to the full his profound knowledge of physics, his practical acumen, and, on the industrial scale, his engineering instincts. It is unfortunate that he was never able to publish a book on the subject, for his great experience and firm grasp of the subject would have certainly provided a strong impulse for further scientific research, especially in the rather neglected field of the electro-chemistry of fused salts. Published scientific knowledge on this subject is meagre compared with knowledge hidden away in the electro-chemical industry, and the industrial electro-chemist must derive little benefit from current scientific literature. Some remarks of Threlfall's in an address to the Birmingham Section of the Institution of Electrical Engineers in 1905 are worth quoting. "The most pressing want at the moment among laboratory electro-chemists is a sense of humour in those who contribute accounts of their work to the various journals. Many of these papers appear to have been written with the idea that people interested in the subject enjoy reading for its own sake, and actually prefer fifty pages to five. . . . It is a thousand pities that the subject of electro-chemistry owes so little to French chemists—had it been otherwise, we should no doubt have had a standard of exposition which would have reduced the volume of the literature in the ratio of, say, ten to one." Possibly some may think that these remarks are true to-day, and that they have an even wider application.

The War gave Threlfall an opportunity of giving his great knowledge and experience to his country, and incidentally benefited him by widening his interests and giving him greater scope for his powers. In his own words, he was beginning in 1914 to settle down to the normal life of a successful business man in the Midlands, his only close touch with the scientific world being through the Royal Society, and its Dining Club, at the meetings of which he was a constant attendant. The War changed all that without bringing him the sorrows of a parent, for three sons, after long war service, all returned safely. Sir J. J. Thomson has already alluded to his valuable work for the fighting services; I need only add, as a matter worthy of special record, that he was the first to suggest the use of helium in balloons and airships, and expressed the opinion in 1915 that sufficient quantities of this gas could be found in the sources of natural gas in the United States.

Fresh opportunity for public service of the highest importance came with the formation of the Department of Scientific and Industrial Research in 1915. Threlfall was one of the original members of the Advisory Council, and remained a member until 1926. It would be no injustice to the other distinguished members of the Council during Threlfall's term of office to describe him as the hardest worked of any who had no direct responsibilities for the work of the research stations. The voluminous papers with which members of the Council were supplied to prepare them for the fortnightly meetings were scrupulously read through by Threlfall and marked copiously with his notes. His criticism could be trenchant, but was always constructive when possible, and seldom destructive without justice. His strong personality, his intense interest in the Department, and his sympathy with and understanding of all phases of the work, made him an invaluable member of the Council. He thoroughly enjoyed it all; he liked the fresh atmosphere, the opportunity of forming new friendships and renewing old ones, the feeling that he was useful and appreciated. The Department was fortunate indeed, in its formative years, to be able to command the services of one who was perhaps the most informed scientific man actively engaged in industry.

It was in the country that one got to know Threlfall best. A country squire himself by tradition and upbringing, he loved every phase of country life; one could not spend a day in the country with him without learning something fresh about Nature, and something, too, of the essential kindliness of the man. He was never happier than when by his beloved River Vyrnwy in North Wales, a long stretch of which he rented for fishing for more than twenty years. He liked to have his friends there, often depriving himself of his own fishing in order to put the expert visitor on to the best parts of the river, or to instruct the beginner. Indeed he overflowed with hospitality and geniality, loading his car with delicacies for his guests until, if boys were of the party, it looked like a travelling tuck-shop. Then there were the long evenings at the Wynnstay Hotel, Llanfyllin, when, after a hearty meal, and hearty laughter at good stories, and discourses on the art of fishing, he would sometimes talk of days gone by: of school days at Clifton and how he shared a study with Douglas Haig; of his classical education, which he thought was overdone ("I could never understand why so much importance is attached to the opinions of men who had access to so little information"); of early days with 'J. J.' at the Cavendish, and how he inoculated him with a lifelong passion for Rugby football; of his life in Australia as a youthful professor, and how he spotted Rutherford as a 'winner' within ten minutes of his entering his laboratory at Sydney on his way from New Zealand to Cambridge with an 1851 Exhibition; of Robert Louis Stevenson, who shut his bedroom windows in the

hottest month at Sydney because it was so cold compared with Samoa; of Ludwig Mond, Kelvin, Rayleigh, and a host of others; with sometimes a sigh for vanished youth—his strength was a by-word at Cambridge in his day—but always a sturdy interest in life and work. A great man, the staunchest of friends, and a most lovable character.

H. T. T.

Prof. K. Suyehiro

Prof. Kyoji Suyehiro, director of the Earthquake Research Institute, Japan, died after a brief illness on April 9 (*Bull. Earthq. Res. Inst.*, **10**, v, 1932). Suyehiro was born in Tokyo on Jan. 24, 1877, the second son of Mr. S. Suyehiro, a well-known writer and politician. In 1900 he finished his course on naval construction in the Imperial University of Tokyo, and two years later became assistant professor on that subject. In 1909 he travelled abroad, and on his return in 1911 was appointed titular professor in the University. In 1925 he founded the Earthquake Research Institute, of which he served as director until his death. He was also president of the Society of Naval Construction and of the Physico-Mathematical Society. Much of Suyehiro's work is connected with naval construction. In seismology, he studied and measured the oscillations of buildings, and last year he visited the United States in order to attend conferences on the influence of earthquake shocks on buildings. Not the least useful part of his work lay in the guidance and encouragement of his numerous students.

News and Views

Prof. J. E. Lennard-Jones

The first occupant of the recently created John Humphrey Plummer chair of inorganic chemistry at Cambridge will be Prof. J. E. Lennard-Jones, of the University of Bristol. During his tenure of office at Bristol, first as reader in theoretical physics and later as professor and first holder of the Melville Wills chair in this subject in the Wills Physical Laboratory, Prof. Lennard-Jones has carried out a number of important investigations in the field of molecular physics. His earlier work on the forces between atoms in gases, and later, in crystals, was of fundamental importance and led him to the study of cohesion and other surface phenomena such as adsorption, as well as the structure of molecules in general. The results that he obtained attracted general attention and were particularly appreciated by physical chemists and metallurgists, both in Great Britain and abroad, because of the light that was thereby thrown upon some of the most fundamental problems of modern chemistry. The post to which Prof. Lennard-Jones has now been appointed affords special opportunities for the continuation of this co-operation between theoretical physicists and chemists, which in the past has been far less marked in Great Britain than on the Continent. On the other hand, the University of Bristol, with which he has been associated for seven years, suffers the loss of an original thinker, a brilliant expositor, and a capable administrator.

International Congress of Prehistoric and Protohistoric Sciences

The first International Congress of Prehistoric and Protohistoric Sciences, held in London on Aug. 1–6, must be counted completely successful. Foreign visitors seemed thoroughly satisfied with the arrangements for their instruction and entertainment; while the whole-hearted manner in which British archæologists supported the meeting both by their attendance and by the contribution of papers, as well as the ready enthusiasm with which they entered into the discussion of mutually interesting problems with their colleagues from other countries, ensured that this new undertaking should at least be launched under favourable auspices. The number attending the Congress was approximately six hundred, and just under two hundred papers were accepted for reading—too large a number perhaps; but the careful arrangement of subdivisions and the classification of papers reduced the inconvenience of clashing to a minimum. A high standard was maintained; and a number of papers, to some of which we hope to refer at a later date, dealt with topics of great importance. Some communications from foreign visitors were perhaps of a more highly technical character than those to which a British audience is accustomed; but this was to be expected with a membership of which a considerable proportion was professional. It is only in Great Britain that that interesting and valued survival, the amateur as archæologist, flourishes to any appreciable extent.

Sensation was not lacking at the Congress, as may be gathered from the accounts, which were somewhat exaggerated, in the daily Press. Among these was the announcement, a little premature, of the deposition of Oldoway man from his pride of place as the oldest specimen of *Homo sapiens*—for which the evidence appears elsewhere in our columns (see p. 237)—and the new conclusions relating to the Lloyd's skull, which Prof. Elliot Smith announced in his review of recent discoveries in human palæontology. Even his opening remarks gave his audience a surprise, for he stated that he had been asked by Dr. E. Dubois to announce his recent discovery of three femora of *Pithecanthropus* among the material he brought from Java in 1900, which support the classification of that type as a true genus, and by their form justify the epithet *erectus*. Prof. Elliot Smith, however, pointed to the possibility of a connexion with Ngandong man, to the recent discovery of which he also referred. In regard to the Lloyd's skull, he made the remarkable announcement that this is now to be regarded as by far the oldest known representative of *Homo sapiens*. Dr. Matthew Young has made a statistical comparison

of the fragment with the skulls of a number of medieval women from Glasgow, which also show the abnormality of a supra-occipital bone such as is present in the Lloyd's skull, and has found it in all essentials of the modern type; while Miss Garrod, after a re-examination of the stratigraphical and archæological evidence, has arrived at the conclusion that it is Mousterian, or even earlier.

Ancient Cave-Dwellers in Texas

FROM the point of view of the student of the ancient cultures of North America, the investigations which are now being carried out by the Smithsonian Institution of Washington in the south-western United States are at present by far the most interesting in American archæology. It would seem well within the bounds of probability that the Basket-Maker–Pueblo sequence will be amply documented at no very distant date, if researches continue to be prosecuted with the vigour and success of the last few years. The Smithsonian Institution now announces the successful result of an expedition, of which Mr. Frank M. Setzler was in charge, to Texas. This expedition has just returned to Washington after exploring seven caves spread over a wide area in the Big Band and Chisos mountain region of south-eastern Texas. A considerable amount of cultural material was found, which points to the caves having been the permanent habitation of a very primitive race of Indian, unfortunately without any indication of its affinities. It is possible that it may be related to the Basket-Makers of Arizona and New Mexico, who were partially cave-dwellers; but there are differences in culture, especially in the basketry and arrow-shaft techniques. The food of the Texan cave-dwellers appears to have been principally cactus, of which they chewed the pulp and spat out the fibre. This was supplemented by the flesh of bear, deer, rabbits, and birds of all kinds. Their clothing and baskets were woven of cactus fibre. The most remarkable custom, however, was that of burying the body of a small child, never more than two years old, in the exact centre of the caves which were their dwellings, a characteristic they shared with some of the ancient Mayas.

Research Management and Budgeting

To a symposium on the management of research, appearing in recent issues of *Industrial and Engineering Chemistry*, W. A. Hamor and G. D. Beal contribute a paper on the control of research expense (April 1932, p. 427). The recognition of the importance of planning and control in management, which has become widespread during the last ten years, has led to the administration of research being placed on a much more accurate basis. The progress in the control of research expenses made possible by systematic planning and budgeting has been to the joint advantage of management, technology, and science in that due attention can be given, in planning research, to the probability of the solution of a problem at a cost commensurate with its value. All research expense cannot, of course, be reduced to a method of accounting, but positive savings which can be classified should be accounted as such and duly credited against the improvement in process efficiency, reduction or disposal of wastes, patents, etc., the remaining research expense concerned with the maintenance of quality through control, improved, or novel products being charged off to product and market improvements.

AN accounting system will guard against the numerous uneconomical practices and wastes that can easily creep in and fritter away resources of time or material. Budgetary control is quite possible in spite of being based on estimates because it is not a substitute for management; and when reasonably close estimates have been prepared, the expenditure of the sum to the most advantage will largely depend upon the director. The methods of control adopted, while sufficiently elastic, should enable time and materials to be costed up against the laboratory investigation on which they have been expended, whether improvement of existing processes or products or the discovery of new products or processes, other expenses such as cleaning, light, heat, power, etc., being charged on a *pro rata* basis. In such budgeting and control, the question of salaries and increases of salary and travelling allowances will be considered from a broad point of view, calculated to encourage the development of scientific enthusiasm and the stimulus of contact with other professional workers at scientific meetings.

Volcanic Steam for Power Generation

ON July 22, Prince Ginori Conti gave a lecture to the International Union of Power Producers at the hall of the French Institution of Civil Engineers. The possibility of utilising the heat energy in the interior of the earth has frequently been considered by engineers, but in practice it is necessary that the heat be localised near the surface of the earth if this is to be done on a commercial basis. In Tuscany, not far from Florence, Prince Conti has an installation in a volcanic region where low pressure steam issues from cracks in the ground. A system of boring has recently been adopted to obtain the vapour at a higher pressure and increase its volume. The vapour is charged with sulphur, borax, and carbon dioxide. For many years borax has been obtained from the ground round the vent-holes, on which much of the vapour was condensed. Owing to the corrosive nature of the vapour, it was very difficult to design suitable apparatus. At one of the stations the steam generated in the boilers is used to supply suitable low pressure turbines. At another station high pressure steam is employed. Aluminium is used for the conductors in the stations, as copper corroded much too quickly. The total capacity exceeds 12,000 kilowatts, but there are several difficulties still to be overcome. The problem is simpler at Sonoma, in California, where the unwanted gases are easily eliminated from the vapour. The hot vapour is found at depths of between 100 and 200 yards. At present this station supplies 11,000 kw. to the surrounding district. According to *World Power* of July, there is a large quantity of power available in the volcanic regions of Bolivia.

B.D.H. Products

WE have received from the British Drug Houses, Ltd., London, N.1., copies of their catalogues of fine chemical products and micro-analytical reagents and organic reagents for 'spot' tests. The standards of purity adopted for chemical products are described in the B.D.H. book of A. R. Standards and those for pharmaceutical preparations in the book of P.P.P. (pure for pharmaceutical purposes) Standards. In the case of the latter, other considerations as well as purity must be taken into account, for example, ease of weighing for dispensing, and ready solubility with the formation of a clear bright solution. Low limits for lead and arsenic are defined, being in the case of most substances only a few parts (1 to 5) in a million. Other metallic impurities may not be physiologically harmful, but may cause precipitation, coloration, or some other reaction and so create difficulties in dispensing: their limits must therefore be fixed as well. The catalogues of fine chemicals run to nearly 150 pages and include lists of standard reagents, indicators, microscopic stains, and dyes. The same firm has also issued recently revised editions of booklets describing their vitamin A and vitamin D preparations, avoleum, radiostol, radiostoleum, and radio-malt. Advance in our knowledge in the vitamin field has been so rapid that frequent revision of brief summaries of this work is required. The activities of the products are controlled by physiological tests and standardised in terms of the international standards wherever such standards are available.

Treatment of Leprosy

DERIVATIVES of chaulmoogra and hydnocarpus oils now have an established position in the treatment of leprosy. The active constituents are certain fatty acids, which are usually administered as their soluble sodium salts or as the ethyl esters. A mixture of esters of the acids of the chaulmoogric series with 0·5 per cent iodine has been recently recommended for the intradermal treatment of the superficial lesions of the disease: the addition of the iodine reduces the irritating properties of the ethyl esters. The intradermal method is relatively free from general and local reactions: rapid resolution of the raised macules, infiltrations, and nodules is reported when small amounts of the solution of esters and iodine are injected into the skin around them. Messrs. Burroughs, Wellcome and Co., London, have issued a solution of these esters with 0·5 per cent iodine, suitable for intradermal and intramuscular administration, under the name "Iodised Moogrol". It is recommended that 5 c.c. be given at weekly intervals: the intradermal injection should be 0·1 c.c. at each point. Intradermal administration should be combined with intramuscular, part of the dose being given by each route.

Oceanography of the Baffin Bay Region

THE United States Coastguard in 1928 sent an expedition in the ship *Marion* into Davis Strait and Baffin Bay to carry out scientific investigations connected with the international ice patrol, particularly in regard to ocean currents, ocean depths, and ice conditions in the region north of that usually covered by the ice-patrol vessels each spring and summer. The ship followed a zigzag track northward from the Gulf of St. Lawrence to and fro between Labrador, Greenland, and Baffin Island. An account of the expedition and its results are being issued as the U.S. Coastguard *Bulletin* 19, published in three parts. Part 1 (Washington: Government Printing Office, 1932; pp. 81, 50 c.), just issued, contains a fascinating narrative of the cruise, illustrated by 38 well reproduced photographs; it gives also a report and discussion of the sounding work accomplished (by the echo method), and a description and discussion of the bottom samples obtained at some of the places where wire soundings were made. Part 3, published last year, dealt with the arctic ice and its drift into the North Atlantic Ocean, while Part 2, to be issued shortly, will report on the oceanography of Baffin Bay and Davis Strait.

Physiography of the Nile Basin

IN recent years a great deal of information on the Nile basin, the regime of the Nile, and the control of its floods has been collected by the Irrigation and Physical Department of the Egyptian Ministry of Public Works. This has resulted in a series of valuable papers, including the volumes on the Lake Plateau Basin of the Nile published in 1925 and 1927. This work continues and is being correlated with meteorological and hydrographical work in Uganda and other parts of East Africa. The Irrigation and Physical Department has now published the first of a new series of volumes on the Nile ("The Nile Basin." H. E. Hurst and P. Phillips. Physical Dept. Paper 26. Cairo, 1931. P.T.50). It deals particularly with the topography of the Lake Plateau, Bahr-el-Jebal, Bahr-el-Ghazel, Sobat basin, and White Nile basin, with a full account of the meteorology of the whole basin. A feature of the book is the large number of coloured folding maps, including maps of the whole basin on a scale of 1 to 2,000,000. There are also numerous climatic maps and many excellent illustrations. The volume concludes with a long bibliography of the Nile.

Plains of Southern Alberta

A REGION embracing such well-known names to the petroleum technologist as Calgary, Turner Valley, Bow Island, and Medicine Hat, will always preserve a certain freshness, but more because of its oil and gas industry than on account of any special geological merit. Yet the Alberta Society of Petroleum Geologists has made much lately of its stratigraphy and palæontology, and publications concerning these aspects of research have not been by any means restricted. As is often the case where a sense of vastness seems to engulf human effort, so in the Southern Plains has much of the significance of disconnected work been lost to the wider fraternity of geologists. The Donaldson Bogart Dowling Memorial Symposium on this stratigraphy (Tulsa, Oklahoma: Amer. Assoc. of Pet. Geol.; London: T. Murby and Co. 3 dollars) is not only a happy thought to the memory of a

man who probably knew his "Plains" better than any other, but also a genuine effort at co-ordination and presentation of the results of carefully focused investigations. It might, however, have been substantially improved by a more complete summary of the present position of our knowledge, by way of introduction to the several contributions, than is attempted in the brief foreword; this, though sufficiently lucid so far as it goes, still leaves to the reader the task of fitting together the various pieces of evidence to make a pleasingly intelligent picture of the whole.

Index of Publications of the Royal Society

THE Royal Society has issued in one alphabet an author index to its *Proceedings*, Series A and B, from 1905 to 1930, and to the *Philosophical Transactions*, Series A and B, from 1901 to the same year, the entries being arranged chronologically under each heading. A previous index to the *Proceedings* was published in 1913, which covered the period from 1800 (when the series began under the title "Abstracts of Papers printed in the Philosophical Transactions") to the year 1904, so that the author index to this publication is now complete to the year 1930. The only indexes to the *Philosophical Transactions* hitherto available have been author and subject indexes down to the year 1830, but the "Catalogue of Scientific Papers", which includes papers in the *Philosophical Transactions*, may be considered to continue the indexing under authors' names down to the year 1900, whence the new volume completes it to the year 1930. So far as the author index is concerned, therefore, the indexing of the two publications is available for their entire runs. A subject index from 1800 is still lacking, except in so far as the mathematical, mechanical, and physical papers for the period 1800–1900 are concerned, since these have been included in the three published subject indexes to the "Catalogue of Scientific Papers", which covers both publications.

Science and Letters in Poland

THE principal contribution to vol. 15 of *Nauka Polska* (Polish Science), which has recently appeared, is Prof. Z. Szweykowski's account of the Institute for the Promotion of Science and Letters in Poland. This Institute, which is to-day under the patronage of Prof. I. Mościcki, the President of the Polish Republic, and himself a distinguished chemist, was founded in 1881 in difficult circumstances from the Mianowski Fund. It has had a chequered history, but the Mianowski Institute now occupies the spacious Staszic Palace, and its future is assured. The aim of this Institute is the furtherance of all branches of science in Poland. It has already published or supported financially the publication of 1200 volumes and the preparation of 200 scientific works, and has subsidised fifty scientific periodicals. In addition, it has made grants to some fifty societies, research laboratories, and museums. The same volume of *Nauka Polska* includes a comprehensive survey of the progress of science in Poland between 1800 and 1880 by Prof. F. Bujak. It constitutes a summary of the works of Polish men of science during the greater part of last century. Other articles deal with the present-day needs of applied physics, the position of the State libraries in Poland, and the scope and organisation of the Institute for Slavonic Studies.

Habits of Bats

IN the *Journal of Mammalogy* for May (p. 133) Mr. C. E. Johnson gives some notes on a family of red bats (*Lasiurus borealis borealis*) in captivity, and mentions that the old female, when let loose indoors, alighted more than once on the floor, and rose as easily as a bird. In the eighteenth century, Gilbert White alludes to a tame bat he saw, which several times confuted the vulgar opinion that bats could not rise from a flat surface, by rising with great ease from the floor; and the writer of this note has found the common yellow bat of India (*Nycticejus kuhli*) and the collared fruit-bat of Africa (*Rousettus leachi*) also quite able to take wing from the flat. These examples are worth giving because the error mentioned by White still persists, and in quarters where 'vulgar opinion' might not be supposed to be the vogue. The fact is that a bat does not voluntarily remain on the flat in the open, but may no doubt be found there unable to rise owing to some incidental disability, just as a man may be found lying helpless on a pavement for a similar reason.

Safety in Mines

THE Safety in Mines Research Board has recently issued its tenth Annual Report, which contains a good deal of matter of scientific interest. Perhaps the part that will be most widely read is Appendix No. 9, which refers to researches intended to obviate fatalities from falls of ground. It commences by a record of researches on the strength of supports, etc., carried out under the direction of Prof. S. M. Dixon, and, furthermore, contains summaries of the results obtained by the various district committees working on the subject throughout Great Britain. The body of the Report shows considerable activity on the part of the Board, and indicates how greatly the scope of the work has been extended and how much has been done to make the results accessible to mining men generally. It must, however, be admitted that the work so far has been rather of the nature of collecting scientific material which will, no doubt, be useful at some future date in increasing the safety of mining, for up to the present the results obtained are of scientific interest rather than of practical importance.

American Railway Progress

THE issue of the *Journal of the Franklin Institute* for March contains the address of Mr. W. C. Dickerson, president of the American Locomotive Company, on the progress made during the interval 1920–30. The 15 charts reproduced allow it to be readily seen. The weight on the driving wheels of the goods locomotive has increased from 245 to 247 thousand pounds, but the drawbar pull, at 28 miles an hour, from 32 to 50 thousand. For the passenger locomotive the corresponding figures are 192 to 187 and 18 to 44 thousand

pounds, at 60 miles per hour. Engine runs have been increased from 140 to 400 miles, crews being changed at intervals. As a result there are fewer locomotives in use to-day than ten years ago. Goods waggons have increased in size and decreased in number, and ordinary passenger coaches have been replaced by Pullman cars. The ton miles for goods have risen from 410 to 447×10^9, but the passenger miles have fallen from 47 to 31×10^9. Revenue increased from 6·2 to $6{\cdot}3 \times 10^9$ and operating expenses decreased from 5·8 to $4{\cdot}5 \times 10^9$ dollars. Mr. Dickerson is not satisfied that 45 per cent of the locomotives in use are more than twenty years of age. He shows that it is in the end more economical to replace old locomotives rather than to rebuild them. He considers that the diesel-electric locomotive has a wide field of usefulness.

Smoke Abatement

THE *Quarterly Journal* of the National Smoke Abatement Society, issued by the Society, 23 King Street, Manchester, among other things analyses the progress of smoke abatement as revealed by the latest Report on Atmospheric Pollution issued by the Department of Scientific and Industrial Research. This records for the average of a number of stations a decrease in 'total deposits', in tar, and sulphate averaging 16 per cent, 24 per cent, and 19 per cent respectively. While this decrease may partly be due to industrial depression, it is concluded that there has been a definite reduction of domestic smoke. Some of the figures, if correct, suggest that current ideas require revision. While the atmosphere of industrial cities seems to be improving, conditions in London get worse, and now appear to be similar to those of Hunslet—an industrial area in Leeds. Again, the suburbs of Leeds yield figures better than those of Southport. Such comparisons will suggest the need for caution in interpretation, but the figures show that conditions can be improved, and the *Journal* does a good service in emphasising this.

Food Technology

REFERENCE has previously been made in these columns to the problems of food preservation and their importance to modern civilisation. The more scientific aspects of the subject are dealt with in the reports of the Food Investigation Board and the Empire Marketing Board, and references to the extensive literature on the subject can be found in the "Index to the Literature of Food Investigation". *Food Technology* is described as a monthly review of manufacture, packing, and transport for production managers, food chemists, and engineers, and is designed to make known the work of research centres and to secure greater publicity for their achievements. The journal contains articles on different aspects of the food trade, answers to readers' inquiries, and notes on recent patents, amongst other features. It appears that it should fulfil its object of keeping those engaged in modern food factories in touch with research work on the treatment of food, as well as with the necessary auxiliary trades. It is edited by Dr. H. D. Law, 153 Stratford High Street, London, E.15; price 12*s.* a year.

Best Books in 1930

UNDER the title "Best Books of 1930" a selected list of books published during that year has recently been issued by Mr. Alex. J. Philip, "Lodgewood", Gravesend, and Messrs. Simpkin Marshall, Ltd., London, E.C.4. The list is classified on the Dewey Decimal System and has been selected with the help of many authorities, institutions, and societies. The main headings of the classification include general, philosophy, metaphysics, religion, sociology, philology, science, arts, literature, and history, and these are subdivided into their various groups. About 2500 "Best Books" are thus classified for the year 1930. Such a list should prove useful as a work of reference, and should be an asset to all lending and reference libraries, as well as to departmental and institutional libraries. Nevertheless, we venture to suggest that since the comparative value of a book is often a matter of opinion, such a selected list cannot be expected to be anything other than a tentative guide to choice.

Announcements

THE Third International Congress of Cytology will be held in Cambridge at the end of August 1933. Further particulars will be published in due course.

MR. I. W. M. ARMSTRONG-BLACK has been appointed assistant agricultural chemist, Nyasaland (Colonial Agricultural Service).

A SHORT training course for curators and assistants has been arranged by the Museums Association to be held at Manchester on Sept. 27–30. The course will be devoted to the study of the technique and administration of science and art museums and galleries, and will include visits to the Manchester Museum at the University, the Manchester City Art Gallery and branches, the Whitworth Art Gallery, and the Royal Museum and Art Gallery, Salford. No fees will be charged for attendance. Applications for grants towards students' expenses in attending the course will be considered by the Committee and should be addressed to the Secretary, The Museums Association Short Training Course, Public Museum, Bootle.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant agricultural chemist in the Department of Agriculture and Horticulture at the University of Bristol—Agricultural Advisory Office, 22 Berkeley Square, Bristol (Aug. 20). A lecturer in mechanical engineering at the Municipal Technical College, Hull—The Director of Education, Education Offices, Guildhall, Hull (Aug. 20). A principal of the Lester Technical School and Institute, Shanghai—The Secretary, Association of Principals of Technical Institutions, Chelsea Polytechnic, Manresa Road, S.W.3 (Sept. 1). An attendant for the Departments of Botany and Zoology at the North of Scotland College of Agriculture—The Secretary, 41½ Union Street, Aberdeen. An assistant tobacco chemist in the Chemical Laboratories of the Ministry of Finance, Egypt—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, London, S.W.1.

Letters to the Editor

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

Artificial Disintegration by Neutrons

FOLLOWING up the experiments already reported,[1] I have recently taken 1490 pairs of photographs of the tracks produced in an expansion chamber filled with oxygen (97 per cent by volume) when a source of polonium and beryllium was placed in the centre. The conditions of experiment and the source itself were the same as in the previous work, the initial pressure of the gas being roughly atmospheric.

About sixty recoil tracks were obtained and, in addition, seven or eight examples of paired tracks, providing certain evidence of disintegration. These numbers may be compared with about a hundred recoil tracks and thirty disintegration pairs recorded in the nitrogen photographs (1740 in number). It appears, therefore, that the disintegration probability for neutron-oxygen nucleus encounters, though doubtless somewhat smaller, is yet of the same order of magnitude as that which characterises similar encounters with nitrogen nuclei. This is in itself an interesting result, for hitherto no certain evidence has been obtained for the artificial disintegration of oxygen —either by α-particles or protons.[2]

The disintegration photographs have been examined and measured by the stereo-reprojection method previously employed. It appears likely that in all cases so far observed, disintegration has occurred with capture of the incident neutron. If that be accepted, then the disintegration particle is almost certainly an α-particle. The nuclear reaction may be written

$$O^{16} + n^1 \longrightarrow C^{13} + He^4.$$

(From momentum relations alone it is practically impossible to distinguish this process from that in which the resulting nuclei are C^{12} and He^5, but for the present this latter possibility may be passed over.) In the accompanying table, E, the kinetic energy of the responsible neutron, and W, the energy absorbed in the disintegration process, are given as deduced for the eight cases observed. The energy unit employed is 10^6 electron volts.

No.	1	2	3	4	5	6	7	8
E	7·0	7·0	6·2	7·6	4·2	5–7	4–7	2·2
W	2·2	4·3	3·5	5·2	1·7	1·0	2·5	1·2

Numbers 1 to 4 may be regarded as satisfactory, with a probable error of $0{\cdot}5$–$0{\cdot}7 \times 10^6$ e.v., numbers 5 to 7 carry somewhat less weight, and number 8 is rather doubtful.

The results as a whole, however, show that the capture disintegration in question takes place with the absorption of energy, the amount absorbed being different on different occasions. This probably means that in some cases the nucleus C^{13} is left temporarily in an excited state, afterwards emitting a quantum of γ-radiation in its return to the normal. Now, this nucleus is also produced in the artificial disintegration of boron by α-particles, and the existence of proton groups having an energy separation of 3×10^6 e.v. and of the accompanying γ-rays are established facts.[3] Some such energy difference as this is consistent with the values of W given above.

The neutron energies given in the table are in general somewhat greater than those deduced in most of the cases of capture disintegration in nitrogen. The energies deduced from recoil track measurements, on the other hand, were in complete accord with the nitrogen results. It is possible that the smaller disintegration yield in oxygen is the necessary consequence of the greater mean energy required for disintegration; moreover, the present results confirm the suggestion that a small fraction of the radiation from beryllium is of higher energy than was previously believed to be the case. This suggestion was first made by Curie, Joliot, and Savel from other considerations.[4] We may conclude, in fact, that the upper limit of energy of $6{\cdot}4 \times 10^6$ e.v. previously obtained is appreciably too low.

The experiments here described are being continued with oxygen at greater dilution, in the hope of increasing the accuracy of measurement and further investigating the disintegration phenomena which occur.

N. FEATHER.

Cavendish Laboratory,
Cambridge, July 28.

[1] *Proc. Roy. Soc.*, June 1932.
[2] Cockcroft and Walton, *Proc. Roy. Soc.*, A, **137**, 229; 1932.
[3] Chadwick, Constable, and Pollard, *Proc. Roy. Soc.*, A, **130**, 463; 1931. Becker and Bothe, *Z. Phys.*, **76**, 421; 1932.
[4] *C.R.*, **194**, 2208; 1932.

The Oldoway Human Skeleton

DR. L. S. B. LEAKEY'S claim that the Oldoway man of *Homo sapiens* type was buried in Bed 2 of his succession, before the formation of the overlying Beds 3 and 5, rests on his statement that no material from Beds 3 and 5 was found in intimate association with the skeleton in the burial, although such material is found lying on the present surface-slopes of the gorge at and near the site.[1]

On discussing the matter with Prof. D. M. S. Watson and Mr. A. T. Hopwood, I came to the conclusion that more thorough investigation of this critical evidence was desirable, especially as subsequent alteration of rock-material in the neighbourhood of the skeleton might have rendered it less easily recognisable than in its unaltered condition. I therefore suggested that the deposits of Beds 2, 3, 4, and 5, as well as the material found within the ribs of the skeleton, should be carefully re-examined. Mr. Hopwood kindly supplied typical samples of Beds 2, 3, 4, and 5 collected by him at Oldoway. The petrological investigation of the deposits was undertaken at the Imperial College by Dr. J. D. Solomon, who had formerly worked with Dr. Leakey in East Africa and was familiar with the occurrence of similar beds in the field. Dr. Solomon found that each of the deposits possessed distinctive lithological and mineralogical characters. The way now being clear for a useful examination of the grave-contents, Prof. Reck, at Mr. Hopwood's request, persuaded Prof. Th. Mollison of Munich to send us a sample of material which, he assures us, was part "of the material in which the Oldoway skeleton had been embedded". Dr. Solomon, Mr. Hopwood, and I together examined this material. It contains (*a*) pea-sized bright-red pebbles like those of Bed 3, and (*b*) chips of concretionary limestone indistinguishable from that of Bed 5 and enclosing at least one mineral (an amphibole), in relative abundance, not found in Beds 2 and 3, but present in Bed 4.

Assuming, therefore, that the provenance of the materials supplied to us is as stated (and we have no reason to doubt it), the Oldoway interment is not contemporaneous with Bed 2 containing Chellean-

Acheulean implements, but was made after the formation of the concretionary limestone ('steppe-lime') of Bed 5, that is, is post-Aurignacian.

The samples are being kept for reference in the British Museum (Natural History), South Kensington.

P. G. H. BOSWELL.

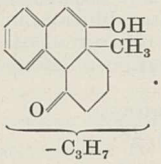
Department of Geology,
Imperial College of Science and Technology,
London, S.W.7, July 29.

[1] NATURE, **129**, 721, May 14, 1932.

Chemical Constitution of the Follicular and Testicular Hormones

Follicular Hormone

IN a paper published recently by Butenandt and his co-workers,[1] the hypothetical formula (I) was developed for the follicle hormone.



. . . . . (I)

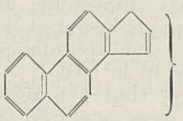
This formula attempted to correlate the X-ray measurements of J. D. Bernal,[2] which made a three-ring system for the hormone probable, with the chemical evidence at that time in hand.

A series of new experiments up to the present have not substantiated formula I, but indicate that in the hormone molecule there are only three aromatic double bonds (a benzene ring) present, that is to say, four rings altogether.

(1) Even by most energetic catalytic hydrogenation, only three double bonds are saturated in the hormone and hormone hydrate molecule. The following derivatives were prepared: Hexa-hydro-hormone-hydrate $C_{18}H_{27}-(OH)_3$ (F.P. 256°), Hexa-hydro-desoxy-hormone-hydrate $C_{18}H_{28}-(OH)_2$ (F.P. 153°), Hexa-hydro-desoxo-hormone $C_{18}H_{29}.OH$ (F.P. 105°). All three alcohols react as completely saturated substances. The hexa-hydro-hormone-hydrate, which was the product most fully investigated, is completely stable towards potassium permanganate, perbenzoic acid, and ozone. As in the case of the other alcohols, it gives no reaction with tetranitromethane.

(2) Careful *molecular refraction measurements* of the hormone hydrate, its acetate, and its methyl ether, as well as of the desoxo-follicle hormone, $C_{18}H_{23}.OH$ (F.P. 133°), give values which completely agree among themselves, and are only compatible with a hormone formula containing three isolated double bonds or one benzene ring. These results are of especial interest, because hormone formula (I) demands increments not only for four double bonds, but also a marked exaltation due to the conjugation of the enolic double bond to the benzene ring.

(3) *Attempts at dehydrogenation* with electrolytic zinc dust produced an aromatic hydrocarbon (F.P. 234°), which is perfectly stable towards potassium permanganate, and, according to the analyses and molecular weight determinations to date, has the formula either $C_{18}H_{14}$ or $C_{17}H_{14}$. This formula points to the existence of four rings (for example, three benzene rings and one five-membered ring).



. . (II)

Inasmuch as a zinc dust distillation should be applied only with the greatest caution to a structural determination, these results are given only as contributory evidence pointing to the existence of a four-ring structure in the hormone molecule.

The discrepancies of these results with the measurements of Bernal [2] and with the 'enolic nature' of one of the three aromatic double bonds [3] must be fully investigated before a decision can be reached regarding the basic skeletal system.[4] The similarity of formula II to the new formula recently suggested by Wieland and Windaus [5] for the sterols, bile acids, and pregnandiol, indicates the possibility that the hormone is closely related to these compounds.

Testicular Hormone

During the past year, four different crystalline products have been isolated from the oily fraction of human male urine which is highly active in the cock's comb test as well as on the vesicular glands of rodents.[6] These products are at present being investigated. The tentative results, which have been carried out on extremely small amounts of substance, give the following picture, the details of which must all be confirmed:

(1) Substance, $C_{18}H_{28}.(OH)_2$, F.P. 232°, isomeric with hexa-hydro-desoxy-follicle-hormone-hydrate; $\alpha = +16{\cdot}6°$; acetate F.P. 112°.

(2) Oxy-ketone, $C_{18}H_{30}O_2$ or $C_{17}H_{28}O_2$, F.P. 163°, $\alpha_D = +76°$, oxime F.P. 216°.

(3) Oxy-ketone, $C_{16}H_{26}O_2$ (?), F.P. 176·5°, $\alpha_D = +89{\cdot}9°$, acetate F.P. 158°, oxime F.P. 215°.

(4) Oxy-ketone, $C_{16}H_{26}O_2$ (?), F.P. 178°, acetate F.P. 160°.

Only the last-mentioned oxy-ketone, F.P. 178°, produces high physiological activity in the smallest doses in the capon test, and is to be considered as the hormone producing comb growth. A total of 1·1·2 γ given in four doses within two days produces a growth effect up to 30-35 per cent in the area.

The remaining crystalline products appear to be completely inactive as regards growth of the comb when they are absolutely pure, even in doses 600 times as strong (detectable activity in the larger doses might be due to traces of the hormone). The physiological activity of the crystals on the genital tract of rodents is at present being investigated.

A. BUTENANDT.

Laboratory of General Chemistry,
University of Göttingen.

[1] *Z. physiol. Chem.*, **208**, 149; 1932.
[2] *Chemistry and Industry*, **51**, No. 12; 1932.
[3] *Z. physiol. Chem.*, **208**, 153; 1932.
[4] Marrian and Haslewood (*Lancet*, Aug. 6) have just put forward evidence which also shows that only three double bonds are present in the molecule. They also suggest a four-ring structure.
[5] Several papers in press by Wieland and by Windaus.
[6] *Z. angew. Chem.*, **44**, 905; 1931.

Gill-Morrell and Barkhausen-Kurz Oscillations

MR. R. COCKBURN has shown that with one vacuum tube he obtained by means of the Barkhausen-Kurz method electromagnetic oscillations of two kinds.[1] These oscillations differed one from the other by the dependence of their wave-length on the length of the oscillating circuit connected with the tube. One of these oscillations he referred to as the *GM*-type and to the other one as the *BK*-type.

The oscillations with similar dependence of the wave-lengths on the length of oscillating circuits as described by Mr. Cockburn were obtained by us several times with different vacuum tubes. These oscillations we obtained by means of a generator of our usual construction [2] which had oscillating circuits in the plate and in the grid circuits of the tube. The oscillations obtained by us, and similar to those referred to by Mr. Cockburn as the *GM*-type, corre-

sponded to those parts of the regions of oscillations of the 'working diagrams' of the tubes[3] for which the grid potential E_g was near to the potential E_s of the upper bend of the statical I_gE_g-characteristics of the tube. The oscillations similar to those referred to by him as the BK-type corresponded to the same regions of oscillations but to potentials $E_g > E_s$. Fig. 1 confirms this, showing the dependence of the wave-lengths of the oscillations on the length of the plate and grid circuits. These latter were always in resonance with each other. The measurements were performed with a constant heating current and at constant grid potentials.

It is seen from Fig. 1 that the oscillations corresponding to $E_g = 100$ v., 120 v., and 150 v. ($> E_s$) do really differ from the oscillations corresponding to $E_g = 50$ v. ($< E_s$). The wave-lengths of the former depend on the length of the oscillating circuits rather less than the wave-lengths of the latter. In spite of this difference, it is impossible to refer to one of these oscillations as the BK-type and to the other as the GM-type.

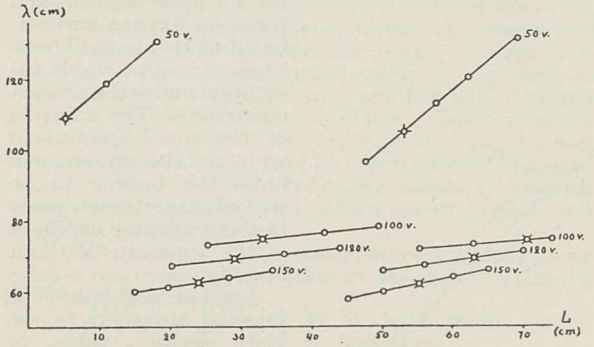


FIG. 1.—The dependence of the wave-lengths λ on the length L of the oscillating circuits; ¤ the observations corresponding to the maximum of the energy of the oscillations.

With full confidence, all of them could be referred to as one and the same type of GM-oscillations. The greater dependence of the wave-lengths on the length of the oscillating circuits at $E_g < E_s$ is due to the fact that these potentials are limiting, that is, further decrease of E_g causes a cessation of the oscillations. Because of this, the oscillating 'regime' at $E_g < E_s$ is less stable than at $E_g > E_s$, and all external factors, including the variation of the length of the oscillating circuits, produce a greater influence on wave-lengths.

The results of Mr. Cockburn's investigations, as it seems to us, also do not give grounds to refer to the oscillations described by him as different types. In any case, no one of these oscillations can be referred to as the BK-type, because all of these are dependent more or less on the length of the oscillating circuits. Such a dependence cannot exist in the case of BK-oscillations. Unfortunately, using Mr. Cockburn's measurements, one cannot show with confidence the cause of the difference between the two oscillations described by him. This is due to the fact that during the observations he changed simultaneously the emission current and the length of the oscillating circuits. But, as is well known, the wave-length depends on both of them. It seems to us therefore very desirable that the conditions of observations should be changed in the future in such a manner that the dependence of the wave-lengths on the emission current and on the length of the oscillating circuits may be investigated separately.

In connexion with Mr. E. C. Megaw's letter,[4] we should like to point out that in our opinion the rôle of the space charges in the process of the generation of the GM-oscillations is rather limited, at least in the modern gas-free tubes. The generation of such oscillations is defined by the fulfilment of the conditions[5]

$$T = \tau, \frac{\tau}{2}, \frac{\tau}{3}, \ldots \qquad (M)$$

where T is the natural period (fundamental or overtone) of the oscillating circuit in which the oscillations arise and τ is the time necessary for the electrons to pass from the filament to the plate and back to the filament. In the case of tubes with close mesh grid, τ is a shorter time, since in this case the electrons will go from the filament to the plate and back to the grid only.[6] The condition $T = \tau$ corresponds to the 'normal waves', and the conditions $T = \tau/2, \tau/3, \ldots$ correspond to the 'dwarf waves', that is, waves of higher orders.[7] In the case of a fulfilment of one of the conditions (M) the tubes can transmit energy into the corresponding oscillating circuit and can maintain their oscillations. The rôle of the space charges generally is to influence the time τ of the passage of the electrons. In rare cases, when the natural period of the space charges[8] will coincide with T and τ or with T and $\tau/2, \tau/3, \ldots$ the intensity of oscillations must increase considerably. The oscillations described by G. Breit, H. Hornung, and by W. H. Moore[9] must be referred to these cases.

G. POTAPENKO.
Norman Bridge Laboratory of Physics,
California Institute of Technology,
Pasadena, May 28.

[1] NATURE, **129**, 202, Feb. 6, 1932.
[2] G. Potapenko, *Z. techn. Physik*, **10**, 542-548; 1929: *Phys. Rev.*, **39**, 625-637; 1932.
[3] G. Potapenko, *Phys. Rev.*, **39**, 638-665; 1932.
[4] NATURE, **129**, 542, April 9, 1932.
[5] G. Potapenko, *Phys. Rev.*, **38**, 584; 1931.
[6] H. E. Hollmann, *Ann. Physik*, **86**, 129-188; 1928.
[7] We avoid calling the 'dwarf waves' 'harmonics' or 'overtones' for the reason that they are not such in a usual meaning of these words, because they are generated completely independently of the 'normal waves'. In several cases, for example in absence of a suitable oscillating circuit, the 'normal waves' can generally be absent, but that does not preclude the generation of the 'dwarf waves'. The 'dwarf waves' have also a different character of dependence on the heating current from the 'normal waves' (see *Phys. Rev.*, **39**, 542; 1932). Because of all this, the similarity between the conditions (M) and the series of harmonical overtones is purely superficial.
[8] Concerning the natural period of the space charges see Th. V. Ionescu, *C.R.*, **193**, 515-577; 1931; and A. Rostagni, *Atti della R. Ac. di Torino*, **16**, 123-130, 217-223, 383-395; 1931. These authors place more importance on the rôle of space charges in the process of generation than we do.
[9] G. Breit, *J. Franklin Inst.*, **197**, 335-358; 1924: H. Hornung, *Ann. Physik*, **1**, 417-456; 1929: W. H. Moore, *Canad. J. Research*, **4**, 505-516; 1931.

Heats of Dissociation and the Periodic Law

LOTHAR MEYER'S curves illustrating the periodicity of the physical properties of the elements are capable of extension to the heats of dissociation of simple compounds, not merely in the same group, but also in the same period. While interpreting results obtained by the examination of the infra-red spectra of triatomic molecules, Mr. A. B. D. Cassie and myself were able to show that a direct ratio exists between the heats of dissociation of certain related molecules and the force constants for the bonds concerned.[1] Two illustrations are given in the following table:

Molecule.	$K \times 10^{-5}$ dynes/cm.	*H.D.* kcal.	*K* ratio.	*H.D.* ratio.
CO	18·8	237	—	—
$\frac{1}{2}CO_2$	14·2	182	13·2	13·1
CS	8·4	158	—	—
$\frac{1}{2}CS_2$	6·9	132	1·2	1·2

Henri, from the extrapolation of the ultra-violet band spectrum of CS, had previously obtained the value of 193 kcal. for the heat of dissociation of this molecule; since the publication of our paper, he has shown that this value represents dissociation into a

normal C atom and an excited (^1D) S atom. Similarly he has determined from his own experimental results a heat of dissociation for SO of 148 kcal. and regards this as giving normal S and O atoms. Since the heat of dissociation of the oxygen molecule is only 118 kcal., the experimental value for SO is evidently too great. We have shown that the force constant for SO_2 is $9{\cdot}6 \times 10^5$ dynes/cm., and for SO is $7{\cdot}8 \times 10^5$ dynes/cm.; since the heat of dissociation of each SO_2 bond is 248/2, the corresponding quantity for SO should, from the above, be approximately $124 \times 7{\cdot}8/9{\cdot}6 = 101$ kcal., and hence the experimental value again represents dissociation into one normal and one excited atom, possibly in this case a (^1D) O atom.

It was further observed that the force constants for the molecules CO, NO, OO were proportional to the heats of linking for these substances; the periodicity thus observed suggested the calculation from band spectra data of the heats of linking of a large number of non-polar compounds of the second and third periods of the table: many of these, such, for example, as NS, have become only very recently available. Some of the data are given in Figs. 1 and 2, and it will be seen that the values lie on regular curves which are very nearly straight lines, the heat of formation of the inactive gas compound being taken as zero. If SO is taken either as the sulphide of oxygen in the second period or as the oxide of sulphur in the third period, it will be seen that the previously accepted value lies high above the curve in each case, interpolation giving the calculated value of *c.* 100 kcal. The method has been extended to the diatomic molecules of the elements and the nitrogen and carbon compounds; the regular nature of the curve holds in all cases. A number of interesting consequences arise and will be expounded in a subsequent paper: it will suffice to mention two of them, taken from the nitrides of the second period: (1) the experimental value for CN lies some 1·6 volts below the curve, suggesting decomposition into normal N and C atoms, C (^3P) being below C (^5S) by this amount; and (2) half the heat of formation of N_2O lies midway between NN and ON, confirming the structure NNO and not NON for this substance.

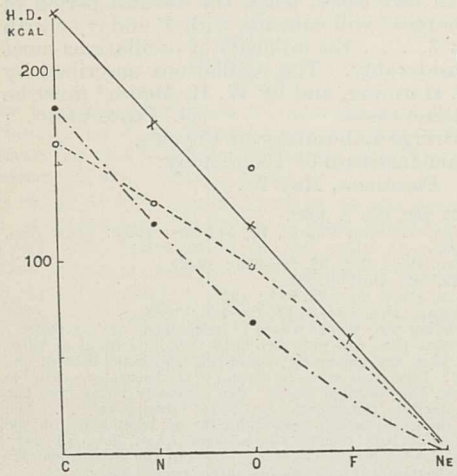


FIG. 1.—Heats of decomposition in second period. -x- oxide, -o- sulphide, —●— dioxides/2.

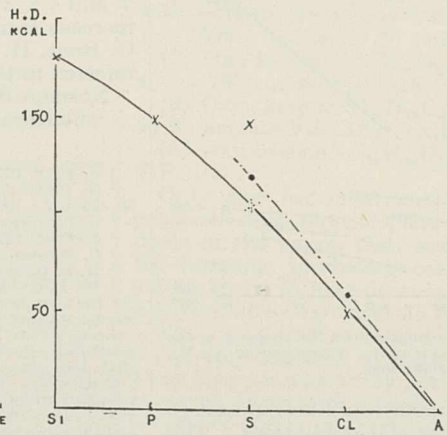


Fig. 2.—Heats of decomposition in third period. —x— oxides, —●— dioxides/2.

C. R. BAILEY.

The Sir William Ramsay Laboratories of Inorganic and Physical Chemistry, University College, London, July 1.

[1] *Proc. Roy. Soc.*, A, **132**, 236; 1931.

Micro-Analysis of Gases

KROGH'S micro-analysis method as originally described,[1] for small bubbles of from 50 to 100 cubic millimetres and containing oxygen, carbon dioxide, and nitrogen, is limited to bubbles which have been in contact with a fluid, because the lower cup of the micro-apparatus must be filled with some of the same fluid with which the gas bubble has been in equilibrium, otherwise the gas bubble will lose some gas, particularly carbon dioxide, which is so soluble in most fluids.

I have been attempting to modify this method so that gas tensions in any small bubble from an animal's tissues may be estimated, that is, also in bubbles which have not been in contact with excess of fluid. The problem was investigated using a freshly prepared solution of 80 per cent glycerol and 20 per cent distilled water to fill the cup, capillary, etc., of the micro-apparatus. The coefficient of solubility of nitrogen in glycerol is too low for measurement, and those for oxygen and carbon dioxide are too low to cause any appreciable absorption under the present conditions. The addition of the small amount of water to the glycerol enables the bubble to be moved up and down easily in the graduated capillary of the apparatus without breaking up.

A small gas bubble is injected anywhere in the body cavities, tubes, or tissues and after some hours' interval it is withdrawn by means of a standard 1 c.c. syringe fitted with a very fine needle, the dead-space of which is filled with the above glycerol solution. The bubble is then carefully transferred to the cup of the apparatus, which has been previously filled with the same solution. The remainder of the technique for analysis of carbon dioxide and oxygen is as described by Krogh. I have been able to analyse mixtures, of from 0 to 15 per cent carbon dioxide and from 0 to 20 per cent oxygen with the remainder nitrogen, in gas bubbles (50-100 c.mm.) using the micro-apparatus in this way; the gas tensions obtained agree, within 2-3 mm. Hg, with those obtained from analyses of 10 c.c. of gas in the ordinary Haldane analyser. Carbon dioxide and oxygen tensions in the bladder and uterus have been estimated with the above accuracy using this modification of the micro-method.

I have diminished the risk of entry of small bubbles of outside air into the lower cup during the manipulations by attaching a glass tube 8 cm. in length to its lower end by means of a short piece of rubber tubing. The lower end of the glass tube is bent slightly, and its opening is so cut that the under edge projects beyond the upper; the whole tube is kept filled with the same fluids as used for the lower cup.

J. ARGYLL CAMPBELL.

National Institute for Medical Research, Hampstead, N.W.3, July 15.

[1] *Skand. Arch. f. Physiol.*, **20**, 279; 1908.

Raman Spectrum and Molecular Structure of Ozone

AN attempt has been made to find the Raman spectrum of ozone, using a 30 per cent solution of ozone in liquid oxygen and a mercury arc as the exciting light. The solution is a dark purple in colour and absorbs the mercury line at 4358 A. quite considerably. The mercury line at 4046 A., however, is scattered fairly strongly, but it has no strong Raman companions. There is an extremely weak doublet corresponding to a mean frequency shift of 1280 cm.$^{-1}$, but no other Raman lines could be observed even with exposures lasting 80 hours. The spectrograph used was not particularly fast, but photographs of the weak oxygen line at 1550 cm.$^{-1}$ from 4046 A. could be obtained in 10 hours.

The conventional representation of the ozone molecule is an arrangement of the oxygen atoms at the corners of an equilateral triangle. More recently a straight line model has been proposed.[1] The weakness of the Raman spectrum is important as evidence against any simple symmetrical structure of the ozone molecule. On Placzek's theory,[2] either of these models would give rise to at least one strong Raman line, since each has a symmetrical mode of vibration in which the polarisability varies sharply with changes in the associated normal co-ordinate. The conclusion that the form of the ozone molecule is triangular but not equilateral is supported by the results of investigations of the infra-red absorption bands of gaseous ozone under high dispersion which one of us (S. L. G.) is carrying on at present.

A full account of the latter investigations, along with a discussion of the form of the ozone molecule, will be published later.

G. B. B. M. SUTHERLAND.
S. L. GERHARD.

University of Michigan,
Ann Arbor,
June 29.

[1] Jakowleva and Kondratjew, *Phys. Rev.*, **39**, 533; 1932.
[2] Placzek, *Z. Physik*, **70**, 84; 1931.

Post-Dissociation Radiation from Sulphur Trioxide

ACCORDING to Franck's theory of photodissociation of the halogens, the effect of light absorption is to split I_2 into a normal iodine ($^2P_{\frac{3}{2}}$) and an excited iodine ($^2P_{\frac{1}{2}}$). No direct proof has yet been forthcoming that the metastable atoms are actually produced in the reaction.

A direct proof of the production of the $^2P_{\frac{1}{2}}$-atoms may be attempted in various ways. The most convincing proof will be afforded if it can be shown that the illuminated I_2 vapour gives out radiations of frequency $\nu = {}^2P_{\frac{3}{2}} - {}^2P_{\frac{1}{2}}$ at very low pressures. The low pressure would avoid collisions of the second kind, and thus the energy of excitation would be available again as a radiation. The experiment with I_2 would be difficult, as the line $\nu = {}^2P_{\frac{3}{2}} - {}^2P_{\frac{1}{2}}$ would be in the far infra-red. But there is promise of better success with photodissociation of SO_3.

It was recently postulated by me[1] that SO_3, on absorption of light of wave-length less than λ2300 A., decomposes into SO_2 and O ($^1D_2$). If the assumptions are correct, it would mean that by irradiating SO_3 with light of wave-length below λ2300, we would obtain oxygen atoms in the $^1D_2$-state. If we prevent collisions of the second kind by sufficiently lowering the pressure, the forbidden transition line of the oxygen atom O ($^3P_1 - {}^1D_2$), corresponding to the wave-length λ6364, would be expected from the SO_3 gas.[2]

After repeated trials a weak line has been obtained by illuminating for 50 hours a 100 cm. long column of SO_3 gas at a pressure of less than 1 mm. The illuminating source was the condensed spark lines of cadmium below λ2300. The wave-length of the observed line is the same as that of the O ($^3P_1 - {}^1D_2$) line, that is, λ6364.

ARUN. K. DUTTA.

Physics Department,
University of Allahabad, July 2.

[1] Dutta, "On the Absorption Spectrum of SO_3, etc.", communicated to *Proc. Roy. Soc.*
[2] Paschen, *Z. Physik*, **65**, 1; 1930.

A New Photoelectric Phenomenon

METAL films are subjected to the passage of electric current and exposed to light, which is interrupted with acoustic frequency by a rotating disc with holes. A thermionic amplifier permits a sound of the same frequency to be heard in a telephone when silver, gold, platinum, and tin are tested: aluminium and zinc give no effect.

A copper wheel with sinusoidal border, carrying as many teeth as the holes of the disc, turns jointly with it. Against the border of the wheel, a jet of mercury is directed, the length of which pulsates with the same period as the light. The jet is included in the circuit of the metal film. By regulating the position of the jet and the resistances of the circuit, the sound at the telephone may be extinguished. It may, therefore, be concluded that:

1. The metals examined *increase* in resistance under action of the light. For silver, the maximum effect seems to be obtained in the ultra-violet region; for the other elements, such a maximum is displaced towards the visible spectrum and perhaps the infra-red.

2. The increase in resistance is of the order of 1/10,000 to 1/100,000 of the resistance of the metal.

The same experiments have been repeated by plunging the metal films into a current of water, but no sensible variation in the intensity of the effect has been noted. The effect appears, therefore, to result from direct action of light on electrical conductivity.

Q. MAJORANA.

Institute of Physics,
University of Bologna,
July 9.

Origin of the Coronal Lines

IN a recent communication in these columns, Frerichs[1] has criticised de Bruin's classification of the strongest visible lines of the corona. In the same issue of NATURE, Dingle[2] also has criticised the identification of these lines. In each of these communications the authors failed to direct attention to another very strong objection to de Bruin's conclusion that the green auroral line and the green coronal line originate on the same metastable level of oxygen, the $^1S_0$ level. Since no trace of the green auroral line has ever been observed in the corona, and as no one has ever observed the green coronal line in either the aurora or in laboratory discharges in which the green auroral line was very intense, it is extremely difficult to see how the two lines can originate on the same initial state. If the two lines did originate on the same initial state, their relative intensities should be the same in both the aurora and the corona spectra. One might be able to account for a slight difference in relative intensities by postulating reabsorption of one of the lines, but it seems impossible to explain the profound difference which would follow from de Bruin's classification of the green coronal line.

JOSEPH KAPLAN.

University of California at Los Angeles,
July 2.

[1] NATURE, **129**, 901; 1932.
[2] NATURE, **129**, 902; 1932.

Sex-Differences in Crossing-over and Chiasma-Frequency in the Mouse

HALDANE (1922) stated the law, based on the observations of many researchers, that if crossing-over is reduced or entirely suppressed, this occurs in the heterozygous sex. Reduction of crossing-over in the heterogametic sex is found in the Tettigidæ, *Gammarus*, *Mus musculus*, and *Mus norvegicus*, and complete suppression of crossing-over in the male of the Drosophilæ and in the heterogametic female of *Bombyx*.

Recent investigations on meiosis in diploids and polyploids have dispelled many difficulties and have increased our understanding of genetical segregation. Darlington (1930), adopting Janssens' (1924) partial chiasmatype hypothesis, states that "a chiasma is constituted by genetical crossing over between two of the four chromatids taking part in it, and association

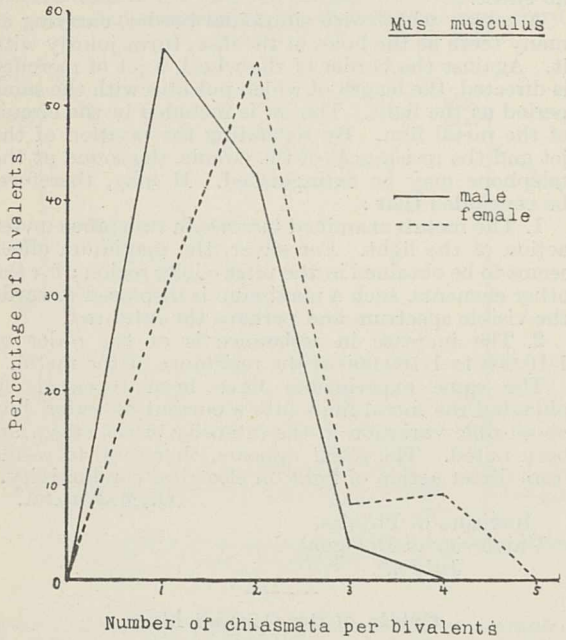


FIG. 1.—Graph illustrating the chiasma frequency of male and female *Mus musculus* at metaphase.

at diplotene is between chromatids derived from the same chromosome". Here Darlington is in direct opposition to the 'classical' theory held by Wenrich (1917), Wilson (1925), Sax (1930) *et alii*. Darlington's view assumes a close parallelism between chiasma formation and crossing-over. One important theoretical objection to Darlington's hypothesis, as he himself stated (1931), was that "the difference in crossing-over between the sexes has not been paralleled by the direct observation of differences in chiasma formation".

It was thought desirable to examine chiasma frequency in male and female mice, in view of the fact that it has been shown that linkage between the albino and pink-eye factors in *Mus* is closer in the heterogametic male, that is, the crossing-over value is lower in this sex than in the female. From these genetical data a difference in the chiasma frequency in the two sexes would be predicted on the chiasma-type hypothesis, whereas if any correlation between differences in chiasma frequencies and crossing-over values is to be expected on the alternative hypothesis that crossing-over is caused by the breaking of chiasma, the sex with increased crossing-over should have a reduced chiasma frequency.

Observations on chromosome behaviour during meiosis in *Mus* have revealed differences in the chiasma frequencies and terminalisation coefficients in the two sexes. In the female at metaphase the chiasma frequency per bivalent is 1·9 and terminalisation coefficient 0·43, whereas in the male it is 1·4 and 0·67. Since the animals examined had the same genetic constitution, the differences in chiasma frequency could not be due to genic dissimilarity.

CROSSING-OVER VALUES BETWEEN ALBINISM AND PINK-EYE IN *Mus musculus*

(Castle and Wachter, 1924)

	Gametes tested.	Cross-over Gametes.	Crossing-over Value.	Authors.
Female	2789	444	15·92 ± 0·9	Dunn, 1920
Male .	3683	503	13·65 ± 0·78	,,
Female	556	106	19·06 ± 2·02	Castle and Wachter, 1924
Male .	3374	462	13·89 ± 0·82	,,
Total Female	3345	550	16·44 ± 0·82	
Male .	7057	965	13·77 ± 0·57	

CHIASMA FREQUENCY AND TERMINALISATION COEFFICIENTS DURING FIRST METAPHASE IN *Mus musculus*

	Total No. of Bivalents.	Total No. of Chiasm.	Total No. of Term. Chiasm.	Mean Chiasm. Frequency.	Term. Coeff.
Female	100	197	86	1·9	0·43
Male .	100	147	100	1·4	0·67

These observations strongly support the partial chiasmatype hypothesis of crossing-over.

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University of Edinburgh.

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Measurement of the Electricity liberated during Downgrade Reactions of Organic Compounds

MR. WOLFENDEN'S letter on this subject [1] has, I regret, only recently come to my notice. I had thought that our correspondence had cleared up the points at issue. I would point out that the liberation of electricity by the action of micro-organisms during the downgrade reactions of organic compounds, as set forth in my paper,[2] has been confirmed by Elema,[3] Gillespie,[4] Hewitt,[5] and others, and my results are quoted as the starting-point for the investigations of oxidation-reduction potentials in biochemistry and bacteriology. In this paper it was emphasised that the electrical effects only occurred under conditions favourable to the growth of the micro-organisms in question.

It is well known that aqueous solutions of pure sucrose are unsuitable for the growth of yeast, and that little or no fermentation takes place when these culture media are employed. When, however, sucrose is used in Pasteur's solution, fermentation proceeds rapidly.

In my experiments I have found that sucrose and the highly refined cane sugars are unfermentable with

yeast and give no electrical response.[6, 7] On the contrary, the unrefined sugars, such as Barbadoes, give a vigorous fermentation and corresponding electrical response. It is not therefore surprising that Mr. Wolfenden's experiments conducted with pure sucrose gave negative results, and the discrepancy between us may thus be explained.

In the two sets of experimental conditions Mr. Wolfenden used pure sucrose while I used unrefined sugar, and I cannot agree that "it seems unlikely that the impurities could play a decisive part", as they evidently promote yeast-sugar fermentation and thus constitute a decisive factor in the electrical response.

M. C. POTTER.

Corley Croft,
New Milton, Hants,
July 11.

[1] Wolfenden, J. H., NATURE, **128**, 69, July 11, 1931.
[2] *Proc. Roy. Soc.*, B, **84**; 1911.
[3] Elema, B., "De bepaling van de Oxydatie-Reductiepotentiaal in Bacteriencultures en hare beteekenis voor de Stofwisseling". Delft, 1932.
[4] Gillespie, L. J., "Reduction Potentials of Bacterial Cultures and of Water-Logged Soils", *Soil Science*, **9**; 1920.
[5] Hewitt, L. F., "Oxidation-Reduction Potentials in Bacteriology and Biochemistry". Publication of the London County Council, 1930.
[6] Potter, M. C., "Measurement of the Electricity liberated during the Downgrade Reactions of Organic Compounds", NATURE, **127**, 554, April 11, 1931.
[7] Potter, M. C., "A Method of Measuring the Electricity produced during the Decomposition of Organic Compounds", *Zentralb. Bakteriologie*, Abtl. 2, Bd. 84; 1931.

Hydrolysis in Green Plants by Moonlight

IN view of the recent interesting discussion on 'Lunar Periodicity in Organisms', which has appeared in these columns,[1] some very simple experiments, carried out in South Africa in the grounds of Huguenot University College, would appear to throw some light on the subject.

On a bright moonlight evening, about 10.30 P.M., on the 9th day of the moon, that is, near the time of maximum polarisation, I noticed a very sharp shadow cast by a vine leaf on the one beneath it, the tip being very brightly illuminated. The lower leaf was picked

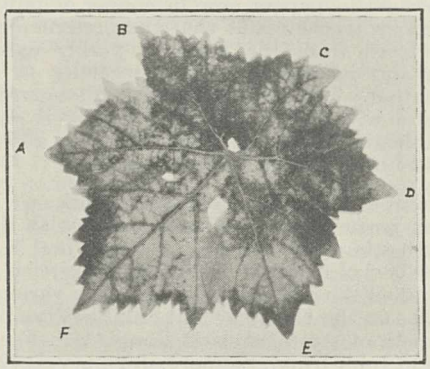

FIG. 1.—Hydrolysis of starch by exposure to moonlight of lobes *F*, *E* of a vine-leaf.

and quickly plunged into 95 per cent alcohol. On staining with iodine, a remarkable disappearance of starch was found to have occurred in the portion irradiated by the moonlight (Fig. 1, *E* and *F*), while the basal portion *ABCD* in shadow still retained its starch.

Similar results had previously been found on exposing leaves of spinach and *Tropæolum* to moonlight, a portion of the leaf having been covered by cardboard or tinfoil. The exposed part of the leaf showed distinct hydrolysis, while the starch remained in the covered part.

This did not occur at full moon, as the light is not then polarised. It will be noted that these results are in accordance with those described in a former letter,[2] and also with the effect produced by polarised skylight.[3]

ELIZABETH SIDNEY SEMMENS.

University of London Club,
late Huguenot University College,
University of South Africa.

[1] See NATURE, **130**, 23, July 2, 1932.
[2] NATURE, **111**, 49, Jan. 13, 1923.
[3] *Bot. Gaz.*, **90**, 412, Dec. 30, 1930.

Filtration of Plant Viruses

FOLLOWING upon the publication of the interesting letter from Mr. MacClement and Dr. Henderson Smith upon the above subject,[1] it may be worth while recording the results of some similar work in this direction. During the past nine months, I have been filtering two potato mosaic viruses, *X* and *Y*,[2] by means of the same collodion membrane technique developed by W. J. Elford. This work has been carried out at the Molteno Institute at Cambridge under the direction of Prof. D. Keilin, to whom I am deeply indebted, I wish also to express my thanks to Dr. W. J. Elford for much assistance willingly given.

Before attempting to filter these two potato viruses through the collodion membranes, some preliminary filtration work was carried out with Pasteur-Chamberland candles. These experiments showed that while the *X* virus was filterable through an L_3 and occasionally an L_5 candle, the virus *Y* would not pass an L_1 candle. The experiments on filtration through the collodion membranes, while admittedly preliminary, showed that *both* viruses would pass a membrane of approximate pore size 0·35μ, and that both are held back by membranes of 0·15μ. This is a parallel case to that quoted by Messrs. MacClement and Henderson Smith, where Dr. Hamilton's virus would not pass an L_3 candle but would pass a membrane of 0·30μ pore size.

The inability of the *Y* virus to pass the L_1 candle is obviously not directly connected with the porosity of the candle or the size of the virus particle, but in all probability it is due to adsorption of the virus by the candle. I have found that if the virus complex, $X + Y$, is merely passed through a kieselguhr bed in a Buchner funnel, the filtrate invariably contains a 'pure culture' of the *X* virus, the *Y* being completely adsorbed to the kieselguhr; this offers a ready means of separating out a complex of these two viruses.

KENNETH M. SMITH.

Molteno Institute and
Potato Virus Research Institute,
School of Agriculture, Cambridge,
July 25.

[1] NATURE, **130**, 129, July 23, 1932.
[2] *Proc. Roy. Soc.*, B, **109**, 251-267; 1931.

Production of Microscopic Test-Rulings

IN NATURE of Sept. 19, 1931, under "Birthdays and Research Centres", I claimed that microscopic test-rulings up to 250,000 lines per inch had been produced in my laboratory.

Lately, for various reasons, I found it necessary to make a personal investigation into this claim, and I regret that I have been unable to find any evidence that rulings beyond 120,000 lines per inch have been produced here.

THOMAS R. LYLE.

Lisbuoy, Irving Road,
Toorak, Melbourne,
June 15.

Research Items

Prehistory and Pollen Analysis.—A demonstration of the bearing on the study of prehistory, and in particular of the quaternary period, of analyses of pollen found in turbaries, is given by Prof. Georges Dubois in *L'Anthropologie*, vol. 42, Nos. 3-4. Owing in a great measure to the researches of G. Erdtman, it has been established that the relative proportion in which the pollens of forest trees occur in a turbary gives an approximation to the character of the forest in that area at the time the turbary was being formed. Numerous investigations of this nature have been made in northern, central, and eastern Europe; but information is inadequate in regard to the British Isles, Holland, Belgium, and France. Applying the principles of stratification to the turbaries, it is possible, by studying the percentages of the various pollens at different stages, to arrive, through inference as to the predominant character of the forest trees, at an idea of the climate at periods which can be equated with de Geer's scheme of chronology. Owing, however, to the distribution in time and space of climatic conditions favourable to the formation of turbaries, it is to post-Mousterian times that the method is more particularly applicable, while the most exact results refer to the epipalæolithic, neolithic, and metal ages. The results for various areas are summarised, and certain reservations made in regard to the quaternary period, though a post-glacial optimum during the neolithic is confirmed.

Indian String-Games.—Dr. James Hornell has published a number of string-figures from Gujarat and Kathiawar (*Mem. Asiatic Soc. Bengal*, vol. 11, No. 4). In his introductory remarks, he points out that this is the first successful attempt to collect 'cat's cradles' from Indian sources, and that only two had previously been published. It is surprising to find that none of the collection is of any complete animal or flowering plant, though this may be due to the fact that the great majority of informants were town-dwellers. The figures are mostly taken from the common objects of life: scissors, a saw, a mirror, a lock and key, a betel plate, handcuffs, etc. Three figures represent fruits, two a bird's feet, and one the nest of a crane. Mythological subjects are not represented. With the exception of the cosmopolitan Eurasian cat's cradle, nine of the ten games found outside India are common to India and Africa. The tenth game, the 'crane's nest', is also found in Africa, but is worked out by different moves. This common distribution emphasises the long connexion of Indians with Africa, and in particular, that of the traders and sailors of Gujarat and Kathiawar with East Africa, through a trade which goes back fully two thousand years. This is undoubtedly the main factor in this remarkable community of string-games. It is urgently necessary that ethnologists should collect the games in inland regions and among hill-tribes, to determine how far the games now described are indigenous to India and how far borrowed from African sources.

Rainfall and the Distribution of Birds.—A study of the birds of south-western Africa, made during an expedition lasting for two and a half months in 1930, leads Baron Rodolphe Meyer de Schauensee to the conclusion that the distribution of the birds in the region is governed largely by rainfall; altitude seems scarcely to play any part as a barrier (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 84, May 1932, pp. 145-202). The region investigated comprises three areas delimited by rainfall averages of 0-10 in., 10-20 in., and 20-40 in. A striking example of the relation between this factor and the presence of a geographical race occurs in the case of *Saxicola torquata*. The race *salax* was first described from the Gaboon, but de Schauensee found it near the Victoria Falls—apparently a case of discontinuous distribution, for the intermediate region of Central Angola contains the race *stonei*. The explanation is that *salax* follows the rainfall region of 20-40 in. around the area occupied by *stonei*, so that the former appears quite naturally to the north and to the south of the latter race. Other striking examples are given, and although the expedition was too short to make the observations adequate (558 birds were collected, representing 254 species and subspecies), the seeming significance of the association and the fact that it explains some otherwise inexplicable problems of distribution suggest that it well deserves further testing.

The Arachnid Order Chelonethida.—Under the foregoing title, Dr. J. C. Chamberlain has contributed an extensive memoir of 284 pp. which forms No. I. of volume 7 of the Biological Series published by the Stanford University, California (1931). The Chelonethida or pseudoscorpions, as they are more familiarly termed, are dealt with from two points of view, namely, morphological and taxonomic. The morphological section of Dr. Chamberlain's work provides the most complete account available of the exoskeletal parts, and is accompanied by a wealth of clear text-figures. There is a full discussion of range of form and structure within the order, and full use is made of the morphological data thus brought together in dealing with the taxonomy of the group. As the result of these studies, the author has completely revised and reorganised the systematics of the group. Older and inadequate systems of classification have been largely discarded and a new taxonomy given in their place. The author has found it necessary to name about fifty new genera and one hundred and fifty, or more, new species. These, however, are all described in papers now in course of publication elsewhere, with the result that the present memoir is largely freed from the mass of purely descriptive matter, and is directed more especially to general classification. The work is one which students of the Arachnida will welcome, and its utility is enhanced by a bibliography listing some 311 titles and by full indexes to both text and illustrations.

Vitamins and Fungi.—Most of the work on vitamins has been performed on higher animals with the view of growth stimulation, but Y. Tochinai and M. Terui, two members of Hokkaido Imperial University, Japan, have studied the effects of vitamin A on various fungi ("Studies on the Effects of Fat Soluble Vitamin upon the Growth of some Parasitic Fungi", *J. Fac. Agri.*, Hokkaido Imp. Univ., Sapporo, Japan, vol. 32, pt. 3, pp. 71-107; 1932). The fungi *Helminthosporium turcicum* and *H. Oryzæ* were both retarded in growth by high concentrations of vitamin A, though the latter fungus was stimulated slightly by low concentrations of the vitamin. *Gibberella Fujikuroi* reacted like *H. Oryzæ*, whilst *Colletotrichum lindemuthianum* was similar to *H. turcicum*, being inhibited by high or low concentrations of vitamin A. Olive oil was the solvent for the growth-promoting substance, so parallel cultures with the oil alone were inoculated with the fungi in order to be sure that the observed effects were due to the vitamin. Whilst *H. turcicum* and *G. Fujikuroi* were indifferent to olive oil, the other two fungi were stimulated by it, though not sufficiently to mask the effects of the vitamin A.

The Permian Yellow Sands.—Dr. M. B. Hodge has made a detailed investigation of the Yellow Sands of north-east England (*Proc. Univ. Durham Phil. Soc.*, 8 (5), 410-458; 1932). Elutriation shows that there are two dominant grades, one between 0·05 mm. and 0·15 mm., the other between 0·6 mm. and 0·8 mm. This is taken to indicate æolian transportation of the grains. The heavy minerals agree in species and type with those of the Scottish Carboniferous rocks. The quartz grains are frosted and the larger ones well rounded. The inclusions indicate a dual granitic and metamorphic source. It is concluded that the Yellow Sands were mainly a deposit of sand on the shore of the Permian sea, the material being derived partly from Carboniferous sandstones near by and partly from a crystalline area to the north. While the Sands were being laid down on the shores and along the adjoining coastal strip, the Marl Slate was accumulating as a calcareous mud in lagoons fringing the shores. With the sinking of the coast the lagoons were gradually invaded by the sea, from which the Lower Magnesian Limestone was deposited. While these changes were in progress the æolian sands would occasionally be blown into the lagoons, giving rise to the intercalations of sand with shale and limestone now found. The three deposits seem to be in part contemporaneous, although the general succession is, as usually stated, from Yellow Sands through Marl Slate to Lower Limestone.

Petroleum Genesis and Volcanic Ash.—For some time past it has been common knowledge that the production of artificial petroleum from animal or vegetable oils by distilling them with different adsorbent materials, for example, clay, charcoal, calcium carbonate, diatomaceous earth, has been achieved. A more sharply focused problem in this connexion has recently engaged the attention of Japanese investigators, who took advantage of the volcanic eruption of Komagadake, Hokkaido, in 1929, and secured from the Earthquake Research Institute some of the ash ejected. Using this material as the adsorbent, extensive physical and chemical tests were carried out with different oils, partly to ascertain the action of the ash thereon, also to see whether the results threw any light on the origin of petroleum in the Japanese oilfield (T. Terada, M. Hirata, and T. Utigasaki, *Scientific Papers*, Institute of Physical and Chemical Research, Komagome, Hongo, Tokyo, No. 343, 1932). The results show that the action of this ash on the oils tried is to produce a distillate closely resembling ordinary kerosene so far as physical properties are concerned, though differing from the petroleum product in chemical behaviour, notably in its reaction to strong sulphuric acid, which points to the presence of a predominance of unsaturated compounds. Notwithstanding this, the authors claim that there is decided possibility that much of the Japanese oil has originated from animal or vegetable oily matter buried beneath volcanic ash.

International Standards.—The degree of accuracy which has now been secured in the international measurement of capacitances is well brought out in a communication by Mr. H. L. Curtis and Miss C. M. Sparks, of the U.S. Bureau of Standards, and Messrs. Hartshorn and N. F. Astbury, of the National Physical Laboratory, to the April issue of the *Journal of Research* of the Bureau. The capacitance of a subdivided mica-tinfoil condenser of 1 microfarad was measured alternately at Washington and at Teddington, at the former by comparison with a standard air condenser the capacitance of which was measured in terms of resistance and time by Maxwell's method, at the latter by comparison with the standards of resistance and mutual inductance. For the whole condenser the capacitance at 60 cycles per second measured at Washington in 1929, 1930, 1931, and 1932 was 1·0019, 1·0019, 1·0017, and 1·0019 microfarad respectively, while at Teddington in 1929 and 1930 it was 1·0017. The unit of capacitance in the two laboratories is therefore identical to within about one part in ten thousand.

Measurements of Cosmic Radiation in Northern Sweden.—A recent issue of the *Lund Observatory Circular* (March 25) contains an account of work done at Abisko on the intensity of the cosmic radiation, by A. Corlin. Both a Kolhörster ionisation chamber and a standard Steinke chamber, of the type being set up at a number of other places in an attempt to correlate the data from different parts of the world, have been used. The results obtained are not given here in detail, the paper being chiefly devoted to an outline of the methods of observation and of reduction of data, but several points of much interest are referred to. Perhaps the most significant is that, apart from small daily variations, the intensity of the radiation remains closely constant at this high latitude (68° 21′), after correcting for changes in the barometer, as has been found farther south. In the Abisko observations, made to the north of the arctic circle, there was every expectation that meteorological effects and an influence of the aurora, if these existed, would be detected. The rate of ionisation under standard conditions is given as nearly 2·78 *J*. Another point, which might have been anticipated, but which it is, nevertheless, satisfactory to have demonstrated directly, is that humidity, as well as temperature, has no perceptible direct influence upon the penetrating radiation, and that the correlation between ionisation on one hand and humidity and temperature on the other is wholly due to the existence of a correlation between ionisation and air pressure. Publication of the full record of this work will be awaited with much interest.

Infra-Red Photomicrography.—The recent placing of infra-red sensitive plates upon the market has stimulated many inquiries as to possible new applications of photographic methods. In a communication to the Eighth International Congress of Scientific and Applied Photography held at Dresden in August 1931, Prof. Köhler and Dr. Paul Kraft of Jena described results obtained with infra-red plates in photomicrography. Three typical examples of objects opaque to visible light but transparent to infra-red rays of about 8000 A. are shown in their paper; these are woollen threads dyed black, the head of a flea, and a fossil from coal. In each example a very great improvement in the detail of structure revealed is evident where infra-red sensitive plates were used. The magnification employed ranged from 20 to 76 diameters.

Corrosion Resistivity of Metals.—Many methods have been devised for following the velocity of metallic corrosion; the loss of weight, the loss of strength, the loss of conductivity in the metal, the evolution of hydrogen, the absorption of oxygen, and even the evolution of heat, have all served as measures of corrosion under different conditions. Lately, Mr. E. W. Zehnowitzer, of the Institute of Metals, Leningrad, has used conductivity changes in the *liquid* for the same purpose, introducing into his corrosion vessel two platinum electrodes, connected to a Wheatstone bridge in the familiar manner. His results, communicated in a letter to the Editor of NATURE, show that during the corrosion of zinc by sulphuric acid the conductivity of the liquid steadily falls, whilst during attack by distilled water it rises; the

conductivity-time curves indicate that an alloy of zinc with 1 per cent copper reacts much more quickly in the acid than comparatively pure zinc, but more slowly than pure zinc in distilled water. In such cases, the conductivity method may prove of real service. For corrosion by neutral salt solutions, it would probably be less sensitive, whilst the removal of salts through adsorption on zinc hydroxide—a possibility indicated by Dr. Bengough's work—would render interpretation of the results difficult.

Activities of Salt Solutions.—If S_0 denotes the solubility of a salt in the otherwise pure solvent, and S that in a solution containing another salt, f_0 and f being the corresponding activity coefficients, the relation $f_0S_0 = fS$ enables the activity coefficient to be determined by the equation $-\log f = \log (S/S_0) - \log f_0$, the last term being evaluated by extrapolation to zero concentration of a plot of $\log (S/S_0)$ against some linear function of the total concentration. A theoretical expression for f, involving the distance of closest approach, a, of the ions, has been deduced by Debye and Hückel. Neumann (*J. Amer. Chem. Soc.*, June), by experiments on the solubilities of silver chloride in solutions of various sulphates and nitrates, finds marked deviations from the Debye-Hückel limiting law as well as from a first approximation formula, even at the lowest concentrations, in the case of sulphates and lanthanum nitrate. The sulphates of unsymmetric valency type exhibit deviations of fluctuating sign from the limiting law when the observed activity coefficient is plotted against the square root of the ionic strength. The symmetric sulphates show only one positive deviation, potassium and barium nitrates scarcely any. The extension of the Debye-Hückel equation due to Gronwall and La Mer (NATURE, **128**, 499; 1931) gives values of a in good agreement with experiment in the case of the symmetrical sulphates and nitrates, but does not explain the peculiar behaviour of the unsymmetrical valency type sulphates, except possibly as a first approximation.

Astronomical Topics

Detection of Borrelly's Comet.—This comet was discovered in 1905 and has been observed at every return since. Its period is so close to seven years that the conditions have been favourable for observation at all the returns. Two predictions of the conditions of this return were made: W. P. Henderson and J. D. McNeile (B.A.A. Handbook) gave Aug. 26·268 for the perihelion passage; M. Schaumasse (*U.A.I. Circ.* 365) gave Aug. 27·816. The truth appears to lie between them. The comet was detected by Prof. G. van Biesbroeck at Yerkes, July $30^d\ 9^h\ 6{\cdot}2^m$ U.T., the position being R.A. $5^h\ 31^m\ 54{\cdot}67^s$, N. Decl. 13° 2′ 13″ (equinox of 1932·0). The date of perihelion given by the R.A. is Aug. 26·690; the declination gives Aug. 27·171. The comet was of magnitude 12 at discovery; as it is approaching the earth until the end of the year it is likely to become brighter. The comet is a morning object in Gemini; the ephemeris in the B.A.A. Handbook will suffice for finding it. An ephemeris is also given there for Brooks's comet, which is likely to be found shortly; two independent computers, Mr. F. R. Cripps and Prof. Dubiago, both find Oct. 7·6 for the perihelion passage; the conditions this year are very favourable for observation, as the comet is in opposition when in perihelion.

Meteor Observations in New Zealand.—An article on meteors by R. A. McIntosh, of Auckland, New Zealand (*J. Roy. Ast. Soc. Canada*, May–June), is welcome since it shows that systematic observation of meteors is now carried on in those islands. For a long time the statistics were based solely on observations made in the northern hemisphere; obviously the inclusion of southern observations adds greatly to their value. When we walk beside a tram-line, more cars meet us than overtake us, since our motion shortens the interval in one case and lengthens it in the other. In the same way, more meteors meet the earth than overtake it. Now, these meteors that are meeting us come from the earth's apex, or point towards which it is moving in its annual revolution; this is a point in the ecliptic 90° behind the sun, which rises some six hours before the sun, or about midnight. Hence the 'meeting' meteors are chiefly visible after midnight, which explains the fact that more meteors are seen in the small hours than before midnight. The apex is at its farthest north in September, so we should expect a maximum of meteors in northern countries in that month; actually the diagram of Mr. McIntosh shows it in August, with a well-marked minimum in the spring; it is doubtless affected by the rich Perseid shower in that month. The diagram that he gives for the southern hemisphere does not show the seasonal effect so clearly; there is certainly no maximum about March, as we should expect; on the contrary, there is a succession of rich months from May to October, the cause for which is not clear. But the diagram of the numbers of meteors for different hours of the night agrees well with theory, and shows a maximum at 3 A.M. The slight falling off after that may be due to dawn, or to fewer watchers. Mr. McIntosh alludes to the effect of Jupiter's action in diverting the Leonid meteors so as to miss the earth in 1899; but he omits to note that the calculations of the B.A.A. Computing Section give hopes that this action may be reversed in 1932.

The Ritchey-Chrétien Reflecting Telescope.—The *Scientific American* for July contains an article by A. G. Ingalls on the improvements which M. Chrétien and Prof. Ritchey are carrying out in the design of the Cassegrain reflector. It is well known that star images in photographs taken with reflectors are generally good in the middle of the field but deteriorate greatly towards the edges of the plate, where large wings generally appear, making accurate determination of position or magnitude difficult. This is because the paraboloid form of the mirror gives good results for rays parallel to the axis, but not for oblique rays. The first improvement is to make the large mirror a hyperboloid instead of a paraboloid. The form of the secondary mirror is much more complicated; it is on the hyperboloid side of the paraboloid, but cannot be described by any simple name, since different zones are specially designed to give the best results. It is also proposed to use slightly concave plates, the curves being designed in conjunction with those of the mirrors. It is noted that the new reflectors are shorter and therefore lighter than the old, so that some of the extra cost of the mirrors is made up by the smaller dome. The article also mentions that Prof. Ritchey has designed new methods of guiding the telescope during exposures, which make the following simpler and more rapid. Two keys, one accelerating, the other retarding, are held in the hands, while an occulter, to cover the plate during moments of bad definition, is worked by the lips. The instrument now under construction has aperture 40 inches, but it is hoped to extend the method to much larger sizes; if so, the cellular type of mirror will probably be used.

Archæological Studies in Great Britain

AN outstanding feature of the first International Congress of Prehistoric and Protohistoric Sciences held in London last week was afforded by the group of lectures which were delivered at the general meetings of the Congress held on the evenings of Aug. 2, 3, and 5, and on the morning of Aug. 6, to which the presidential address on the afternoon of Aug. 1, and the exhibition of British archæology in the field at the London Museum, to which reference was made in NATURE of Aug. 6, p. 196, had formed an appropriate introduction. While Sir Charles Peers, in his address on "The Beginnings of British Archeology", had traced the stages by which interest in the exploration of the past had attained the status of a scientific study, and the exhibition had given a practical demonstration of what is now being achieved in the field, Dr. Cyril Fox, Mr. E. T. Leeds, and Mr. T. D. Kendrick laid before their audiences the results of synthetic study of the facts most lately won in the field at three strategic points in the early history of the British Isles. The picture was completed on the morning of Aug. 6 by Mr. O. G. S. Crawford's account of Britain's achievement in the development of archæological discovery by photography from the air, which was so admirably illustrated by the photographs exhibited by the Ordnance Survey at the London Museum.

Sir Charles Peers, in his presidential address, while tracing the spirit of the archæologist back to the interest of primitive man in his predecessors, distinguished the latter as a hope for treasure, while around the great monuments of the past, which have never failed to arouse the attention of the living, has collected a mass of material, sometimes dignified by the name of folk-lore, which should not be overlooked. Early antiquaries explained prehistory in the light of history as known to them. When anything remarkable remained, the natural tendency was to ascribe it to the Romans. Camden, the learned forerunner of modern antiquaries, saw no reason to ascribe a date before the Roman occupation of Britain to any notable monument except Stonehenge—*insana substructio*. Aubrey, the Wiltshire squire, said Sir Charles, had the definite merit of setting down what he saw. In 1648 he was impressed by the absurdity of deriving such structures as Avebury from the classical tradition. He was persuaded that Stonehenge was a temple of the Druids. Then came William Stukely, a man gifted with a vivid imagination and an insatiable curiosity. "What is all learning", he said, "but a knowledge of antiquities?" Sir Charles then reviewed the work of Sir Richard Colt Hoare, whose book on the Wiltshire monuments, of which the first volume was published in 1810, was prefaced with the words, "we speak from facts not theory"; of William Smith, whose geological map of England demonstrated a succession of ruined worlds, opening the way to a new conception of the prehistory of man; and of John Frere, who attributed his palæolithic implements to a period "even beyond the present world"—the transition from ancient to modern archæology.

Dr. Cyril Fox, in his address on "The Personality of Britain", dealt with some of the fundamental principles of prehistory, demonstrating the bearing of climate and soil, and the resulting vegetable and animal life, on man and his history. As a whole, these represent man's environment and Britain's personality. The position of Britain, he said, adjacent to five hundred miles of European coast, renders the country liable to invasion, while its indented outline is convenient for invaders, and its estuaries and slow-moving rivers invite penetration. Of the three main routes for invaders, the western coast, the English Channel, or the Straits of Dover, and the North Sea, that by the Straits of Dover, was not open or was a narrow gorge, when, in early times, the land was higher; but when subsidence and erosion had moulded Britain to its now familiar form, invasion tended to concentrate on Kent and the Thames estuary.

Dr. Fox then proceeded to show how the structural division of the island of Britain south of the Forth-Clyde isthmus into a western highland zone and an eastern lowland zone led to the imposition of cultures on the east, which was easily overrun by invaders, while in the highland zone they were absorbed. In the same way the fertile lowlands nourished wealthier populations, while north of the Forth-Clyde isthmus the Highlands tended to develop unique cultures. Influences from Ireland were usually limited to the highland zone. The lands washed by the Irish Sea thus tended to develop cultural unity. In the same way, soil was the controlling factor in lowland distribution and elevation in the highland, as man could not stand the cold. The most complete manifestation of any primitive culture entering eastern or southern Britain from the Continent focused in the Salisbury Plain region, but as civilisation developed, overseas trade moved in the direction of the Thames estuary and a change came in the type of soil and country desired by the inhabitants. Hence the progress from subjection to environment to control of environment, from barbarism to civilisation, is expressed by the utilisation of oak forests and the substitution of arable fields.

In "Celtic Art in Britain", Mr. E. T. Leeds sought to trace the origins and development of an artistic epoch which lasted from its beginnings in La Tène style down to the eleventh century of our era. It was first implanted on the south coast, probably in the late fifth or fourth century B.C., and taking root firmly in the third century B.C., when it began to discard the naturalistic tendencies of the parent continental school in favour of geometrical arrangements of curving lines. This school found its most brilliant expression in a western school, the districts first occupied by iron age peoples, which permeated the eastern Midlands and spread to Yorkshire and beyond. A period of decadence ensued. While intruding Belgic tribes developed *champlevé* enamelling, the British craftsman attempted novel designs by "breaking the back of the curve".

Before the Roman conquest, southern Britain was falling under the influence of continental mass production. There is a loss of originality and an increase of formalism. Small geometrical designs in enamel aim at a jewelled effect: on the periphery of the Roman occupation, however, Celtic art survived and the Celtic genius adapted classical models as in the Æsica brooch. A fresh burst of activity set in as seen in the enamelled escutcheons of the Winchester and other bowls, a group confined to the east of the Fosse Way. The outcome was the trumpet scrolls beloved of the Celt with his feeling for the curving line. This renaissance in southern England in the sixth and seventh centuries, in conjunction with certain zoomorphic designs, provides the key to the sudden appearance in Ireland at the close of the seventh century of such masterpieces as the Book of Durrow, unheralded by anything in the previous art history of the island.

Mr. T. D. Kendrick, in "The Crafts in Ancient Britain", dealt with the difficult but none the less interesting period of the Early Dark Ages, holding

out the hope that it may soon be possible for the archæologist to discern the long awaited Arthurian archæology of Britain. Though Vortigern, Aurelius Ambrosianus, and King Arthur mean much to the historian, archæologically they and their subjects are almost unknown. The lost archæology of the Briton has to be reconstructed from material found in the graves of his conquerors. Investigation of the chronological position of such material as the famous 'Kingston' brooch shows that it is more likely to be British than Jutish, as it has been regarded. There is a definite probability of some progress in the task of sorting out minor Arthurian antiquities from the 'Anglo-Saxon' cases of the museums.

Rimu or New Zealand Red-Pine

IN view of the fact that the possibility of obtaining supplies of soft woods from the Empire is so much in the forefront at the present day, a leaflet by W. C. Ward on the "Properties and Uses of Rimu" (N.Z. For. Service, *Leaflet*, No. 17, Nov. 1931) merits consideration. The author states that rimu (*Dacrydium cupressinum*) supplies rank as the most important soft wood in New Zealand. It is milled and marketed in every timber-producing district in the country, and is the principal building timber in the Dominion. It is employed in almost every local wood-using industry, and in many is the chief timber used. At the present time, practically the whole of the rimu produced is consumed locally, less than 3 per cent being exported. The quantity milled annually exceeds that of all other species combined, and during the year ending March 31, 1930, totalled 159,000,000 ft. Board Measure (B.M.), or 58 per cent of the total timber production of the Dominion. In 1920–1930 the annual cut of the species exceeded 140,000,000 ft. B.M., the peak production of 195,000,000 ft. B.M. in 1926 representing 55 per cent of the total timber produced that year. That the fellings are exceeding the annual increment or possibility is exemplified by the statement that a few years ago Auckland supplied a far larger proportion of the total cut than any of the other districts, but its accessible supplies have now dwindled, and Westland has taken the lead and is said to be likely to supply an increasing percentage in future years.

The first detailed statistics on the export of rimu were collected in 1913, when 8,500,000 ft. B.M. were exported. In the War years the trade increased, and by 1918 the total exports had reached 30,000,000 ft. B.M. This was due to the difficulty in obtaining supplies of North American and Scandinavian timber during the War years. With the drop in price of the foreign species at the end of the War, and low ocean freights, it was possible to land the foreign material cheaper in Australia than rimu. The exports of the latter to Australia had fallen to 4,000,000 ft. B.M. in 1925, and have remained at that figure ever since. Recent customs duties on foreign timber in Australia now permit rimu to compete successfully once more, and a recent survey has shown that 20,000,000 ft. B.M. of rimu could be used in Australia annually.

The leaflet is written from the marketing and manufacturing point of view. It is to be hoped that the Forest Department will bear in mind the great value to the country of this fine timber, and will take steps to see that its regeneration is undertaken, in order to perpetuate supplies.

The rimu is a fine forest tree, the height in the average commercial stand varying from 60 ft. to 120 ft. When mature, its trunk is long, straight, unbranched, and with little taper, carrying a comparatively open and irregular crown. From the remarkable weeping habit of its foliage it is the most easily recognised and best known of all New Zealand trees. The commercial bole usually varies from 40 ft. to 80 ft. in length. Its diameter, breast height, in mature stands varies from 2 ft. to 4 ft., although it is said that many of the trees at present converted range below the lower limit. In other words, as is invariably the case when primeval forests are lumbered, immature trees are being felled along with the mature ones. Occasionally trees up to 8 ft. diameter are encountered and milled. It might be suggested that a few stands of these fine old trees should be selected by Government and reserved to show future generations what the New Zealand soil is capable of producing.

Although the tree grows on flat, but not marshy, land, it favours undulating localities and hillsides, being found at all altitudes from sea-level up to 2500 ft. With the exception of the pure beech (*Nothofagus*) stands, rimu occurs in every major type of forest growth, and in the North Island it is an occasional associate of the kauri.

Mr. Ward gives interesting details on manufacture, seasoning, grading, the properties of the wood and durability, and adds notes on its utilisation by various industries.

Winter Climate of Greenland

IN a paper read to the Royal Geographical Society on April 18, by Mr. S. T. A. Mirrlees, new light is thrown on the winter climate of the interior of southern Greenland. Mr. Mirrlees pointed out that nearly all our knowledge of the climate of this region is based upon observations made on summer sledge journeys, supplemented by the observations made throughout the year at the various coast stations of the Danish Meteorological Service. Greenland lies to the north of the region of the world's most persistent cyclonic activity, but—if we accept as accurate the distribution of high and low pressure shown on the daily charts of the British Meteorological Office and similar older publications, such as those of the Danish Admiralty—is at all seasons liable to be invaded by the cyclonic depressions of the North Atlantic.

In a series of observations made every three hours between Sept. 8, 1930, and April 26, 1931, at about lat. 67° N., long. 42° W., at a height of about 8250 ft., by the British Arctic Air Route Expedition, his hypothesis is confirmed. The direct influence of the Atlantic depressions on the weather was found normally to be small, as is shown by the low figures for the monthly mean proportion of the sky covered by cloud, which varied from five-tenths in September to three-tenths in February. The mean for the whole period must therefore have been roughly comparable with the normal for the French Riviera. But there were some stormy periods and even gales, and the strongest winds showed no tendency to be more prevalent from the prevailing northerly direction of the wind than from other quarters; moreover, the characteristic changes of wind, pressure, and weather caused by the passage of the centre of a depression directly over or to the north of the place of observation were observed.

Very low temperatures had been expected, and were not wanting, for a reading of −59° F. was

obtained both in January and February. The nearest approach to a thaw was on an occasion in September when the temperature rose to 29° F. Mr. Mirrlees pointed out that the degree of cold observed was not nearly so great as that experienced in Siberia, at Verkhoiansk, where the mean temperature for January is −58° F., and where −80° F. occurs about once in two years. At both places the greatest cold is usually found with the calmest weather, and must evidently be associated overhead with a very large inversion of the usual fall of temperature with height.

University and Educational Intelligence

CAMBRIDGE.—Prof. J. E. Lennard-Jones, professor of theoretical physics in the University of Bristol, has been elected John Humphrey Plummer professor of inorganic chemistry as from Oct. 1.

PROF. E. F. BURTON, of the Department of Physics, University of Toronto, has been appointed head of the Department and director of the Physics Laboratory (McLennan Laboratory), to succeed Prof. J. C. McLennan, who retired on June 30.

THE Carnegie Foundation for the Advancement of Teaching, after a quarter of a century of sustained and successful effort devoted mainly to improving the economic status of the college and university teacher and, as a secondary activity, to elucidating current educational problems, has now entered upon a new era in which the work of its Division of Educational Enquiry becomes its dominant function. The change of policy is explicitly announced in the twenty-sixth annual report recently presented by the president, Dr. Henry Suzzallo, a part of which is devoted to a discussion of certain features of the very remarkable study now in progress of the relations of secondary and higher education in Pennsylvania. This study, undertaken in 1928 on behalf of the Educational Commission of the State, is not a 'survey' in the ordinary sense. It includes an attempt to trace contemporaneously through the secondary and collegiate periods of their education the intellectual fortunes of a representative group of some twelve thousand pupils who began the seventh school grade in 1928, and it might thus be designated a 'four-dimensional survey'. Year by year for the past four years the president of the Foundation has commented in his annual reports on the progress of this unique enterprise. In the present report he observes that the conspicuous lesson thus far emerging is the dependence of all successful education on adequate provision for proved differences in individual interests and capacities. Next, after a scheme of accurate comprehensive testing for each pupil, the organisers of the study have emphasised a thorough and continuing knowledge of the individual personality in all those phases of life that bear on his education. To provide for the gathering, selecting, and interpreting of the requisite information by a competent teacher-counsellor in continuous contact, and thus gradually maturing an assured knowledge and conviction of the pupil's needs, certain forms of 'home-room' organisation have been devised, some of the more promising of which are described at length.

"HOME-MAKING Education" is the title of a recent *Bulletin* (1931, No. 20) of the United States Office of Education, which describes some notable developments in the application of scientific research to problems of family life and to methods of instruction and training for handling them. The growth of interest in the subject is indicated by bibliographies of research studies in education for 1926–30, which give the numbers of home-economics studies in successive years as 18, 27, 36, and 91, including many M.A. and Ph.D. theses. The White House Conference on child health and protection and 'home-making' conferences called by the Commissioner of Education and the National Education Association in 1929 and 1930 were both symptoms and stimulants of this growth. One of the White House Conference committees formulated a series of recommendations in favour of researches comparable with that recently inaugurated by the B.B.C., with its 'family' form, in changes in family life. Among numerous examples quoted in the *Bulletin* of successful ventures in the field of home-making education is one in which mothers attending classes in child-development were relieved meanwhile of the care of their children by high-school girls from child care and training courses in the home-economics departments of neighbouring high schools: the girls kept records of their observations for discussion the following day in the home-economics classes. The use of nursery-schools as laboratories for the girls in home-making classes is urged by Dr. Popenoe, director of the Los Angeles Institute of Family Relations, who insists that laboratory work is as essential in the learning of home economics as in learning physics or chemistry. In Pasadena Technical High School, all girls enrolled in the eleventh and twelfth years take a course in child-development, in connexion with which is maintained a demonstration laboratory of sixteen children aged two to four years. Home economics is destined, says Dr. Popenoe, soon to find a place in every institution that pretends to fit its students for life anywhere except in a classroom.

Calendar of Geographical Exploration

Aug. 14, 1642.—Tasmania and New Zealand

An expedition in charge of Abel Janszoon Tasman, with F. J. Visscher as pilot-major, sailed from Batavia in Java to explore the South Indian Ocean. Both men were experienced navigators and this certainly contributed to the success of the voyage. Passing through the Strait of Sunda, they reached 49° 4′ S., and on Nov. 4 the south-west coast of Tasmania (named by Tasman 'Antony van Diemen's Land') was sighted. On Dec. 13, the west coast of the south island of New Zealand was discovered in 42° 10′ S. Later the broad bight between the two islands was discovered and the voyage was continued along the west coast of North Island. By Jan. 21 the ships were anchored in the chief island of the Tonga group, afterwards named by Cook the Friendly Islands. Tasman became involved in the reefs off the north-east of the Fiji group, but found a passage among the islands off the north-west of Vanua Levu. The projecting capes of the latter were mistaken for islands, so that its size was not realised. The ships returned to Batavia on May 14, 1643. This great voyage finally demonstrated the absence of any connexion between Australia and a possible south polar continent. Between 40° and 50° south, the vessels covered 115° of longitude, altogether passing through 5000 miles of a hitherto unexplored ocean in latitudes never before reached in this portion of the globe, after which 2000 miles had still to be traversed before known regions were again entered. Visscher's skill resulted in the careful charting of the newly found areas. Tasman's earlier work included the charting of the north coast of Ceram in 1634, the correct charting of Luzon and other islands in that region, and the discovery of the Bonin Islands in 1639. His later voyage in 1644 verified the continuity of the land from the Gulf of Carpentaria to the north-west point of Australia.

Aug. 16, 1761.—The Giraffe

An expedition under Hendrik Hop started from a point near the mouth of the Olifants River, passed the Copper Mountains, and crossed the Orange River. Giraffes were seen to the north of that river, and the skin of one was sent to the Museum at Leyden, the first to reach Europe. Knowledge of the Bechuana tribes was gained and some new country was mapped.

Aug. 18, 1826.—Timbuktu

Major Gordon Laing entered Timbuktu, the first European explorer to reach that remarkable city. One or two European adventurers had penetrated there in the fifteenth and sixteenth centuries, but from that time onwards it had remained isolated from European influences. Laing had previously travelled from Sierra Leone to Falaba and had ascertained that the Niger rose in the highlands of Kurauka, though he did not actually visit the source. Three years after this journey, he set out from Tripoli, crossed the Sahara, and after thirteen months of hardship, during which the rest of the party perished, Laing arrived in Timbuktu. He had hoped to proceed thence to the Upper Niger, but, on Sept. 22, was murdered on leaving the city. On Dec. 12, 1931, a memorial was unveiled to him in Timbuktu, the isolation of which was ended by his pioneer effort.

Aug. 18, 1838.—Wilkes Land

Charles Wilkes, of the United States Navy, set out with a squadron of six ships to prosecute research in the antarctic. He added Wilkes Land, east of Adélie Land, to the map, began a survey of the Paumotu group in the Pacific, and in 1841 reached Oregon and surveyed the Columbia as far as Walla Walla. J. D. Dana, the geologist, accompanied Wilkes and collected data for his " Corals and Coral Islands ". Considering the many difficulties arising both from faulty equipment, for which he was in no way responsible, and from the unwieldy size of the expedition, Wilkes's achievement was remarkable.

Aug. 20, 1860.—Crossing Central Australia

R. O'H. Burke and W. J. Wills left Melbourne on an expedition into Central Australia, to reach if possible the Gulf of Carpentaria near the Albert River. In October 1860 they left Menindee on the Darling River, with both camels and horses in the party. Some members fell out at the start and, in December, Burke, Wills, and King left the remainder of the party at Cooper's Creek and pushed on, reaching the estuary of the Flinders River in February. On the return journey Burke and Wills died of starvation. The numerous relief parties sent out to search for the explorers opened up the area east of a line drawn from the Albert River to Spencer Gulf.

Aug. 20, 1900.—Baron E. von Toll

Baron von Toll's expedition in the *Sarya* reached Yugor Shar. In August 1902, von Toll reached Bennett Island with the astronomer Seeberg and two men, and stayed there until November. Nothing more was ever known of their fate; a relief expedition in 1904 found Toll's records on Bennett Island, but no traces of his party. Von Toll's remarkable work began in 1885, when he and Dr. R. A. Bunge left Yakutsk, explored part of the Yana valley, and reached the New Siberian Islands. Cherski, who in 1891 began to explore the Kolyma, Indigirka, and Yana Rivers, died on the expedition. Von Toll then took charge and successfully completed the plan, surveying 3000 miles of previously unknown country over 50° of longitude. In 1893 he made discoveries of great geological importance.

Societies and Academies

DUBLIN

Royal Irish Academy, June 13.—L. R. Wager: The geology of the Roundstone district, Co. Galway. Remapping has shown a group of hornblende-peridotites, allivalites, anorthosite, and diorites to have been intruded into epidiorites of igneous origin. The magma of this group was rich in water, so that there has been extensive development of reaction rims and hydrothermal effects. Intrusion of quartz-diorite magma followed, giving injection gneisses with the basic igneous and the Connemara schists, and these gneisses are metamorphosed by the Galway granite. The injection is believed to have immediately succeeded the regional metamorphism of the Connemara schists.

PARIS

Academy of Sciences, June 27 (vol. 194, pp. 2249-2364).—Charles Achard, Augustin Boutaric, and Mlle. Madeleine Gautrot: Researches on the optical density and viscosity of therapeutic sera.—Georges Claude: Progress with luminous tubes containing rare gases. An account of work done in satisfying three conditions: white or nearly white light, long life, and high current efficiency.—E. Mathias: Globular lighting in the mountains and high plateaux.—C. Sauvageau: Four specimens of *Ectocarpus*.—L. Léger and Mlle. M. Gauthier; New Endomycetes of the aquatic larvæ of insects.—Pacquement: The figure formed by a quadric and two straight lines.—Georges Darmois: The deformation of space in the theory of relativity.—Pierre Boos: The relation which exists between an arc of a curve and the angle under which it is seen from its origin.—C. E. Winn: A comparison between the oscillation of the means of Cesàro and of Holder.—Viggo Brun: The formula of inversion of Tambs Lyche.—Antoine Appert: A condition playing an important part in the topology of abstract spaces.—Mlle. M. L. Cartwright: The relations between the directions of Borel of certain integral functions and the singularities of analytical functions.—Florin Vasilesco and Rolin Wavre: A method of generating multiform harmonic functions in space or in the plane.—A. Rosenblatt: The stability of the general laminar movement of incompressible viscous fluids.—Gustave André Mokrzycki: The relation between the radius of action and the velocity of departure.—M. Mendes: A treatment of the problem of n bodies of variable masses starting with the equality of Levi-Civita.—Sylvain Arend: The general solution of the connexion of two negatives.—D. G. Dervichian: Surfaces and molecular volumes in superficial solutions. The interpretation and application to the determination of molecular masses.—René Lucas and Marcel Schwob: Dispersion and anomalous magnetic double refraction.—A. Rousset: The Cabannes-Daure effect and the molecular field.—H. Ollivier, Mlle. J. Pernet, and J. Lesne: The thermal variation of the magnetic rotatory power. The utilisation of a slightly prismatic cell. Contribution to the study of solutions of nickel chloride.—G. Reboul: The anomalies presented by radiographs obtained by means of semi-conducting cells.—L. Wertenstein: Considerations on radioactive transformations.—A. Travers and J. Aubert: The passivity of electrolytic iron in alkaline media. The experiments cited show that passivity in an alkaline medium is due to dissolved oxygen and not to the hydroxyl ions.—Henri Lafuma: The hydration of anhydrite in the presence of calcium hydroxide. The quicker setting of plaster of Paris caused by the addition of a small proportion of lime is due to the reduced size of the crystals formed and not to any

catalytic action of the lime on the course of hydration. —Urion: Cyclopentenyl-alkylcarbinols and their dehydration products.—Henri Erhart: The soils of the Rhine terraces to the south of Alsace.—Lefèvre: The presence of peridinians in a fossil deposit at Barbadoes. —Feng Yen-An: The presence of centrosomes and of star-shaped forms in an angiosperm, *Lonicera alpigena*. —Pierre Dangeard: The vacuome of Algæ and its transmission by the zoospores.—A. Guilliermond: The structure of bacteria.—Marcel Mirande: The evolution of hydrocyanic acid by certain fungi. — H. Heldt: Aerial observations for the localisation of shoals of tunny fish and the possibility of the direct study of their migrations. From an aeroplane it is possible to discover the shoals of tunny and fix their size, position, and direction of movement.— Mme. C. Vincent and J. Vial: Researches on the yields of milk and of fat in human lactation.—L. Bugnard and C. Soula: Glycæmic equilibrium and digestive secretions.—A. Gruvel: Some observations concerning the large lake Amer (Suez Canal). A discussion of the effects of variations of salinity on animal life in the lake.—Marcel Avel: The regenerating power of the dorsal and ventral halves of the body wall, in the cephalic region, in *Lumbricus*.—A. Dognon: The biological action of monochromatic X-rays of different wave-lengths on the egg of *Ascaris megalocephala*. The action of the X-rays, in the case of the cell studied, diminishes suddenly at the wave-length 1·54 A., and then remains constant down to the shortest wave-length studied (0·7 A.).—A. and R. Sartory, J. Meyer, and M. Antonioli: The presence of a pigment resembling prodigiosine in *Actinomyces Allenbachii*. The colouring matter was isolated in crystals as chlorhydrate and perchlorate. Its chemical and physical properties, especially the spectroscopic analysis, closely resemble those of prodigiosine.—A. Dorier: The larvæ of *Parachordodes alpestris*.—Ch. Joyeux and J. Piéri: The rabbit as a reservoir of virus for exanthematic fever.

GENEVA

Society of Physics and Natural History, April 28.— R. Wavre: Extension of a theorem of Stokes relating to fluid stars. Generalising the classical theorem of Stokes and of Poincaré relating to planetary figures, the author shows that the attraction of a fluid star (or nebula) on other stars depends only on its total mass, its free surface, and superficial accelerations. The distribution of matter in the interior of the star is without influence.—M. A. Schidlof: (1) The evaluation of the difference between the masses of the α_1- and α-particles. The difference between the masses of these particles of a nucleus is evaluated by a method not making use of the Gamow-Condon-Gurney threshold maximum potential. For two different nuclei (Th^{232}, Pb^{208}) concordant values are obtained, which confirm the value previously deduced from the threshold theory.—(2) The arrest of the periodic systems of the atoms and the greatest electronic concentration of the nuclei. Utilising the value of the mass effect by the proton, calculated by considering the presence of the particles in atomic nuclei of the thorium series, the author has deduced from the condition of the possibility of equilibrium the upper limit of existing atomic numbers. The inequality utilised in this calculation also furnishes the upper limit of the electronic concentration of compound nuclei.—E. Briner, J. Bron-Stalet, and H. Paillard: Researches on the dehydration of phenol. Contribution to contact catalysis. The authors have studied the dehydration of phenol in the presence and absence of a catalyst. In the presence of thoria, the reaction takes place rapidly up to a transformation of 60-64 per cent of phenol into phenyl oxide. If the catalyst is absent, the dehydration of the phenol is very slow but complete.—A. Naville: The cytological bases of the theory of crossing over in the Diptera. The author shows that in *Calliphora erythrocephala* at the commencement of ovocytary evolution a series of premeiotic phases is observed, allowing a parasyndesis, and capable of explaining crossing over. In spermatogenesis, nothing similar is observed and the spermatocytes enter directly into diakinesis without undergoing premeiosis. If these results can be extended to other Diptera, they constitute a striking verification of the hypothesis of Morgan and Sturtevant on crossing over in *Drosophila*.—E. Cherbuliez, E. Ehninger, K. Bernhard: The multiplicity of principles in the croton seed. The authors have extracted from croton oil a substance which is a powerful vesicant but has no purgative effect, while the oil left after its removal retains its purgative properties. Hence there are at least two active substances in croton oil.

VIENNA

Academy of Sciences, April 28.—Wolf Johannes Müller and W. Machu: Theory of passivity phenomena. (15) The passivating action of oxide layers in the anodic passivation of iron in neutral sodium sulphate solution.—Anton Kailan and Walter Haas: Velocities of esterification of methyl and ethyl alcohols in acetic acid. The esterification constants are given for acetic acids containing different amounts of water and in presence and absence of hydrochloric acid.—Franz Fuhrmann: Studies on the biochemistry of luminous bacteria. (2) Influence of sugar, with sodium chloride, on the luminosity. Addition of glucose, fructose, or galactose to cultures of *Photobacillus radians* containing 0·5 or 0·25 M. sodium chloride usually effects no, or but slight, rise in the luminosity. During the early stages of growth, sucrose and lactose enhance the luminosity, and maltose in small proportions causes an increase, but in larger quantities a decrease.—Friedrich Hopfner: The fundamental equations of physical geodesy. Determination of the mean level of the earth's surface from gravitation values depends on combination of Bruns' theorem with the solution of a partial differential equation of the first order. Former known solutions of this problem differ only in form, being variants of the solution of the differential equation.— Otto Fürth and Eduard Herbert Majer: (1) Accumulation of carbohydrate in the liver of lard-fed rats. The formation of glycogen in the liver has been studied with rats fed on lard together with either crude fibre or the sodium salt of one of the organic acids formed during the digestion of fibre in the intestines. Glycogen is formed from beet-slices or fermentation lactic acid, but not from butyric, succinic, or valeric acid. These lower acids are either resorbed from the intestine and possibly used in building up fat, or assimilated by micro-organisms and used in the construction of body-substance.—(2) Phlorizin glycosuria of the pig.—Gustav Götzinger and Helmut Becker: New discoveries of fossils in the Wienerwald.—Herbert Haberlandt: Luminescence of fluorites. Some fluorites exhibit red fluorescence, but none of these shows rare-earth lines in the spectroscope. Many fluoresce after irradiation with β-γ-rays and some only after ignition and irradiation, whilst others display no fluorescence.—Fritz Rieder and Elisabeth Rona: Range of α-rays of actinium products. Investigation of the α-rays of RdAc reveals two prominent groups with the ranges 4·7 cm. and 4·35 cm. respectively, together with three other groups. Preparations of AcX free from RdAc show groups with ranges of 4·1 cm., 4·3 cm., and 4·6 cm., and AcC shows two (5·00 cm. and 5·40 cm.). AcA shows indications of

a fine structure, as it gives, besides the known group of 6·47 cm. range, two faint groups of 6·35 cm. and 6·60 cm. range.—**Rudolf Leutner**: Velocity of hydrolysis of cyclic acetals (1).—**Konrad Funke**: Perylene and its derivatives. (35) Diaminoperylene-3 : 10-quinone.

May 6.—**Karl Brunner and H. Moser**: 5-Ethoxyindolinone.—**Arthur Haas**: Relation between the world's radius of curvature and the radius of the electron.—**Franz Rücker**: Reflection and transparency of animal tissues in the ultra-red. Considerable proportions of infra-red rays traverse the skins of reptiles and amphibia. Thus, with many lizards, 3-4 per cent of the radiation passes through the whole covering of the body, including the black peritoneum, into the body. The influence of the chromatophores is seen particularly well with the tree-frog; almost twice as much of the radiation is transmitted by the skin of the back when the chromatophores are partially contracted as when they are expanded. The chitin of insects is also transparent to some extent. The skins of xerophile, thick-skinned snakes, are usually far less penetrable by the rays than those of the shade- and moisture-loving forms.—**Julius Pia**: The Girvanellæ of the English carboniferous limestone. Three species of *Girvanella* from this source have been named, but the author considers that only two have been clearly distinguished; namely, *G. ducii* Wethered and *G. staminea* Garwood (? *G. incrustans*).—**Johann Koppmair**: General solution of the fundamental problem of photogrammetry.—**Alois Zinke**: Perylene and its derivatives (36).—**N. A. Puschin and M. Deželić**: Equilibrium in systems with erythritol as a component.—**N. A. Puschin and J. J. Rikovsky**: Compounds of carbamide and urethane with acids and phenols.

Official Publications Received

BRITISH

Ceylon Journal of Science. Section D: Medical Science. Vol. 2, Part 5, May 20th. Edited by Dr. L. Nicholls. Pp. 203-341+plates 42-49. (Colombo: Bacteriological Institute; London: Dulau and Co., Ltd.) 3 rupees.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1931. Pp. 9. (Cape of Good Hope.)

Proceedings of the Royal Society of Edinburgh, Session 1931-1932. Vol. 52, Part 3, No. 16: Pressure Effects in the Secondary Spectrum of Hydrogen. By W. G. Guthrie. Pp. 315-322. 9*d*. Vol. 52, Part 3, No. 17: The Adrenal Gland of *Xenopus lævis*. By H. Zwarenstein and I. Schrire. Pp. 323-326. 6*d*. Vol. 52, Part 3, No. 18: The Geodesics in Einstein's Unified Field Theory. By A. Blackwell. Pp. 327-330. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Irish Academy. Vol. 41, Section A, Nos. 1, 2: On the Motion near Two straight Parallel Vortices, by W. B. Morton; The Radiation of Angular Momentum, by Prof. A. W. Conway. Pp. 17. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Department of Scientific and Industrial Research: Food Investigation. Leaflet No. 1: The Cold-Storage of English Plums. By Dr. Franklin Kidd and Dr. Cyril West. Pp. 5. Leaflet No. 2: The Preservation of Fruit and Vegetables by Freezing. By Dr. J. Barker and T. Morris. Pp. 9. (London: Department of Scientific and Industrial Research.)

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds.)

The National Central Library. 16th Annual Report of the Executive Committee, 1931-32. Pp. 55. (London.)

Thirteenth Annual Report of the Ministry of Health, 1931-1932. (Cmd. 4113.) Pp. xii+320. (London: H.M. Stationery Office.) 5*s*. net.

Board of Education. Educational Pamphlets, No. 89: Memorandum on the Teaching of Science in Senior Schools. Pp. 67. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Census of Thunderstorms in the British Islands, 1925-1936. Summer Thunderstorms: First Annual Report, 1931. Pp. 24. (Huddersfield: Thunderstorms Census Organisation.) 2*s*. 6*d*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 427, July. Pp. 145-284+xx. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Department of Public Instruction, Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1931. Pp. 6. (Sydney: Alfred James Kent.)

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1931. Pp. 18. (London: H.M. Stationery Office.) 6*d*. net.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 221, B476: Experiments on the Development of Chick and Duck Embryos, cultivated *in vitro*. By C. H. Waddington. Pp. 179-230+plates 22-28. (London: Harrison and Sons, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1447 (T. 3152): Thrust Integrating Tubes—Wind Tunnel Experiments. By C. N. H. Lock, F. C. Johansen and H. L. Nixon. Pp. 22+10 plates. 1*s*. 3*d*. net. No. 1457 (T. 3204, 3211): Two Reports on Tail Buffeting. By the Aerodynamics Staff of the National Physical Laboratory. Pp. 36+26 plates. 2*s*. 3*d*. net. (London: H.M. Stationery Office.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 61: Studies in the Supplementary Feeding of Merino Sheep for Wool Production. 1: The Effect of a Supplementary Ration of Blood Meal on the Growth Rate and Wool Production of Merino Sheep on Central Queensland Pastures. By Hedley R. Marston. Pp. 31. Bulletin No. 62: A Soil Survey of the Cadell Irrigation Area and New Era, South Australia. By T. J. Marshall and N. J. King. Pp. 24. (Melbourne: H. J. Green.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1931. Pp. 204. (Bristol.)

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 20, Part 2, July. Pp. 77-140+plates 9-11. (London: Dulau and Co., Ltd.) 10*s*. net.

Reports on Comparative Tests on "Armourplate" and ordinary Plate Glass by the National Physical Laboratory and the Department of Scientific and Industrial Research (Building Research). Pp. 48. (St. Helens: Pilkington Bros., Ltd.)

Economic Advisory Council: Committee on Locust Control. Fourth Report: Survey of Locust Investigations in 1931 and Programme of Work for 1932-33. (Cmd. 4124.) Pp. 43. (London: H.M. Stationery Office.) 1*s*. net.

FOREIGN

The University of Colorado Studies. Vol. 19, No. 3. Pp. 163-355. (Boulder, Colo.) 1 dollar.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 175: First and Second Order Triangulation in Oregon (1927 Datum). By Clarence H. Swick. Pp. iii+89. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the American Philosophical Society. Vol. 71, No. 3. Pp. 73-133. (Philadelphia.)

University of California Publications in American Archæology and Ethnology. Vol. 31, No. 3: Ethnography of the Surprise Valley Paiute. By Isabel T. Kelly. Pp. iv+67-210+plates 17-32. (Berkeley, Calif.: University of California Press.) 2 dollars.

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 3: Studies of Teachers and Principals employed in the Rural Schools of the United States. By Walter H. Gaumnitz. Pp. iv+122. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 22: Recent Progress and Condition of Museums. By Laurence Vail Coleman. Pp. 34. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 5, May, Research Papers Nos. 434-445. Pp. 549-668. (Washington D.C.: Government Printing Office.)

Verhandlungen und wissenschaftliche Abhandlungen des 24 Deutschen Geographietages zu Danzig 26 bis 28 Mai 1931. Pp. 272. (Breslau: Ferdinand Hirt.) 12 gold marks.

Memoirs of the College of Science, Kyoto Imperial University, Series B. Vol. 7, No. 1. Pp. 53+3 plates. Vol. 7, No. 2. Pp. 55-101+plate 4. Vol. 7, No. 3. Pp. 103-158+plates 5-14. Vol. 7, No. 4. Pp. 159-203+plates 15-17. Vol. 7, No. 5. Pp. 205-250+plates 18-19. (Tokyo and Kyoto: Maruzen Co., Ltd.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 6, Juin. Pp. 239-284. (Prague: Regia Societas Scientiarum Bohemica.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series I: Mathematics. Vol. 1, No. 3. Pp. 157-209+143-157. (Sapporo.)

Report on Clove Cultivation in the Zanzibar Protectorate, 1931. By Prof. R. S. Troup. Pp. iii+46. (Zanzibar: Government Printer.)

Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1931. (Chemical Section, Publication No. 65.) Pp. 28. (Khartoum.)

The Museum Journal. Vol. 23, No. 2: Primitive Peoples of Matto Grosso, Brazil. By V. M. Petrullo. Pp. 81-184. (Philadelphia: University Museum.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 5: Education in Belgium. By James F. Abel. Pp. vii+145+8 plates. Bulletin, 1932, No. 7: The Legal Status of the County Superintendent. By Prof. N. William Newsom. Pp. vi+42. (Washington, D.C.: Government Printing Office.)

United States National Museum. Bulletin 161: The Foraminifera of the Tropical Pacific Collections of the *Albatross*, 1899-1900. Part 1: Astrorhizidae to Trochamminidae. By Joseph Augustine Cushman. Pp. vi+88+17 plates. (Washington, D.C.: Government Printing Office.)

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1931. Pp. 20. (Entebbe: Government Printer.) 2*s*.

Field Museum of Natural History. Zoological Series, Vol. 18, No. 9: Reptiles and Amphibians from the Solomon Islands. (Reports on Results of the Crane Pacific Expedition.) By Karl P. Schmidt. (Publication 311.) Pp. 173-190. (Chicago.) 35 cents.

CATALOGUES

Astronomical Instruments. (Astro. 103E.) Pp. 16. (Berlin-Friedenau: Askania-Werke A.-G.; London: O. G. Karlowa.)

Cambridge Draught and Pressure Gauges (Indicating and Recording). (List No. 152A.) Pp. 8. (London: Cambridge Instrument Co., Ltd.)

John G. Stein and Co., Limited, Silica and Firebrick Manufacturers. Pp. 136. (Bonnybridge.)