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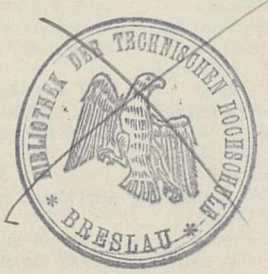
"*To the solid ground*
Of Nature trusts the mind that builds for aye."—WORDSWORTH.



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NATURE

A WEEKLY JOURNAL OF SCIENCE

"To the solid ground
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SATURDAY, JANUARY 2, 1932.

CONTENTS.

Science and Imperial Affairs.

SINCE the War, both Houses of Parliament and those members of the general public interested in Imperial matters have devoted more attention to the affairs of the five countries under British control in East Africa than to any other part of the British Empire except India. Numerous white papers on East Africa have been presented to Parliament: in 1924 a special East Africa Committee was appointed, on which all three political parties and other interests were represented: in the same year Mr. Ormsby-Gore, Major Church, and Mr. Linfield made a tour of the five countries and presented a long report to Parliament in 1925: in 1927 a further commission, to consider the possibility of the closer union of the territories, was sent out under the chairmanship of Sir Hilton Young. Following the publication of the still more voluminous report of that visiting commission, the Permanent Under-Secretary of State for the Colonies, Sir Samuel Wilson, proceeded to East Africa himself to discuss the recommendations of the Hilton Young Commission with the Colonial Governments concerned, and his report was presented to Parliament in July 1929. In June 1930, Lord Passfield, then Secretary of State for the Colonies, issued a "Statement of the Conclusions of His Majesty's Government in the United Kingdom as regards Closer Union in East Africa", and a memorandum on native policy: and finally Parliament appointed a Joint Committee of both Houses to consider the Reports on Closer Union in East Africa and other relevant documents. The report of that joint committee was recently presented to Parliament.

The reports of the Ormsby-Gore and Hilton Young Commissions were the subject of editorial comment in NATURE at the respective times of their presentation to Parliament. The Ormsby-Gore Commission, which was primarily concerned with the economic development of East Africa, quite properly dealt with political questions only in relation to their effect on such development. It was a report in striking contrast with previous reports on Colonial matters because of the exceptional prominence it gave to the dependence of economic progress on the generous provision of education and medical services, the adequate provision of scientific and technical services, and the prosecution of scientific research in connexion with social as well as purely economic problems. It directed attention to the regrettable abandonment by the East African Governments of the once famous Amani Plant Research Institute; to the need for the creation of a central veterinary research station, to serve the five territories; the establishment and endowment of a central research institute for the investigation of human tripanosomiasis (sleeping sickness); the inauguration of a great campaign against tsetse flies directed by qualified scientific experts; the re-establishment of a geological survey department in Tanganyika and the establishment of a similar department in Kenya; the organisation of anthropological research; the more energetic prosecution of plant and animal breeding experiments by the various departments of agriculture; and a scientific and comprehensive survey of the lake and marine fisheries of East Africa.

That practically all the recommendations of the Ormsby-Gore Commission in connexion with these matters were acted upon within two years was due to the energy and enthusiasm with which Mr. Ormsby-Gore and Major Church applied themselves to the task of stirring the authorities at home and in the Colonies to the need for immediate action. The fact that neither the Hilton Young Commission nor the Joint Select Committee on East Africa has found it necessary to add any further suggestions for the furtherance of scientific research is eloquent testimony to the thoroughness of their original survey.

It must be confessed, however, that the various bodies representing the interests of science in Great Britain displayed a lamentable lack of appreciation of the fact that the Ormsby-Gore report provided them with an unusual opportunity to participate more energetically in framing an Imperial policy. At that time they could have made statesmen and politicians realise that the scientific community ought not merely to be consulted by, but represented on, any and every committee set up by Government to consider any aspect of economic development at home or overseas. Incidentally, what is equally important, they could have insisted on their competence to appoint their representatives themselves, and not, as is the custom on those rare occasions when the Government does appoint a man of science on a committee, to have their representatives chosen for them by Government officials.

Since the scientific community in general has taken so little interest in the prosecution of research and the provision of essential scientific services in the Colonies, it is not surprising that successive Governments have ignored them when appointing committees to consider Colonial services and development. There is no representative of science on the Empire Marketing Board, and until recently there was no member of the scientific community on the Research Grants Committee of that body. The scientific interest was not represented on the Committee appointed in 1925 under Sir George Schuster to consider the allocation of the East Africa Development Loan which was recommended by the Ormsby-Gore Commission, although this Committee was dealing with grants for the establishment of research institutions and for *ad hoc* researches. The Hilton Young Commission of 1927, the terms of reference of which included the co-ordination of the scientific and technical services in East Africa, contained no scientific member, although the missionary societies were represented. The Labour Government ignored the scientific community in appointing members of the Colonial Development Advisory Committee, although this Committee had to consider schemes for the provision of scientific research. It is worthy of note also that the Labour Government, which appointed the Joint Select Committee of both Houses of Parliament on Closer Union in East Africa, deliberately excluded Major Church, its only representative in the Commons who had first-hand acquaintance with the territories under review, whose main contributions to the report of the Ormsby-Gore Commission had been the chapters dealing with medical and scientific research, and who could claim to represent scientific interests in Parliament.

The above list of Committees, appointed by various Governments during the past eight years, on which the scientific community should have been, but was not, represented, is by no means

exhaustive. It is long enough, however, to establish the fact that Governments will ignore scientific workers while the latter remain indifferent to the affairs of State, more indifferent, it appears, than any other section of the community, although statecraft is now mainly a question of making humanity fit for science, or at least of modifying the political and economic systems of the world to enable its inhabitants to enjoy the fruits of scientific endeavour.

That the scientific community is indifferent is borne out by the fact that on no occasion has it combined to protest publicly against the omission of its representatives from any of the important bodies enumerated above, all appointed to deal with subjects to which men of science could make important contributions, more authoritative and carrying far more conviction than if made by others with merely a vicarious interest in their work, and usually unable to appreciate the fact that the scientific outlook is even more important in dealing with Imperial or world problems than the mere application of the results of science to productive processes.

The question arises, however, are there many scientific workers themselves who are conscious of the significance of a scientific outlook as distinct from a scientific result? If there were many such, would it not be reasonable to assume that they would recognise this 'outlook' as the integrating force and create a unified representative body for the whole mass of scientific practitioners and believers in science in the British Empire? Such a body is obviously necessary if nations are to be encouraged to think scientifically. Unfortunately, the tendency towards specialisation, inevitable and of paramount importance for the advancement of scientific knowledge, has obscured the essential unity and the grander purpose of those trained in the sciences. This unity can be attained if the many specialist scientific and technical societies and institutions will recognise their limitations, and that as discrete fragments of the world of science they cannot hope to fulfil the nobler aim. They must join forces and create a strong body that can, a body the primary function of which is to inculcate a scientific outlook and promote the application of scientific method and results to national and Imperial affairs. This, in fact, is the avowed function of the British Science Guild, and there is little doubt that, with adequate support from the specialist scientific societies, such a body could get the respect for science which science deserves, and secure for science that representation in the councils of the nation which the nation and the Empire urgently need.

Hermaphrodites.

Die sexuellen Zwischenstufen. Von Prof. Dr. Richard Goldschmidt. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 23.) Pp. x+528. (Berlin: Julius Springer, 1931.) 46·40 gold marks.

IT is now eleven years since Dr. Goldschmidt brought out the well-known volume of which an English translation appeared in 1923 as "The Mechanism and Physiology of Sex-Determination". The present work elaborates that section of his former book, which treated of what are generally termed hermaphrodites, a proper understanding of which is so essential to a full appreciation of the nature of sex itself. To that understanding no one has contributed more than the author; for it was through his remarkable researches on the races of the gipsy moth (*Lymantria dispar*) that the problem of the intersex has crystallised out of that vast conglomerate of miscellaneous knowledge comprised under the heading of sex.

Goldschmidt's interpretation of the phenomena with which he deals is, of course, based upon the fact that sex, like any other hereditary character, is normally determined by specific genes which are definitely located in the chromosomal material. Where the sexes are separate the difference between them is determined by a single gene, or by a gene complex behaving normally as one; whence it follows that in the ordinary way the sexes are produced in approximately equal proportions. Such equality may be upset in various ways—for example, by differences in viability at various stages in development, by the association of a lethal factor with one sex or the other, and by other means. In such cases, however, in spite of the upsetting of the numerical balance between the sexes, their physiological distinctness remains unaffected, and the ultimate result is normal males and normal females.

Such a scheme, based on the ordinary conceptions of Mendelian heredity, offers a satisfactory explanation of most of the phenomena connected with the inheritance of sex. But it does not explain the hermaphrodite. As already stated, attention was first focused on this problem by Goldschmidt's work with the gipsy moth, a species in which the form and colour of the female is very distinct from that of the male. An amateur breeder, Herr Brake, pointed out that in certain crosses between the European gipsy moth (*L. dispar*) and a form from Japan (var. *japonica*) there appeared forms more or less intermediate in sex characters. He called them gynandromorphs, and for some years

found a ready sale for them among those who collect Lepidoptera in the spirit in which others collect postage stamps. In 1910 Goldschmidt started his remarkable analysis of the case—an analysis spread over twenty years and involving visits to Japan in connexion with the determination and crossing of the geographical races, morphological and physiological investigations, and the critical breeding of tens of thousands of moths. The gist of his interpretation is as follows.

As in other Lepidoptera, the male is the homogametic sex with two sex chromosomes carrying a sex factor, the female carrying but one. In other words, the male is homozygous for a factor, *M*, which stimulates the male part of the genital complex, while the female is only heterozygous for this factor. In the cytoplasm, on the other hand, is something which stimulates the production of the female part of the genital complex. This substance (*F*), being cytoplasmic, is maternally transmitted, and all the offspring receive an *F* of the same quality as that of their mother. In an ordinary race, such as the European *dispar*, the genetical constitution of a male is *FMM*, and that of a female *FM*. The female-producing tendency of the cytoplasmic *F* can be overcome by two 'doses' of *M*, but not by one dose. Hence the production of normal males and females in equal numbers, and of normal males and females only; and this is true for each given pure race of *Lymantria*. The explanation of the appearance of intersexes on crossing different races turns upon the assumption that the intensity of the action of *F* and *M* differs in the different races. Thus in *japonica* both *F* and *M* are 'stronger' than in *dispar*, that is, they exert their influence earlier in the course of development: conveniently they may be denoted as F_s and M_s to distinguish them from the *F* and *M* of *dispar*. The cross between *dispar* female (*FM*) and *japonica* male ($F_sM_sM_s$) results in two kinds of individuals of the constitution FMM_s and FM_s respectively. The former are normal males in appearance, but the latter are intersexes. For the 'strong' male factor (M_s) from *japonica* partly overrides the female-producing cytoplasm (*F*) from the 'weaker' parent which is inherited maternally by all the offspring from this cross. From the reciprocal cross, *japonica* ♀ (F_sM_s) × *dispar* ♂ (*FMM*) only apparently normal ♂♂ (F_sM_sM) and normal ♀♀ (F_sM) are produced. For a weak (*M*) and a strong (M_s) male factor together can override the strong cytoplasm (F_s). But in F_2 from this cross appears the fresh combination F_sMM, which must be regarded as the genetical constitution of the so-called male intersexes that appear in this generation. For two doses of the weak *M* cannot completely override the strong F_s.

When in Japan, Goldschmidt distinguished eight races of *Lymantria*, and an elaborate series of breeding experiments enabled him to arrange them in a series of decreasing 'strength'. The difference between the extremes of this series was greater than between European *dispar* and the Japanese race used in the earlier work. Indeed, it was so great that when the weakest was used as the mother and the strongest as the father, males alone resulted. Subsequent experiment showed that while about half of these males were chromosomally males (FM_sM_s), the rest were really females (FM_s) in which the male factor (M_s), introduced from the strong race, was so strong as to override entirely the cytoplasmic *F* of the weaker, and to cause a complete reversal of the sex as judged by chromosomal constitution. Conversely, Goldschmidt was also able to obtain from these two races insects of the constitution F_sMM, individuals chromosomally males but in appearance females owing to the complete overriding of the weak *M* by the strong F_s. Through crosses between the different races every grade of intersex could be obtained, but with given races the grades could be predicted even in highly complex crosses. Although the 'strength' or 'valency' of the sex factor differed for each race, it was in each race fixed, and Goldschmidt suggests that this fixity is at bottom quantitative, depending upon definite amounts of the sex-determining material present in any case. He supports his views by reference to the triploid intersexes in *Drosophila*, which cytological work has shown to depend upon the relative proportion of *X* chromosomes and autosomes.

In these cases among insects, to which may perhaps be added a few more among other invertebrates, the intersexuality depends upon the constitution of the zygote as determined at fertilisation. Goldschmidt then proceeds to consider a group of cases, also among arthropods, where parasitic infection by another arthropod may lead to partial, or even complete, reversal of sex; and he argues that this group of cases may also be brought into line with the conceptions derived from the *Lymantria* case. Perhaps the best known of this group is that of the crabs, in which infection by the rhizocephalan *Sacculina* leads to the male assuming in varying degree the female type of abdomen and appendages, and even developing ovarial tissue after the loss of the parasite. Goldschmidt suggests that the action of the parasite may be to upset the

normal balance between the *F* and *M* substances, either by destroying one or by increasing the other. There is, however, a peculiarity about this group of cases in that, with the possible exception of the stylopised *Andraena*, the intersex is always the result of the male becoming more or less feminised. Such changes as occur in the female may be regarded as merely an arrest in the normal development. The case for what may be called 'reciprocal reversal' rests upon the colour changes in the clypeus of *Andraena* in different species, and one would like to know more about the genetics of this character before accepting Goldschmidt's view.

The so-called parasitic castration group shows, however, that the sexual characters inherent in the zygotic constitution of the individual may be largely modified by influences extraneous to the cell. This is of course markedly the case for the vertebrates, where the development of sexual characters is largely dependent upon the hormones or internal secretions developed by the gonad, and by other glands as well. The wide difference in this respect between arthropods and vertebrates is well shown by castration experiments. In *Lymantria*, as Meisenheimer showed many years ago, castration in the larval stage, whether simple or followed by transplantation of the gonad of the opposite sex, has no effect either on the sexual apparatus or on the secondary sexual characters. The turning-point is already past and the sex irrevocably determined before the operation has become a practical possibility. In vertebrates, however, as is well known, castration produces marked changes, the magnitude of which is to some extent dependent upon the stage at which the operation is performed. In general, it may be said not only to arrest the development of the sexual apparatus itself, but also to inhibit in many cases the appearance of secondary sexual characters. The normal condition may, however, be restored by implantation of a gonad of the same sex. Even more remarkable is the result of implanting a gonad of the opposite sex; for in this way a female may be caused to develop many of the characters of the male, and vice versa.

Goldschmidt's book provides an excellent and critical account of all the more important work that has been done along these lines. He points out, too, that although the sexual complex in vertebrates is so sensitive to hormonal secretions, we can nevertheless distinguish certain cases in which an intersexual condition must be regarded as directly dependent upon the zygotic constitution of the individual. The clearest cases are in the goat and the pig, particularly that of the remarkable New Hebridean swine described by Baker, and Goldschmidt is justified in pointing out the parallel which they afford to his Lymantrias. For there can be little doubt that here also the peculiarities are hereditary, and due primarily to zygotic constitution. A valuable feature in Goldschmidt's book is his review of intersexuality in man, a subject hitherto much confused by the speculations of medical men who lack genetical training. Though most of the phenomena can be brought into line with those exhibited by the pig and the goat, there are certain others that are very puzzling. Among these are gynæcomasty and homosexuality, and Goldschmidt is inclined to look for an explanation in a defect of some endocrine secretion rather than in zygotic constitution, the criterion of intersexuality proper.

The last part of the book is devoted to a consideration of gynandromorphs as distinct from intersexes. This important distinction we owe to the author himself, who once aptly described the former as hermaphrodites in space and the latter as hermaphrodites in time. For, whereas the latter are sex compromises dependent upon the relative speeds at which the *M* and *F* substances get to work, the former are merely mosaics of purely male and purely female tissues. The formation of such a mosaic generally depends upon the elimination of a sex chromosome at some stage or other in cell division. Thus, if a fertilised *XX* egg of *Drosophila*, which would normally develop into a female, drops out an *X* from one of the two cells resulting from the first division, and if then development proceeds normally, one half of the resulting insect will be *XX* and the other half *X* in constitution. Hence one half of the body will be female and the other half male, that is, the insect will be a bilateral gynandromorph. But polyspermy or binucleate eggs may also be sources of gynandromorphs, and the reader will find a clear exposition of the various possibilities. Of great interest, too, is the account of the hereditary nature of gynandromorphs in the silkworm, the working out of which we owe to the author.

Taking it altogether, the book gives what is undoubtedly the fullest and most lucid exposition of the subject that at present exists. On some points the reader may disagree with the author's views, but the position of those with whom he may not hold is always fairly met, however sharply criticised. As befits a master of his subject, the dominant idea throughout is synthesis, the attempt to weave into a coherent whole a great mass of facts, using *Lymantria* as the guiding thread. The result is a

valuable and highly stimulating book, admirably documented on an excellent bibliography. On one point alone is it possible to quarrel with it. For, though well produced and fully illustrated, the price appears to us to be exorbitant. One can only hope that this will not restrict the sale of a work that in the interests of knowledge deserves a wide circulation.

Comparative Psychology in the Field.

The Intelligence of Animals : Studies in Comparative Psychology. By Frances Pitt. Pp. 320 + 46 plates. (London : George Allen and Unwin, Ltd., 1931.) 15*s.* net.

FOR many years Miss Frances Pitt's books have adorned the front rank of observational studies in animal behaviour. One was always sure of finding fresh material, as reliable as it was interesting. Gradually, however, the gifted observer has become more frankly reflective, as in her " Animal Mind " ; and now we have a record in which the inferences are definite contributions towards a solution of some of the deeper problems of biology. The outcome is a psycho-biological picture, convincing us afresh that we cannot describe the ways of animals, or account for their survival, unless we do justice to their ' mentality ', including in that term all the creature's mental acquirements, characteristics, and predispositions. That intelligence and parental affection may have survival value will be admitted by most open-air naturalists, but Miss Pitt shows that we must also take account of subtler qualities, such as tameness and confidingness, wariness and shyness, a desire to be left alone, and a liking for neighbours. Inferences cannot, of course, claim the cogency of observations, but Miss Pitt states a strong case for the validity of psycho-biology, stressing the mind-body as much as the body-mind. Even temperament may have survival value in wild Nature.

The first studies have to do with call or decoy ducks, a domesticated race of mallards, which show how the ' wild ' may give rise to the ' tame ' and lose some of its most characteristic features, such as monogamous and migratory habits. The wild mallard is not turned into the tame decoy, but a selection of stay-at-home individuals, sustained for generations, results in the elimination of the wandering and migratory impulse. The tame type is in most cases quite content to stay all the year round upon two or three small pools, despite the fact that it has wings at its command and might wander far if it pleased. " The strict monogamy that characterises the mallard suffers in the case of the decoy duck from the deteriorating influences of man and domestication." The duck remains faithful, but the drake generally makes use of his opportunities to ' transgress '—a term which is not, of course, meant to imply an avian code of morals in the strict sense.

In the second set of studies, centred in the semi-domesticated peafowl, Miss Pitt has many observations of great interest. It looks as if the peacock's display is in the main an expression of exuberant sex-excitement : he may show off to ducks ; the hen is often bored by the display ; there is little to suggest that the cock has any inkling of his own splendour. As the display involves considerable strain, as in rattling the quills, we search for some other utility if we abandon (as we are not yet prepared to do) the theory that it infectiously rouses the interest and sex-excitement of the hen. Miss Pitt interprets its biological function as " probably that of advertisement, so that the female may know the whereabouts of the male, and *especially her male* ". For the hens are faithful to their chosen polygynous cock.

Very important, as it seems to us, is the conclusion that the showing-off attitude, with erection of the tail-coverts, is the same in the tiny chicks, in the young birds of both sexes, in the old hens, and in the adult males. " Under stress of emotion they all behave in the same manner." In other words, the sex-urge utilises and emphasises a general gesture. Chicks not ten days old, excited by the sudden appearance of a pet raven, erected their diminutive tail-coverts just as did their strutting sire.

Another observation on young peafowl is very interesting : that when they lost their mother, about three weeks after hatching, and were pining, they took courage when the hurriedly stuffed body was brought on the scene, and behaved to it, doubtless on the strength of established associations, exactly as if the mummy, which became flat and loathsome, were actually alive. There are many similar treasures in this delightful and reliable book, but we cannot do more than indicate the general nature of the observations.

The third part of the book deals with the horse, cow, sheep, and pig ; and readers of Miss Pitt's " Animal Mind " will not be surprised that her estimate of the horse's mentality is lower than that usually approved, while her estimate of the other three ungulates is higher. Scientific and impersonal as we try to be, we cannot, while comparative psychology remains relatively inexact, readily get away from our individual experience of individual

animals. Thus we personally think that the horse's intelligence is much greater than Miss Pitt can see her way to allow.

The fourth section of the book is devoted to dog and cat, and it pricks some bubbles of reputation. We breathe more freely when we discover that the dog still remains worthy of being called intelligent, while the cat's mind is left as an elusive mystery behind its inscrutable green eyes.

The fifth part deals with the fox, as a type of the thoroughly wild mammal. As a sample of the careful phrasing that marks the whole book, we quote Miss Pitt's verdict on the fox:

"My opinion of the average fox is that it ranks high in the scale of intelligent mammals, but that much of its conduct is regulated by inherited response, though such instinctive aptitude is ever qualified by experience, by which the fox profits to a marked degree, its very educability proving its intelligence. . . . If not so super-intelligent as some sporting writers and the sentimental story-writers would have us believe, it is equally far removed from the thing of merely automatic responses that the behaviourist school make of our mammals."

This is well and wisely said, yet perhaps there is something to be gained by keeping the word 'conduct' for those rationally or ethically controlled human activities which rise above 'behaviour'.

The sixth section is perhaps the subtlest in the book, and thus the least convincing. It takes lemming, crane, and Skomer vole as illustrations of the thesis that temperament has survival value in the struggle for existence. The lemming's behaviour is characterised by the temperamental quality we call tameness, which is made possible by certain compensatory advantages, such as the habit of burrowing beneath the enveloping mantle of snow and the capacity for very prolific multiplication. The apparently contradictory intimidating display in a tight corner is the outcome of a mixed emotion of fear and anger. It is a useless and often risky form of 'bluff'.

Why is this delightful book of high scientific value? Because it is a vindication of the importance of the mental factor in determining the status of an animal, its survival and distribution—a vindication by an expert observer who is aware of the many pitfalls of psycho-biological interpretation. We quote her concluding sentence:

"Every bird, beast, and lower creature supplies us with a problem of the highest interest—namely, the elucidation of the factors that control its position in the web of life, of which factors those governing behaviour are the most vital, especially the mind that governs purposive action."

J. A. T.

The Science of Oceanography.

Oceanography: its Scope, Problems, and Economic Importance. By Henry B. Bigelow. Pp. vii + 263. (Boston and New York: Houghton Mifflin Co.; London: Chapman and Hall, Ltd., 1931.) 12*s.* 6*d.* net.

IT is barely sixty years since H.M.S. *Challenger*, by her exploratory voyages round the world, built the foundations upon which the modern science of oceanography has grown up. For centuries man had roamed the seas and charted their boundaries, looking for new land or trade routes rather than for a knowledge of the sea itself. Exploration showed that less than one-third of the earth's surface is dry land; now that most of this has been mapped, attention is being turned more and more to the remaining two-thirds, which forms a world of its own, and by the very reason of its vastness holds the key to many of the secrets of land phenomena.

The geologist must look to the nature of the ocean bed for help in the solution of some of the most pressing questions in the study of the earth's crust. This involves a knowledge of the sediments now being deposited on the sea floor, of the rate of their deposition, and the question of their subsequent solution. These phenomena are so intimately bound up with the physics, chemistry, and biology of the sea that they emphasise at once the unity of oceanographical science. The presentation of the whole story of the course of events at the present day would throw much light on the past history of our sedimentary rocks. The study of dynamic geology further demands a more complete knowledge of the contours of the great ocean beds, combined with gravity measurements to determine the density of the earth's crust.

To the biologist the sea represents a world in itself; in fact, once the excitement of research on life in the sea has gripped the beginner, he is liable to forget that a zoology of animals on dry land exists. This is pardonable, when it is realised that there are probably few problems on land that have not their parallels in the sea, in which all life was evolved. Owing to the peculiarity of the environment also, the very fundamentals of life appear to be best open to attack, for it is in the sea that life is at its simplest and the living organism is least cut off from its surrounding medium by the development of protecting structures. It is for this reason, perhaps, that the marine biologist at once feels that any observations he makes are sadly lacking if he does not possess the necessary physical and chemical

data of the environment. For the sea is a whole, and must be treated as such for a correct understanding of the manifold problems that surround us. Where the whole water mass is in constant circulation, changes in one locality may be far-reaching and make their effects felt in the remotest regions. Perhaps nowhere is this more obvious than in the study of the great fluctuations in marine life, the ultimate effects of which are brought home to us in the fisheries from which we draw so much of our food supply.

We have travelled a short way only along the road of oceanography, but everywhere the signposts point to the need for networks of fuller and more complete observations over wide spaces and over long periods of time. Such need is, perhaps, most outstanding in the realm of physical and chemical oceanography, where the actual movements of the water masses are concerned; movements which, apart from their enormous biological implications, must have a bearing on meteorology and on navigation. It awaits to be shown whether correlation can be found between the conditions of water masses in one region and later meteorological conditions in far distant localities, a problem that alone involves many years of labour. But if such correlation should be found, its great economic value in the possibilities of long range weather forecasting is obvious to all.

Oceanographical investigation is expensive, entailing as it must do the running of a well-found ship. The solution of many of the most pressing problems is not insurmountable with mechanics to our aid; and here again the building and elaboration of effective apparatus is always expensive. For these reasons, with few exceptions, most schemes of research have been State-aided, and apart from the great exploratory voyages, the ultimate assistance of the fishing industries or the safeguarding of navigation have been held up as the main ends in view.

Last summer, however, one of the finest private marine institutions opened its doors at Woods Hole, alongside the two well-known existing laboratories. As a true marine laboratory, it has as its object the advancement of any knowledge that can be gained from an investigation of the sea. Operating from the laboratory is an ocean-going research vessel, the *Atlantis*, which has already completed her maiden voyage across the North Atlantic Ocean. The institution, which has been fully endowed by the Rockefeller Trust, is thus in a position to carry out a continuous study of the sea unhampered by the desire for immediate economic return for knowledge gained. The Director of the Woods Hole Oceanographical Institution, Prof. Henry B. Bigelow, has brought together in a masterly manner the present position of oceanographical research and its implications. One may conjecture that this report, which was laid before the National Academy of Sciences, was in no small degree responsible for the birth of the Woods Hole Institute. In the author's words, the book "is in no sense a text-book or a compendium of oceanographic knowledge". It does, however, very adequately lay before us some of the many problems still awaiting investigation in the science of oceanography, and as such deserves to be read by the research worker and the student.

F. S. RUSSELL.

Short Reviews.

(1) *Dorure-encadrement: technique des différents genres de gravure, comment reconnaître les fausses estampes et les faux papiers.* Par A. Broquelet. (Bibliothèque pratique de l'amateur.) Pp. 95. (Paris: J.-B. Baillière et fils, 1930.) 6 francs.

(2) *Décoration des verres, émaux, céramiques.* Par Prof. Suzanne Zaborowska. (Bibliothèque pratique de l'amateur.) Pp. 90. (Paris: J.-B. Baillière et fils, 1930.) 6 francs.

(3) *A Treatise on the Air Brush: with Progressive Lessons.* By Samuel W. Frazer and George F. Stine. Pp. x+203. (London: Chapman and Hall, Ltd., 1930.) 12*s.* 6*d.* net.

THE first two works form a portion of a library for amateur craftsfolk, but being written by cognoscenti, they should prove welcome to others also. (1), in successive chapters, deals with a brief historical survey, modelling, moulding, pyrography, adhesives, methods of engraving, lithography, photography, protecting engravings, framing, watermarks, mounting and wood gilding. In the space allotted are provided a large amount of useful information and many appropriate diagrams and illustrations, two of the latter (on pyrography) being from sketches by the writer of (2), which deals with a most interesting branch of art. But this manual is less satisfying than (1), for there is too much vapouring and too little practical exposition. The chapters relate to decoration of glass of various kinds, enamels and ceramics. Stained and leaded glass are well treated. "Nous avons expliqué les différents procédés" (p. 65) is not self-evident. The writer is a mistress at her craft and has a vigorous stroke for illustrations; she shows vividly how to adapt natural to conventional treatment. Special mention may be made of the stork (Fig. 25) and the strawberry leaf (Fig. 49). The third book is a very masterly exposition of that modern tool, the air-brush. The literary style is unexceptionable, the information direct and well balanced, and the illustrations as effective as American work is apt to be. There is

no doubt that the use of the air-brush can be well learnt from this treatise. There are, however, many who would still prefer the older method of brush treatment. P. L. M.

Applied Mathematics for Engineers. By T. Hodgson. Vol. 3: *Differential Equations with Applications.* Pp. viii + 320. (London: Chapman and Hall, Ltd., 1931.) 13*s.* 6*d.* net.

FOLLOWING the very lucid and interesting application of the calculus to dynamics, given in vol. 2, Mr. Hodgson has produced an excellent sequel in the present volume. The course has been thoroughly well planned and clearly dealt with. The subject matter embraces ordinary equations, simultaneous linear equations, partial differentiation and equations, with two good chapters on double and triple integration and spherical trigonometry.

The theoretical aspect has been well developed, though not, perhaps, with the strict rigour so dear to the pure mathematician, for this would be quite out of place in such a book. Nevertheless, just as much theory as is essential to the intelligent understanding of fundamental processes is given, so that the engineering student need no longer be a mere seeker after ready-made formulæ, but may acquire an efficient mathematical equipment by which he can be certain that his calculations are based upon a sure foundation. The chapter on partial differentiation is a striking example of the skill by which the author develops the theoretical basis. An index is unfortunately omitted from the *y* in the sixth line from the bottom of p. 80.

Not the least interesting part of the book is its manifold applications. These are carefully selected and demonstrated with great clarity. Beginning with the usual deflexion of beams, the author leads on to thermodynamic problems, harmonic analysis, and alternating currents, which are dealt with by vectors, by complex quantities, and by the Steinmetz operator. Numerous exercises for the student are also provided and these have evidently been carefully selected so that few problems of purely academic interest have been included.

(1) *The Macmillan Table Slide Rule.* By Prof. J. P. Ballantine. Pp. 4 + 4 slides + 4 plates. (New York: The Macmillan Co., 1931.) 2*s.* 3*d.*

(2) *Natural Trigonometric Functions to Seven Decimal Places for every Ten Seconds of Arc, together with Miscellaneous Tables.* By Howard Chapin Ives. Pp. vi + 329. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 45*s.* net.

(1) FOUR plates contain five figure tables of 10^x, 10^{10^x}, arc sin 10^x, arc tan 10^x. The four slides consist of tables of 10^x, 10^{-x}, 10^{2x}. By aligning the slides on the appropriate plate all the usual slide rule calculations which depend on $\log x$ and $\log \log x$ can be performed. The alignment needs great care if a wrong reading is to be avoided.

(2) The main table gives on 270 pages natural sines, cosines, tangents and cotangents for every 10 seconds of arc, each page covering a range of 10 minutes of arc. The functions corresponding to an integral number of minutes are more boldly printed. The effect is pleasing and makes the table convenient in use. First differences and proportional parts are also given. The remainder of the book contains various subsidiary tables connecting chords, arcs, radii and central angles in a circle, adapted to the use of railway and road engineers. The book concludes with trigonometrical formulæ and an explanation. The origin of the values in the main table is not mentioned. The author states that the manuscript was twice checked and the proofs read four times and by three persons. The binding is strong and the printing is excellent. L. M. M.-T.

Motor Benzole: its Production and Use. By W. H. Hoffert and G. Claxton. Pp. xxi + 689. (London: The National Benzole Association, 1931.) 25*s.*

FARADAY discovered benzene, Perkin made synthetic dyes from aniline; it was found to be an easy step by nitration and reduction from benzene to aniline. Benzene became ennobled, the world preened itself in a coat of many colours, and birth was given to the great dyestuffs controversy which, perhaps, has now found an honourable senescence amongst the acts in the Expiring Laws Continuation Bill. Now a new child has been born, motor benzole, with a more aristocratic name. After one or two false starts in 1903 and 1907, it became an established fact as a fuel in 1913, and now National Benzole pumps are to be seen every few hundred yards on our highways. The proportion of the total production used—Prof. H. E. Armstrong terms it misused—by the motorist increases each year, and considerably exceeds that required by the dye-maker, who, however, has to pay the higher price based on the fuel value of the spirit.

Benzole is extracted in gas works and coke ovens, but nothing like the total quantity possible is recovered. Some day a commercial synthesis of benzene will be achieved. It takes a book of more than 600 pages, including 120 tables, to tell us about motor benzole from every aspect of practice and theory. It is authoritative since it is prepared under the auspices of the National Benzole Association, which has established a highly competent research department.

The Problems of Evolution. By Prof. A. W. Lindsey. Pp. xiii + 236. (New York: The Macmillan Co., 1931.) 8*s.* 6*d.* net.

THE object of this essay is to show how impossible it is to separate heritage and environment in the study of evolution. This involves the author in a discussion of the inheritance of acquired characters, and references are given to much recent research. The limitation in its application to the methods of evolution lies in the difficulty of associating the responses of somatic structures with the germ cells. The book will be useful to teachers and students of biology for their lighter reading. They must be critical, and they should try some experiments for themselves.

Scientific Centenaries in 1932.

THE value of the commemoration of the centenaries of notable men of science, of famous institutions, and of important discoveries, was demonstrated in many ways in 1931. The various celebrations not only gave opportunities for recalling great achievements but also provided occasions for reviewing the progress made in scientific research and its application to industry, and for stimulating public interest in modern developments. But apart from any direct gain which arises from such celebrations, it is only just that tribute should be paid to the memory of those who in the past have added to the spread of natural knowledge.

Foremost among the centenaries which fall within the year 1932 is that of Sir William Crookes, who was born on June 17, 1832. From the time of his discovery of thallium in 1861, until his death in 1919, he was in the front rank of investigators, while from the day he first published the *Chemical News* in 1859, he gradually attained to the highest eminence as a leader of scientific thought. His presidential address to the British Association in 1898 will long be remembered, while his name is to be found among the Copley medallists and the presidents of the Royal Society.

Born three months before Crookes, the eminent French man of science, Charles Friedel (1832–99) was both chemist and mineralogist. He assisted to found both the French Chemical Society and the French Association for the Advancement of Science and was the successor of Wurtz at the Sorbonne. Another chemist, born in 1832, who achieved distinction was Walter Weldon, who from journalism turned to scientific studies, and by his introduction of the manganese recovery process in the manufacture of chlorine, cheapened, as Dumas said, "every sheet of paper and every yard of calico throughout the world".

To the year 1832 also belong the names of Cailletet, König, Varley, Wimshurst, and Sir Charles Bright. Louis Paul Cailletet (1832–1913), one of the greatest ironmasters of France, in 1877, at the same time as Pictet, liquefied oxygen. He has been called the 'father of modern cryogenics'. Rudolph König (1832–1901), a German instrument maker of Paris, was well known for his researches in acoustics; James Wimshurst (1832–1903), the Board of Trade ship surveyor, built influence machines which did much to revolutionise the science of static electricity; Samuel Alfred Varley (1832–1921) was the inventor of the compound-wound dynamo, while Sir Charles Bright (1832–88) will always be remembered as a pioneer in submarine telegraphy. He was only twenty-four years of age when, in 1856, he joined with Brett and Cyrus Field in planning the project for the first Atlantic cable.

To these names may be added those of Nicolas August Otto (1832–91), originally a commercial traveller, who is remembered to-day for his outstanding work on the internal combustion engine; Gustave Eiffel (1832–1923), whose great tower was but one of many notable civil engineering works for which he was responsible; Alexander Lyman Holley (1832–82), "foremost among those whose genius and energy established in America and improved throughout the world the manufacture of Bessemer steel"; and Octave Chanute (1832–1910), another engineer, who became a pioneer of gliding and whose "Progress in Flying Machines" published in 1894 is a mine of information on early aeronautics. Chanute was born in Paris, but was taken at the age of six to America, where all his work was done.

The following were also born in 1832: Henry Seebohm, author of the "History of British Birds and their Eggs" (4 vols., 1882–85); Sir William Turner, formerly professor of anatomy in the University of Edinburgh and president of the British Association at the Bradford meeting in 1900; and Sir Edward Burnett Tylor, for whom a professorship in anthropology in the University of Oxford was instituted.

The losses in the ranks of men of science by death in 1832 were severe. Especially so was this the case in France, where an epidemic of cholera raged, which led to the death of eighteen thousand persons in Paris alone. Among the victims of the epidemic were Sadi Carnot (1796–1832), immortalised by his essay, "Reflections sur la puissance motrice de feu"; Baron von Zach (1754–1832), the Hungarian astronomer who from 1791 directed the observatory at Seeberg; and General Berge (1779–1832), of the French artillery, one of the earliest students at the École Polytechnique, who drew the plates for Monge's "Géométrie descriptive". The Marquis de Jouffroy D'Abbans (1752–1832), the French representative among the pioneers of the steamboat, and Baron de Sané (1755–1832), the eminent naval constructor, "le Vauban de la Marine", who built the historic *Orient*, also died in 1832, as likewise did the veteran chemist Chaptal (1756–1832), and the great naturalist Cuvier (1769–1832). Both these distinguished men played a part in public affairs under Napoleon, and Cuvier, as permanent secretary of the Paris Academy of Sciences from 1803 onwards, was one of the most prominent among the brilliant group of French men of science of that time.

To these names must be added that of the young French mathematical genius, Evariste Galois (1811–1832), who was killed in a duel and whose tragic biography has been written by Dr. G. Sarton, and also those of the Italian astronomers and ecclesiasts, Angelo Cesaris (1750–1832), and Barnaba Oriani (1752–1832), who made Milan Observatory famous; of Stephen Groombridge (1755–1832), the London merchant who compiled a star catalogue and helped in founding the Royal Astronomical Society, and that of Sir John Leslie (1766–1832), the successor of Playfair and the predecessor of J. D. Forbes in the chair of natural philosophy at Edinburgh.

Bicentenaries are naturally less numerous than centenaries, but many are of considerable interest.

In 1732, for example, both Maskelyne and Lalande were born. For forty-six years Maskelyne (1732–1811) was Astronomer Royal, and to him was due the founding of the *Nautical Almanac*. Lalande (1732–1807) also has many claims to our homage. Indefatigable in his exertions on behalf of science, by his lectures at the Collége de France he gained for astronomy an unexampled popularity, and one of his books was called "the great newspaper of astronomy". It was to Maskelyne that Herschel first communicated the discovery of the heavenly body now known as the planet Uranus, but it was Lalande who wished to call it Herschel, a name it was actually known by for some years. Another astronomer born in 1732 was David Rittenhouse (1732–96), who succeeded Franklin as president of the Philosophical Society of Philadelphia and was among the first to welcome Priestley to America. The French mineralogist, Gabriel Jars (1732–69), the compiler of the "Voyages métallurgiques"; Alexander Cronstedt (1732–65), the Swedish discoverer of nickel, were also born the same year, as also was Richard Arkwright (1732–92), the greatest of the founders of our textile industry.

Carrying the survey a hundred years still further back, in 1632 Sir Christopher Wren and the great Dutch naturalist Leeuwenhoeck were both born, while that year saw the deaths of several mathematicians who were contemporaries of Kepler, Napier, and Galileo. The two British mathematicians, Thomas Allen (1542–1632) and Nathaniel Torporley (1564–1632), died in September and April respectively; the Dutch mathematician, Albert Girard (1595–1632), who collected and published the works of Stevinus and discovered various properties of spherical triangles, died in December; Lansberg (1561–1632), of Belgium, both mathematician and astronomer, whose tables were used by Horrocks, died in November; Christopher Borrus (1583–1632), of the Society of Jesus, who travelled to the Far East and in his charts of the Atlantic and Indian Ocean anticipated some of the work of Halley, died at Rome in May 1632, while another mathematician who died that year was Jobst Bürgi (1552–1632), whose system of anti-logarithms was worked out by him independently of the contemporary discoveries of Napier.

Hydro-Electric Power Development in the Pyrenees.

By Dr. BRYSSON CUNNINGHAM.

AN interesting and efficient system of electric power generation and distribution, serving the Southern Railway of France (Chemins de Fer du Midi) and a number of important regional industries, has been developed, mainly during the past decade, from the natural water resources of the western Pyrenees. During a recent tour in southern France, I was afforded, through the courtesy of the Midi Company, an opportunity of visiting several of the generating stations, and the following is a brief description of the salient features of the undertaking, known as the Union des Producteurs d'Électricité des Pyrénées Occidentales (U.P.E.P.O), which controls more than half a million horse-power, say one-fourth of the total water power developed in France, as registered at the end of 1930. The gross potential water resources of that country are estimated to be between nine and ten million horse-power.

The Pyrenees, forming, as is well known, the frontier barrier between France and Spain, with a length of about 240 miles between Cape Cerbera on the Mediterranean littoral and the south-eastern corner of the Bay of Biscay, apart from their engaging geological structure, present an interesting hydrographic feature, in that there is a marked difference in the rainfall and snowfall between the eastern and western halves of the chain, the quantity being much greater in the west. I certainly acquired a confirmatory impression of the western abundance during three consecutive days spent in the neighbourhood of Pau in September, when the rainfall was almost incessant and its intensity surprising. The notable absence of glaciers in the eastern Pyrenees is accounted for by the insufficiency of the falls of snow for their formation. Obviously then, the great preponderance of moisture in the centre and west has marked out this region as a suitable area of exploitation for the development of hydro-electric power, and it is within the limits of the latitude of Oloron in the west and the

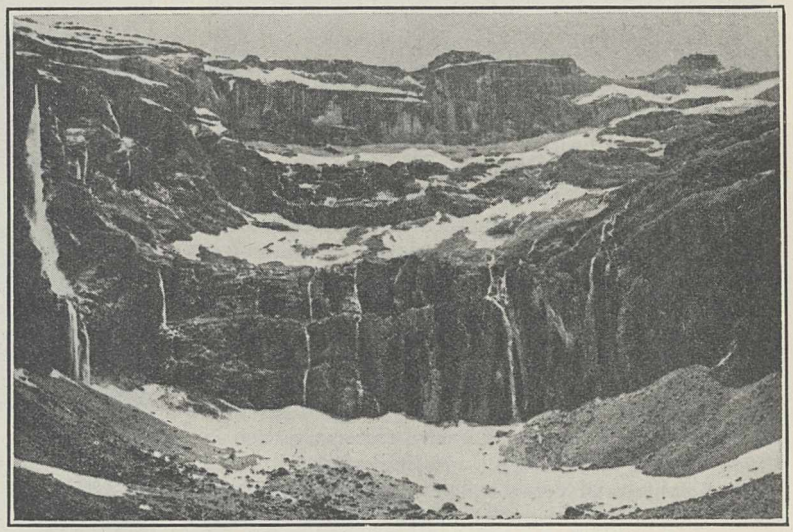

FIG. 1.—Cirque de Gavarnie.

Val d'Aran in the east that the leading stations of the U.P.E.P.O. are located.

From the hydrographic point of view, several other characteristic features of the range lend themselves admirably to water-power development. Despite the general absence of great lakes, such as those in the Alps, there is a number of natural basins of moderate extent which have been adapted as storage reservoirs for a working or a reserve supply of water, possessing potential energy of high value. In addition, waterfalls are numerous and lofty, being surpassed in Europe only by those of Scandinavia. The highest is the celebrated Cascade de Gavarnie with a fall of 1515 ft. The mountain streams or torrents which give rise to these falls are known locally as 'gaves'.

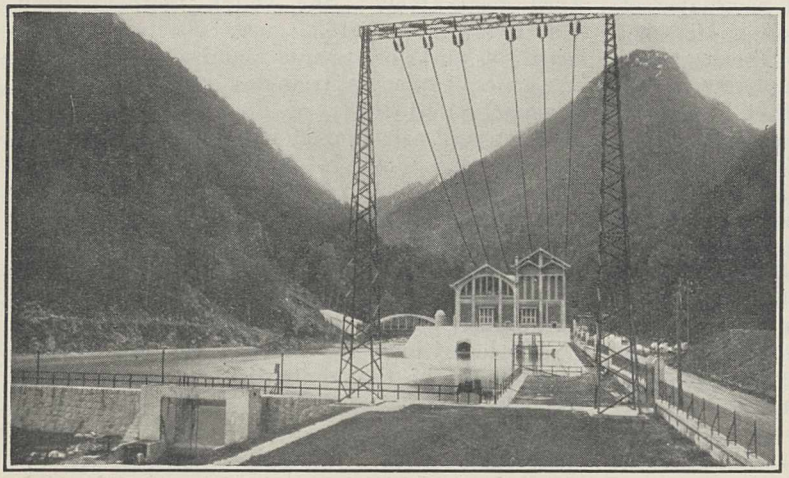

FIG. 2.—Miègebat generating station. The pipe lines are to the left and cannot be seen in the photograph. They enter the station across the bridge in the background.

It is a curious feature of the topography of the Pyrenees that the upper ends of the valleys frequently expand into gigantic arcs of circles surrounded by towering, precipitous cliffs, crowned by snow and ice. These enlargements are designated 'cirques'. The most notable is the Cirque de Gavarnie at a height of 5000 ft. above sea-level, about a mile and a quarter in diameter, with rugged sides several thousand feet high, scored and intersected by hundreds of silvery cascades, including the Cascade de Gavarnie mentioned above (Fig. 1).

The U.P.E.P.O. came into existence in the early part of 1923, with the object of utilising to the best advantage the supplies of hydro-electric power in the western Pyrenees, by providing service lines to distant centres of consumption and by regulating the output of the various generating stations, using the surplus, after meeting the requirements of railway traction, for chemical and metallurgical industries. Eleven bodies are now affiliated to the Union, which possesses thirty 'centrales' or generating stations, totalling a maximum available power of 400,000 kva. and producing energy in a normal year to the extent of more than 1500 millions of kilowatt-hours.

Of the thirty stations, the Midi Railway Company operates five of the largest: three in a chain, or stepped series, and two detached and isolated insulations. The chain lies in the upper valley of Ossau and commences at summit level with a source in the lake Artouste, a deep basin situated near the frontier line with its natural surface at a height of 1968·6 metres above sea-level. By means of a dam, the depth of water has been increased by 25 metres so as to form a reservoir with a capacity of 25 million cubic metres. From the lake a tunnel through the granite rock, 8·5 km. in length and about 6 ft. in diameter, conducts the water to a point just above the station of Artouste, which is entered by means of three pressure tubes under a gross head of 758 metres. The diameter of the tubes gradually decreases from 800 mm. to 600 mm. The flow actuates three Pelton wheels, each of 10,000 horse-power, coupled to three C.E.F. alternators of 7000 kw. capacity.

After passing through the Artouste Station, the water is received into two basins, each of 95,000 metres capacity, in succession, forming a working reservoir for the next station below at Miègebat, distant about 7·6 kilometres (Fig. 2). These basins also receive direct the waters of two mountain streams, or gaves: the Gave de Bious and the Gave de Brousset. The combined supply enters the Miègebat Station through four pressure tubes of 950 mm. diameter, under a net head of 380 metres. The generating plant consists of five Pelton turbines of 10,000 horse-power each and five alternators of 7000 kilowatts.

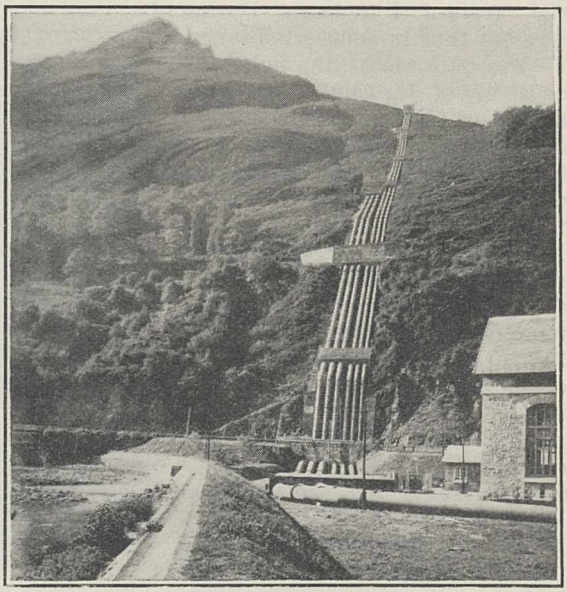

FIG. 3.—Soulom generating station and pipe lines.

The next and final stage is the drop to the level of the station of Le Hourat, which is adjacent to

the head of the railway line at Laruns. The water is conducted through a canal having a length of 5·75 kilometres to four pressure tubes of 1200 mm. diameter, falling through which under a head of 204 metres, it actuates five Francis turbo-alternators of 10,000 horse-power each. Altogether, throughout the entire length of the Ossau Valley, there is plant for the development of 130,000 horse-power, producing 230 millions of kwh. annually.

The detached stations are those of Soulom and Eget. The former (Fig. 3) adjoins the railway line at Pierrefitte and is not far distant from the charming mountain resort of Cauterets, which is reached by an electrically operated tramway. The station at Soulom receives supplies of water from the Gave de Pau and the Gave de Cauterets under very different heads—the former being low and the latter high—necessitating two distinct forms of generation. The net fall of the Gave de Cauterets is 240 metres, and the water is conveyed through three pressure tubes of 810 mm. diameter to two Pelton wheels of 3500 horse-power, each coupled to alternators. The fall of the Gave de Pau is only 106 metres, and in this case the three pressure tubes have a diameter of 1200 mm. and the generating plant consists of three Francis turbines of 3500 horse-power each. The total capacity of the station, accordingly, is 21,000 horse-power, and its annual output is 80 million kwh. It is the smallest of the Midi installations, and was inaugurated before the War. A curious feature which I noticed is the variegated colouring of the pressure tubes, which, at first glance, I thought might possibly be a relic of War-time camouflage, especially as it had a faded appearance. I was told, however, that it was an attempt at æsthetic treatment with the view of harmonising the appearance of the pipes with the mountain background. As such, it could not be considered altogether successful. If a pipe line can be hidden or rendered less obtrusive by shrubs and vegetation, the advantage from a scenic point of view is, no doubt, considerable, but variegated tinting of the pipes only seems to produce a tawdry and unquestionably artificial effect.

The last station to be noticed is that of Eget (Fig. 4), which is located in the high valley of La Neste de Couplan. It benefits in part from an arrangement made in 1870 by the French Minister of Agriculture in order to create dry weather reserves to feed the lakes of the region, the streams of the plateau of Lannemezan, and the district of Gers. The following four lakes have accordingly been impounded so as to provide increased capacities, namely:

Orédon	7,000,000 cu.m.
Cap de Long	7,000,000 ,,
Aumar	1,100,000 ,,
Aubert	4,500,000 ,,

In addition, the Midi Company, by means of a barrage, has formed in the valley of the Oule an artificial reservoir of 6,500,000 cu.m. capacity, receiving supplies from a catchment area of 30 square kilometres. This brings the available reserves for the Eget Station up to 25 million cu.m. The head at the station is 710 metres, and the water passes through seven tubes of 560 mm. diameter to a corresponding number of turbo-alternators of 5000 horse-power each. The mean annual output is 90 million kwh., of which 30 millions, due to stream flow, must be consumed between the months of April and July, while the remainder, provided by lake supply, can be consumed as required.

Time did not permit me to visit any stations outside the Midi groups. With three exceptions,

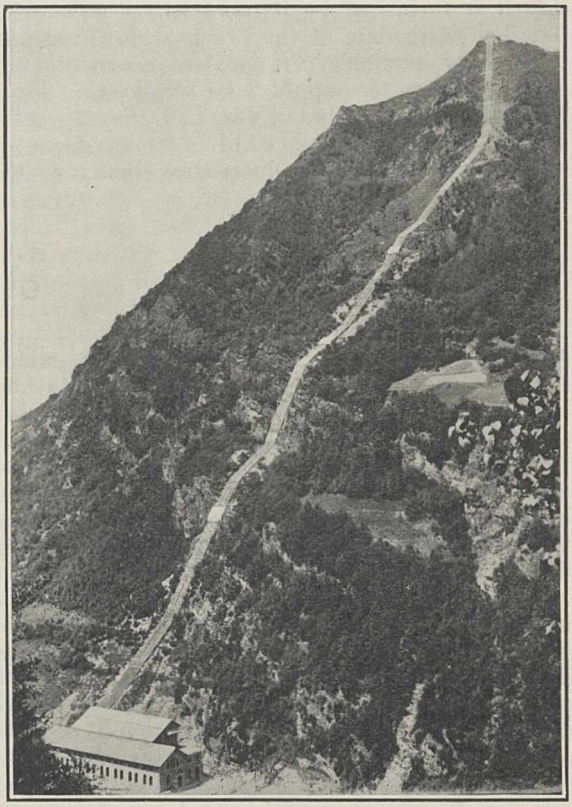

FIG. 4.—Eget generating station and pipe lines.

however, the rest are of relatively minor calibre, that is, less than an aggregate of 20,000 horse-power per station. The largest is one of 50,000 horse-power at Pinet, operated by the Énergie Électrique du Rouergue. Two others, of 35,000 and 33,000 horse-power respectively, belong to the Societé Hydroéletrique de la Cère and the Sté. des Forces Électriques de la Vallée de Gavarnie.

An account of the stations can scarcely be considered complete without some reference to the system of distribution, which is very capably organised and constitutes one of the chief duties and responsibilities of the Union. The U.P.E.P.O. takes delivery of the energy furnished by its affiliated concerns at a tension of 60,000 volts at one or other of two transformer stations at Lannemezan or Laruns, belonging to the Midi Company, where, apart from a quota to meet local demands, it is transformed to a voltage of 150,000 and dispatched in the directions of Bordeaux and Toulouse. Each concern undertakes the transport of its own output to the points of delivery. Two lines of

50,000 kw. convey the current to Bordeaux and one of 50,000 kw. to Toulouse and beyond, the total distance exceeding 500 kilometres. At the two extremities of the high-tension system (Bordeaux and Toulouse) and at the intermediate point of Dax there are transformer stations to reduce the voltage again to 60,000. The various demands of traction and industry are met from these centres, as well as from those of Laruns and Lannemezan.

The duties of the central organisation of the U.P.E.P.O. at Tarbes are considerable. Each day it is furnished by its constituent units with detailed particulars of the previous day's output, the energy available, the local requirements, the state of the water supply, lake levels, etc. From these data is prepared a chart of the aggregate resources, and a scheme of apportionment is arranged to meet the fluctuating demand, the deficiency at one centre being made good by the surplus at another. The whole system is planned, in fact, with the view of eliminating unnecessary waste, obviating local breakdowns or shortage, and ensuring a regular and sufficient supply for the needs of the important region which it serves.

My acknowledgments are due to the U.P.E.P.O., as well as to the Midi Railway Company, for information courteously placed at my disposal and for their kind assistance. The photographs of the stations have been supplied by the Midi Railway Company, from which I learn that, up to the date of writing, a length of 1256 kilometres (say 785 miles) of track is electrically operated, representing about thirty per cent of the whole system. A further 336 kilometres is now being equipped for electric traction, and the electrification of a length of 270 kilometres is under consideration.

Obituary.

Dr. J. P. Lotsy.

THE death of Dr. Johannes Paulus Lotsy, which occurred at Leyden in November at sixty-four years of age, terminates the career of one of the leading workers of the day on evolution and heredity.

Dr. Lotsy's botanical work began when he was sent out to the East Indies in 1896 to study the alkaloids contained in various species of *Cinchona*. The results of his work were published in 1898. He then settled down to a long career of teaching and research in Leyden, varied by frequent visits to almost every part of the globe. In 1906 he published the first part of his "Vorlesungen über Deszendenztheorien", the second part of which appeared two years later. This very useful work was based on his lectures on evolution at Leyden and comprised a comprehensive survey of the state of evolutionary thought at the time. At the same time another monumental work began to appear, "Vorträge über botanische Stammesgeschichte" (3 vols., 1907–1911), an unfinished treatise on the plant kingdom from a phylogenetic point of view.

Lotsy now began to develop the views on evolution and the species question with which his name will always be associated. During the years 1912 to 1916 he published a series of papers putting forward the view that the fundamental unit of taxonomy was the homozygous biotype, and that to this only should be given the name species. Subsequent work has shown that such a unit has no existence in ordinary allogamous populations, and later on Lotsy himself abandoned his opinion and went to the further extreme of doubting the existence of such homozygous biotypes in Nature even in pure lines.

In 1916 Lotsy published his well-known book, "Evolution by means of Hybridisation", in which he vigorously attacked de Vries's work on mutations in *Œnothera*, and claimed that the phenomena observed in that genus were due to the heterozygosity of the material. He advanced the view that the sole method of evolution was by means of hybridisation, and denied that gene mutations played any part. The book was written in a style entirely the author's own, and many of his views cannot now be maintained, but, nevertheless, it will remain a classic in evolutionary literature. Lately, moreover, evidence has accumulated showing that hybridisation plays a greater part in evolution than Lotsy's critics imagined. One of the most striking examples of this is the grass *Spartina Townsendii*, which has recently been shown, beyond doubt, to have originated from a cross between *S. alterniflora* and *S. stricta*, followed by a doubling of the chromosomes. Other cases could be quoted, and it seems clear that one of the means of evolution of new species is interspecific hybridisation followed by chromosome doubling.

During the last six years, having given up regular teaching on being made emeritus professor at Leyden, Lotsy visited New Zealand, South Africa, and other parts of the world for the purpose of collecting evidence for his views on evolution. He was a tireless worker in the field, and everywhere he went he amassed a wealth of material and brought together a great number of arguments in support of his views. In South Africa he worked especially on the genera *Cotyledon* and *Euphorbia*, and took back material of the former genus to Leyden, where he was breeding them on a large scale. He also turned his attention to hybrid populations in the human species, and a large part of the paper on his South African work, published in conjunction with Dr. Goddijn, deals with the various races he had studied there.

At the time of his death, Lotsy was engaged on a large work dealing with his ideas on evolution, and it is much to be regretted that he did not live to bring it to completion.

Lotsy was always a welcome visitor to Great Britain, his last visit being to attend the London meeting of the British Association. His views, always frank and forcibly expressed, were very stimulating and were generally appreciated; since,

however, he was apt at times to disregard the opinions of some of his botanical colleagues, his theories and conclusions have not perhaps received the recognition which they merit.

PROF. HUGO DE BÖCKH.

THE recent death at the age of fifty-seven years of Hugo de Böckh will occasion deep grief amongst those who in many lands enjoyed his gifts of friendship, admired his independent judgment and vigorous personality, and feel the loss to science. He was the son of a distinguished Hungarian geologist, and received part of his training under Karl von Zittel at Munich. In 1902, at the age of twenty-eight, he was appointed professor of mineralogy at the Hungarian School of Mines at Selmeczbanya, and there turned his attention to economic geology and to the tectonic problems which he realised would prove of practical value in mining. He wrote a text-book on geology in Hungarian, and amongst other investigations studied the applications of the Eötvös balance to subterranean prospecting. During the War he was appointed Under-Secretary for Mines in Hungary.

In 1923 de Böckh received the appointment which gave him his great opportunity—he became the geological adviser to the Anglo-Persian Oil Company, and had a great influence in its development by his superintendence of its geological work. He was in charge of its surveys in Persia and Mesopotamia, Albania, Colombia, and Venezuela, and of the international survey of the oil-fields of Iraq. In this work his indomitable, restless energy, originality and insight, and his inspiring enthusiasm made him a most efficient leader in the pioneer field work.

Prof. de Böckh was asked to succeed Baron Nopcsa in 1929 as director of the Hungarian Geological Institute, and returned to Buda-Pest in 1930. He was given a seat in the upper house of the Hungarian Parliament. It was hoped that as soon as he had reorganised the Hungarian Geological Survey he would have time to publish the general conclusions of his world-wide study of oil-fields and their structures. He had published relatively little, partly owing to lack of time and to much of his work being confidential. His most important contribution was that, in conjunction with Dr. G. M. Lees and Mr. F. D. Richardson, to the British Association symposium on the structure of Asia (1929), in which he included some striking results of a study of the Magdalena rift-valley in Colombia.

Prof. de Böckh gave early this year a series of lectures under the auspices of the University of London, in which he summarised his general conclusions on current tectonic problems, and showed his independence of judgment by emphasising the need for caution with Eötvös balance observations and deductions from isostasy. It is to be hoped that those lectures will have been left in a form available for publication, as they state the matured judgments of a geologist of unusual insight and of unique experience and qualifications.

MR. J. H. LEONARD.

BY the death of John Henry Leonard, which took place at a Kensington nursing home on Dec. 4, the Trustees of the British Museum have lost the services of one who was the first to hold the office of guide-lecturer at the Natural History Museum. The appointment was, at the beginning, regarded purely as an experiment, and was the result of the steady campaign conducted by the late Lord Sudeley to make the great national museums more attractive and more interesting to the general public.

That the experiment was such an undoubted success at the Natural History Museum was due to Mr. Leonard's qualities, which rendered him so eminently fitted to discharge the duties of the post. To hold the attention of a group of people haphazardly brought together for a tour of part of the Museum, and with very varying capacity for understanding and appreciating what they were shown and were told, is no easy task, especially round exhibition cases in galleries of difficult acoustical properties. Mr. Leonard possessed the fundamental quality of a good carrying voice, and at the same time was successful in appraising the mentality of the average listener; he was always patient of questioners and took great pains to enlighten the genuine inquirer. With school children he was particularly successful, partly because he was naturally fond of young people; and there are many, of tender years when they first visited the Museum, who will ever bear him in kindly remembrance.

Born on April 19, 1864, Mr. Leonard was educated at Kensington Grammar School and at King's College and University College, London. He obtained the B.Sc. degree, his subjects being zoology, botany, and geology, in the last of which he gained honours. He taught science for a time, and was associated with the science sections at some of the exhibitions held at Earl's Court and Shepherd's Bush. He was appointed guide-lecturer at the Natural History Museum on May 20, 1912. Without having written anything, he has done no mean service in awakening an interest in natural history among those who, to the average annual number of 12,500, have attended his tours. He was also a lay reader for whose services in the pulpit there was always a good demand.

WE regret to announce the following deaths:

Dr. Melvil Dewey, formerly director of the New York State Library, originator of the decimal system of book classification, on Dec. 26, aged eighty years.

Mr. Beeby Thompson, formerly principal of the Northampton Technical School, who was a well-known consulting water engineer, on Dec. 12, aged eighty-two years.

Prof. Hermann Thoms, formerly director of the Pharmaceutical Institute of the University of Berlin and president of the German Pharmaceutical Society, aged seventy-two years.

News and Views.

Calendar of Geographical Exploration.

THE century in which we live, young as it is, has yet been remarkable for its achievements in exploration. Both poles have been reached, much of the previously unconquered Sahara has been explored, surveys have been carried out in the north polar basin, in the antarctic regions, and in north-east Siberia, where a new range of mountains is known, but not yet marked on our maps. Attempts have been made to scale the heights of Everest. Expeditions such as those organised by Sven Hedin, Sir Aurel Stein, and R. Chapman Andrews in Central Asia, and by L. S. B. Leakey in East Africa, have contributed rich stores of geographical, geological, and archæological knowledge of these regions. In spite of the accumulated experience of centuries and the increasing mastery over the elements which modern science is bringing to mankind, explorers still face situations which call for courage and sacrifice. Men like Oates and Amundsen have continued the tradition of heroism, and their names are added to the long list of pioneers who have willingly sacrificed their lives for others.

INEVITABLY, the character of exploration is changing from the extensive to the intensive. Regional survey in its widest sense, including a study of geology, past and present climates, flora and fauna, and human cultures, is rousing interest in the popular, as in the scientific, mind throughout the world. Scientific regional survey is specially developed in modern Russia and has proved of economic importance in the opening up of the apatite district of the Khibinsk tundra and in the discovery of naphtha-bearing beds in the Urals. The revival of interest in geography in the British Isles is evidenced by its recent inclusion as a separate subject of study in British universities. Our calendar for 1932 will record some outstanding events in the history of exploration. Appropriately enough, the first entries (p. 33) include the names of Scott, Shackleton, and Hassanein Bey, whose work, both from the point of view of science and from that of heroism and endurance, shows our century taking its place in the best traditions of exploration.

Geological Exploration of the Andes.

PROF. J. W. GREGORY is leaving England on Jan. 4 with an expedition to investigate some little-known parts of the coastal cordillera of southern Peru and their relations to the Andes and to the recent extension of South America into the Pacific. It is hoped to examine especially the structure of the part of the Peruvian coast that trends from north-west to south-east, and the geology of the desert belt between that coast and the western front of the Andes. A geological section is also to be prepared across the little-known belt between Ica and the Urubamba valley. The earth-movements and volcanic epochs of the Andes appear to have significant correspondence in date with the main stages in the formation of the Great Rift valley that were discovered in its exploration by Prof. Gregory thirty-nine years ago. The expedition will descend from the Andean plateau down one of the head streams of the Amazon, and may return to England across Brazil. Miss McKinnon Wood will accompany the expedition especially to collect fossils. Mr. A. V. Coverley Price will join the expedition at Lima. The work will be helped during parts of the journey by Mr. M. A. Tarnawiecki and Señor Don Alberto Calderon.

Old London Bridge.

THE Exhibition commemorating the centenary of the demolition of old London Bridge, which was opened on Nov. 5 in Regis House, close to the northern end of London Bridge, is to remain open until Jan. 24. The display has been organised by the Rev. H. J. Fynes-Clinton, rector of St. Magnus the Martyr, to raise funds for the restoration of Wren's tower and spire, and many societies and individuals have sent exhibits to it. The series of engravings, water-colours, and prints of the old bridge at various periods of its existence, with and without the houses upon it, and with the new bridge being erected close to it, are of very great interest to students of the history of London, while the two splendid models by Mr. J. B. Thorp are alone worth the trouble of a journey to the spot. The first of these is a 25-ft. model of the old bridge as it was about thirty years before the Great Fire. At the Southwark end are the water-wheels for corn grinding, while at the City end are the water-wheels erected in 1582 by the Dutchman, Peter Morice, for working the pumps which supplied water from the river to certain parts of the City. Mr. Thorp's other large model shows a London street with the Lord Mayor's show passing along it in 1616. Lectures are given on these models at short intervals. While these exhibits are perhaps of general interest, there are others which will appeal to the historian, the antiquary, and the engineer.

Early Cloth Fulling.

AT a meeting of the Newcomen Society held in Prince Henry's Room, Fleet Street, on Dec. 16, Mr. E. Kilburn Scott read a paper on early cloth fulling and its machinery. Though it has remained for modern science to explain what happens to woollen threads when cloth is treated with moisture, heat, and pressure, the process of fulling, which involves the use of all three, goes back to very early days. There are references to fullers in both the Old and New Testaments, in the city of Pompeii can be seen pictures of the various processes of the fuller's craft and a fullery complete with its basins, cisterns, and compartments, and no one knows when machinery was first introduced which superseded the use of the hands or the feet in fulling. The object of fulling is to fill the interstices of the cloth as woven, to add to its appearance, its strength, and its 'feel', and the coarser the cloth the greater amount of fulling required. Cloth to-day is either treated in fulling stocks, in which are incorporated stamps which are worked somewhat in the same manner as tilt hammers,

or in milling machines with rollers. The fulling stocks have been known for several centuries, but the milling machine was first introduced by John Dyer, of Trowbridge, Wiltshire, who took out patents in 1833 and 1838. Mr. Kilburn Scott himself was brought up in the works of Kilburn of Leeds and has been familiar with textile machinery all his life. His paper contained much of interest to the antiquarian, the inventor, and those connected with the cloth industry.

Progressive Science and Happiness.

AMONG the publications issued in the United States with the object of directing attention to the value of science and engineering in human progress, are the Research Narratives, published monthly as small folders by the Engineering Foundation, the joint research organisation of the four leading engineering societies of America. Hitherto, these narratives have covered a wide range of subjects, but the last three numbers contain the first contributions by various writers, dealing with benefits from engineering progress. Happiness, it is remarked, has ever been a condition that human beings have earnestly desired, but the question may be asked: How wisely has mankind used the means of happiness provided by engineering? One of the problems yet to be solved is the maintenance, without disastrous fluctuations, of the steady flow of enjoyment through well-ordered production, distribution, and consumption. "The present conditions", says one contributor, "are difficult to contemplate with mental serenity and undisturbed confidence, but they carry more of ultimate value than the prosperous years that preceded them." Many interesting views are expressed, and Dr. C. E. K. Mees, director of research of the Eastman Kodak Company, after remarking that happiness is not a thing which depends upon the possession of material things beyond a certain minimum, concludes his article by saying: "I believe that a large portion of mankind will abandon the feverish quest for material things and will employ its greater leisure in the development of art and the cultivation of its soul". The wise use of leisure is certainly one of the problems which is becoming of increasing importance, but perhaps the greatest problem of the moment is the provision for every one of that minimum of material things, the want of which is felt by so many millions.

Commercial Crystalline Vitamin D.

THE investigations carried out during the past few years by Bourdillon and his colleagues at the National Institute for Medical Research on the formation of vitamin D have now led to the preparation of a pure crystalline compound, as recently reported by Askew, Bruce, Callow, Philpot, and Webster, in NATURE for Oct. 31, p. 758. This compound, called by them 'Calciferol', is prepared by the irradiation of ergosterol in ethereal solution under strict anaerobic conditions, excess ergosterol being afterwards removed by fractional crystallisation and with the use of digitonin. The calciferol is separated from other products of irradiation by fractional crystallisation of the dinitrobenzoates and subsequent hydrolysis of the ester. The process has now been repeated on a larger scale in the technical laboratories of Messrs. The British Drug Houses, Ltd., London. N.1. The sample of calciferol submitted is a white crystalline solid: it is stated to melt at 114·5° C., to have the same empirical formula as ergosterol, and to have the high vitamin D potency of 40,000 international antirachitic units per milligram. It is available for the use of research workers in tubes containing 100 mgm. The commercial production of pure vitamin D is a satisfactory culmination of the brilliantly directed but laborious research work of the Medical Research Council's investigators, and should lead to greater precision in therapeutics and to the possible discovery of new applications for its use.

69-in. Mirror for Perkins Observatory.

DR. HARLAN T. STETSON, director of the Perkins Observatory, Ohio Wesleyan University, Delaware, Ohio, informs us that the large 69-inch mirror for the new telescope was installed at the Observatory on Dec. 14. The disk of glass, weighing 3000 lb., was cast as an experiment in American glass making in the optical shops of the U.S. Bureau of Standards, in May 1927. The exceptional annealing of the glass, which required eight months of controlled temperature, facilitated greatly the polishing and figuring of the mirror's surface, which was executed in the factory of J. W. Fecker, in Pittsburgh. Exhaustive tests carried on at Pittsburgh by Dr. Stetson, Dr. J. S. Plaskett, of the Dominion Astrophysical Observatory, and I. C. Gardner, chief of the Division of Optical Instruments, of the U.S. Bureau of Standards, showed the surface to be of the highest order of excellence. Quantitative measurements revealed departures from the mean focus of twenty-five feet to be not greater than 0·01 in. for any zone. The completion of the Perkins telescope brings into the central States the third largest telescope in existence, the two other instruments of greater aperture being the 72-in. reflector of Victoria, B.C., and the 100-in. reflector at Mt. Wilson, California. These great telescopes in North America have all led the way to important additions to astronomical knowledge, and it may be confidently anticipated that the new instrument, under Dr. Stetson's direction, will carry on the tradition.

Sixth International Congress of Genetics.

ACTIVE preparations are being made for the sixth International Congress of Genetics, to be held at Ithaca, New York, in August 1932. A series of quarterly bulletins of information has been issued and a number of committees has been at work for more than a year. A recent bulletin outlines the arrangements being made with regard to exhibits in connexion with the Congress. Several laboratory rooms will be used for cytological and other genetical exhibits, including recommended varieties of various crop plants. A new feature proposed is a genetical garden of three and a half acres, in which extensive exhibits of *Zea*, *Nicotiana*, *Œnothera*, *Antirrhinum*, *Petunia*, *Brassica*, and *Melandrium* will be grown from

seeds sent by geneticists in all parts of the world who are investigating these genera. Exhibits illustrating fruit breeding will be shown at the Agricultural Experiment Station, Geneva, New York, and an extensive series concerning human genetics is being arranged in connexion with the Third International Congress of Eugenics, to be held in New York immediately before, on Aug. 21-23. A long series of animal exhibits, including domestic mammals and birds, fishes, insects, and molluscs, is also in preparation, the assembling of each group being in charge of a different person. Arrangements have been made for delegates to book passage on s.s. *Westernland* at a special rate of 200 dollars for the return voyage.

SUGGESTIONS have been made that the Congress should be postponed until world conditions improve, but Dr. C. C. Little, of Bar Harbor, Maine, Secretary-General of the Congress, has issued a communication stating that the Council, after prolonged consultation, has decided not to postpone the Congress. Among the factors which influenced the Council in deciding to carry on the arrangements as originally intended, are the facts that a number of prominent European geneticists have already indicated their intention to attend, that a large number of lectureships for visitors to the Congress are being arranged by American universities, that obligations have already been made and commitments undertaken, and that early improvement in economic conditions is uncertain, making postponement inadvisable. Now that the matter is finally settled, it is hoped that all geneticists who can possibly do so will plan to attend.

Electric Equipment of the Dolomites Railway.

THE narrow gauge Dolomites railway which joins Calalzo, in the Piave valley, to Dobbiaco, a distance of about forty miles, has now been working very satisfactorily for over two years. As the railway passes through Cortina d'Ampezzo, it is much frequented by tourists. The railway is operated by electricity and so there is no smoke and steam to detract from the beauty of the scenery. Fears were entertained in case, during heavy falls of snow, water would get into the motors and interfere with their working. A special arrangement was therefore devised for them so that when necessary they could be made 'enclosed' motors. Even in snow-clearing operations, when they were considerably overloaded, the motors suffered no damage. In the *Brown Boveri Review* for October, A. Brodbeck gives an account of the electric equipment of this railway. It receives its power from a three-phase network at Calalzo at a pressure of 18,000 volts; but for operating the railway, direct current at 2700 volts is adopted. This is done by the use of only one substation situated near Cortina, a little more than half-way from the power terminus. The conversion of the alternating to direct current is done at the substation by means of two mercury arc rectifiers each of 11,000 kilowatts capacity at 3000 volts. It is interesting to learn that a momentary load of 200 per cent does them no harm, and that they can withstand a 25 per cent overload for half an hour. Owing to the comparatively small currents they take, they require little space and their efficiency is extremely high, being 99·1 per cent over a large range of output. The use of rectifiers in railway plants is increasing, and we anticipate a rapid increase in the future.

Novel Slot Electricity Meter.

WE learn from *A.E.G. Progress* for October that many hotel, boarding-house, and convalescent-home keepers now instal in their bedrooms a special slot meter to collect the cost of the electric energy consumed by the visitor. It is not uncommon for travellers to carry about with them all kinds of portable electrical appliances which are readily connected to the plugs in the bedroom, notwithstanding the printed regulations to the contrary. This sometimes leads to the blowing of fuses and is a source of fire risk to the building. It is therefore now not uncommon to put slot meters in the bedrooms, so that by the insertion of a coin the guest purchases a given amount of energy. Unlike an ordinary prepayment meter, the coin mechanism can be returned to the 'off' position by resetting a simple device. In this way the new visitor cannot consume at the expense of the previous one any energy that still may be available. The resetting device is actuated by a key, kept by the proprietor, who cancels for his own benefit the credit still due to the departing visitor. The company which makes this meter suggests that the constant source of revenue obtained in this way should be utilised to make the rooms more comfortable, and furnish them with plug points for all kinds of electric devices.

Indian Antiquities.

SIR EDWARD GAIT'S review of British research work in India in the fields of archæology, philology, and ethnology in his address to the first meeting of the Royal Society of Arts in the current session (*Jour. Roy. Soc. Arts*, Nov. 13) records a remarkable achievement, especially when it is taken into account that such research, often demanding intense application, in the majority of cases has been no more than the distraction of a busy official career. India can now boast of an ancient civilisation and a literature, of which the older elements may go back so far as 2000 B.C.; but when British rule began in the eighteenth century, Sanskrit literature and lore had lapsed into disrepute, the ancient monuments had been allowed to fall into decay, and the course of events in the Hindu period had been forgotten. From the time when the study of Indian antiquities was placed on an organised basis by Sir William Jones, who had gone to India as a judge of the Supreme Court in 1783, and the Asiatic Society of Bengal was founded, British officials have engaged in all branches of Indian studies with enthusiasm. Forgotten scripts, forgotten languages, and even forgotten empires have been rescued from oblivion, while the investigation of the customs, races, and religions of the people of India has been pursued in a scientific spirit without reference to racial or political prepossessions. Thanks largely to the efforts of

Lord Curzon, ancient monuments have been restored and the care of antiquities made a matter of administrative charge. It is to be regretted that Sir Edward Gait has to record a falling off in the number of British civil servants who now devote themselves to such studies ; but on the other hand there is a measure of compensation in the fact that the number of natives of India who are interested in the history and antiquities of their own country is on the increase.

Birds of Paradise.

IN the Bird House and the small Tropical House adjoining it, the Zoological Society of London now exhibits a dozen species of birds of paradise, several of them recent arrivals along with the rare Matschie's tree kangaroo (see NATURE, Dec. 12, p. 996), also coming from the Rawlinson Mountains in north-east New Guinea. Most noteworthy is the Emperor of Germany's Bird of Paradise (*Paradisea gulielmi*), a species new to the collection ; it bears a general resemblance to the well-known Lesser Emerald Bird of Paradise, but has the crown as well as the throat green, and the side-plumes shorter and of a different and less downy texture, more recalling the nuptial plumes of the egrets. Among those species that have been in the collection some time, special mention may be made of the Twelve-wired (*Seleucides ignotus*), because of the pecularity it exhibits of having the legs bare for some distance above the hock, as in a wading-bird. This peculiarity is shared by a very different bird from the same zoological region and also in the collection, the great black Palm-cockatoo (*Microglossus aterrimus*) ; this is noteworthy, for neither affinity nor habits can be invoked for the explanation of this nudity in these two species. A very humble bird by comparison, but also of much scientific interest, is a newly received specimen of the melanistic mutant of the blackcap : this variation, which is found in the Canaries and Azores, has been known for upwards of a century, and is called Heineken's Blackcap. The bird is on view in one of the small cages in the Bird House.

British Empire Hardwoods and Turnery.

IN Museum No. 1 in the Royal Botanic Gardens, Kew, a temporary exhibit of articles turned from Empire hardwoods by the skilled hands of Mr. A. L. Hetherington, assistant secretary in the Department of Scientific and Industrial Research, has been arranged. While indulging his hobby of turnery, Mr. Hetherington also carried on important research, for he worked upon some eighty different kinds of Empire woods, many of which are new to the turner, the results of his work being demonstrated by excellently carved boxes, chalices, tazzas, goblets, dishes, ash trays, and other articles. Particularly beautiful are a chalice made from sapodilla wood (*Achras Sapota*), two tazzas made of African blackwood (*Dalbergia melanoxylon*), a goblet of bulletwood (*Mimusops littoralis*), a string box of puriri (*Vitex littoralis*), and two match stands of gidgee (*Acacia Cambagei*). Mr. Hetherington has added to the value of his demonstrative work by writing an account of the various kinds of wood used, with particulars of their peculiar working properties. This book has recently been published by the Empire Marketing Board under the title " British Empire Hardwoods from the Point of View of Turnery." After discussing the properties of eighty kinds of wood, he goes into further particulars about those he considers of greatest importance for ornamental turning. All who are interested in wood turnery should make an effort to visit Kew within the next few weeks and inspect this interesting collection.

Forest Survey by Aeroplane.

IN the development and protection of Canadian forests, aircraft have come to play a most important part. The *Canadian Surveyor* for October in a general account of aviation in Canada explains how aerial photography is used to show the character, distribution, and accessibility of the timber, thus facilitating exploitation on sound lines. Even more valuable is the use of air patrols for noting forest fires, and of air transport in carrying crews and equipment for extinguishing the fires. In Ontario alone during the year 1929 more than three hundred fires were thus detected. Aircraft are also used in combating insect and other pests. These attempts are still in an experimental stage, but the results so far are promising. Areas of fir and spruce affected by spruce budworm and of hemlock and balsam affected by hemlock looper have been dusted with calcium arsenate from the air. The method is certainly cheap and fairly thorough. Experiments in Manitoba have shown the effectiveness of dusting wheat with sulphur in order to fight the destructive wheat stem rust. Aircraft are also being used to expose spore traps, in an endeavour to determine the spread of wheat rust and white pine blister rust.

Quantity of Matter in the Universe.

IN the discussions taking place at the present time on the structure of the universe, the amount of matter distributed throughout the whole of space is determined by calculating the total mass of existing protons and electrons. In all the celestial bodies revealed by the means of observation yet available, the whole number of these corpuscles is found to be 10^{79}. All other hypotheses must, therefore, be based on this figure and on the dimensions of the radius of the universe. In a note by Prof. Gianfranceschi, broadcast from the Vatican on Nov. 26, it was pointed out that limitation of the consideration of this question to that of the matter constituting the corpuscles is scarcely justifiable. Protons and electrons represent a special, but not the original, form of matter. They exert forces of attraction and repulsion originating in their character as electrified corpuscles and in their masses, that is, in measurable magnitudes. The possibility of the transformation and formation of the corpuscles must, however, be assumed. In considering such changes, not merely the energy variations but also the inertia must be taken into account, and any theory of the universe which may be formulated, whether static or dynamic, should be based on these

active and passive principles jointly. The curvature of space is not produced solely either by the visible masses, which must be regarded as singular points of space, or by the energy transported in the form of photons, which in their turn can constitute only lines of singularity, but it must exist in a kind of background or support, filling the universe and composing real physical space. Thus it becomes necessary to be able to express the contribution of this real space, with its twofold element of energy and primordial inertia, to the geometrical scheme of the universe.

Flutter of Aeroplane Wings.

IN 1928 a monograph on the "Flutter of Aeroplane Wings", by Messrs. R. A. Frazer and W. J. Duncan, was produced at the National Physical Laboratory, summarising in a single useful volume the work that had been done by them on that subject up to that time. Since that period this work has been continued, while the associated problem of tail flutter in aeroplanes has also been the subject of study. A new volume has now been produced under the comprehensive title of "The Flutter of Monoplanes, Biplanes, and Tail Units" (Air Ministry: Aeronautical Research Committee. Reports and Memoranda, No. 1255 (Ae. 404): The Flutter of Monoplanes, Biplanes, and Tail Units (a sequel to R. and M. 1155). By R. A. Frazer and Dr. W. J. Duncan. Pp. viii + 179 + 12 plates. (London: H.M. Stationery Office, 1931, 7*s.* 6*d.* net)), embodying results that have already been issued from time to time on wing and tail flutter under one cover. The subject is well illustrated by cinematograph pictures of some simple experiments designed to show the various types of flutter that may arise in practice, and the nature of the dynamical problems they expose. While much of the work is of a mathematical complexion, recommendations are included regarding the design of tail units and of biplane wings that should be exceedingly useful to designers. Altogether the monograph is a comprehensive record of a valuable series of investigations. It is understood that the subject of airscrew flutter, which has been under study for some time, will be produced in due course as a separate report.

Lead Content of Rocks

PROF. ARTHUR HOLMES points out that there is a serious discrepancy between the data for lead in rocks (*a*) as given by Prof. Hevesy and Dr. Hobbie and (*b*) as cited by him in the letters on this subject which appeared in NATURE of Dec. 19, 1931. The latter figures (under **Pb** on p. 1040) refer to the preliminary results obtained by the gravimetric method, whereas those announced on p. 1039 are the final results obtained by the use of the radioactive indicator method. Both sets of figures will appear in a forthcoming detailed record of the investigation. It appears that Prof. Hevesy substituted the final results for the preliminary figures after Prof. Holmes had passed the proofs of his own letter. The effect of the corrections, however, is to emphasise the validity of the conclusions based on the original figures. It now appears that in the composite sample of granitic rocks the total lead is eight (not five) times the radioactively generated lead. Thus, if the atomic weight of the lead originally present in the earth be taken as 207·22, that of the lead now present in granitic rocks should be about 207·19. Actual determinations on ore-lead correspond very closely with these figures.

Prof. Alexis Saposhnikoff.

NEWS has been received that Prof. Alexis Saposhnikoff, the well-known Russian chemist, who, as recorded in NATURE of April 25, 1931, was arrested about a year ago and condemned to ten years' deportation, has had his sentence so far ameliorated that he is transferred daily to the 'Technical Bureau' under guard, where he works without pay, returning to prison in Leningrad at night. An escaped prisoner reports that he was confined with the "old Prof. Saposhnikoff. Frequently he gave us lectures on poison gas. He spoke well but I did not understand much. Prof. Saposhnikoff had been in prison for a year. The Interrogatories of the Ogpu took place between eleven and three o'clock. Prof. Saposhnikoff was often disturbed and returned always very anxious. He and others had their food in the common canteen. Nothing was brought to them from outside, and visits were prohibited. It was like being in a tomb."

Announcements.

THE Astronomical Society of the Pacific has awarded its Catherine Wolfe Bruce Gold Medal for the year 1932, "for distinguished services to Astronomy", to Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B.C.

IT is announced by the Johannesburg correspondent of the *Times* that fire broke out in the main building of the University of the Witwatersrand on Dec. 24, destroying the Gubbins Library and Mrs. Hoernlé's ethnological collections, the Leonard Memorial Law Library, and a natural history collection. The damage to the building is estimated at £20,000.

IT is announced by Science Service that Mr. Frederick Hodge has been appointed director of the South-west Museum, Los Angeles, California. Mr. Hodge is well known for his work on ethnology, having conducted several expeditions in order to study American Indian tribes. He was formerly editor of the *American Anthropologist* and of the "Handbook of American Indians", and in 1916 he was president of the American Anthropological Association.

AT the meeting of the London Mathematical Society on Jan. 14, there will be a discussion on "Generalisations of Fourier's Integral". The discussion will be opened by Dr. Norbert Wiener, of Massachusetts, and Prof. G. H. Hardy, Prof. E. C. Titchmarsh, and Prof. G. N. Watson, among others, will take part in it. At the meeting on Feb. 4, Mr. M. H. A. Newman will deliver a lecture on "Topological Methods in the Theory of Continuous Groups". Members of other scientific societies who may be interested are invited to attend these meetings, which take place at 5 o'clock at Burlington House.

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.*]

Examination of Protein Films.

THE simplest types of molecular architecture are to be found in materials in the form of films. The examination of films of protein materials is attended with many difficulties, absent in the case of simpler organic substances like the fatty acids.

Whilst the long chain organic compounds containing polar groups can readily be converted into the state of uniform unimolecular films on liquid surfaces on account of their solubility in volatile non-polar solvents, this method is not available for proteins. The method of dispersing the protein in alkaline or acid solutions and spreading the dispersion on a water surface was adopted by Gorter and Grendel, who with the aid of a Langmuir trough obtained a series of interesting measurements on the force-area curves of various proteins. Optical ultra-microscopic examination of such films by Zocher and Stiebel revealed that, except in a few cases, for example, hæmoglobin and casein on strongly acid solutions, protein films spread in this manner were not uniform, whilst the magnitude of the mean limiting thickness obtained, 9-10 A., indicates either that films obtained in this manner even when uniform must be in a relatively close packed state or that part of the protein must have disappeared into the bulk phase. Denatured protein films alone appear to be formed from disperse solutions by the operation of the forces of surface tension ; a somewhat lengthy procedure.

We have found it possible to spread a number of proteins such as egg albumen, gliadin, and glutenin in the form of highly disperse uniform films on the surface of water in the following manner : a thin quartz fibre which may for convenience serve as the arm of a microbalance is coated with pure paraffin wax of relatively low melting point. The surface of the wax is lightly dusted with the powdered protein. The protein is then rendered slightly moist by holding the fibre over steam until the increase in weight is some ten per cent of the weight of protein present. On touching a water surface with the fibre tip the protein spreads relatively slowly and apparently quite uniformly over the surface. The microbalance is readily calibrated by spreading myristic acid from the fibre, for both the force-area curves as well as the potential-area curves are well established for this material.

Some proteins, for example, keratin and the xerogel of gelatine, cannot be spread in this manner, and, indeed, unimolecular films of this latter protein do not appear attainable on water surfaces owing to the readiness with which the gelatine undergoes dispersion in the bulk phase. We have examined a number of such films with the aid of a Langmuir trough and, as was to be anticipated, their properties are distinct from the thicker films examined by Gorter and Grendel. In the case of gliadin, for example, a homogeneous film exerting a perceptible surface pressure is obtained with a surface concentration of $0{\cdot}36 \times 10^{-7}$ gm./cm.^{2}. On compression a linear force-area curve is obtained up to a surface concentration of about $0{\cdot}7 \times 10^{-7}$ gm./cm.^{2}. The form of the curve is altered by alteration of the acidity of the substrate. At higher compressions the film, originally fluid, undergoes transition to a gel-like film. Over a limited range of pressure at least, this transformation appears to be reversible. The ' gel ' form is curiously elastic, and the protein in this form may be related to that which, in the bulk phase, is generally described as denatured.

Examination of aqueous protein systems by the method of surface potentials gives us information even more complete than that obtainable from data on the force-area characteristics. It is found, for example, that no change takes place in the magnitude of the vertical component of the electric moments of the polar groups comprising the film material until the two-dimensional sol gel transition sets in ; an indication that this latter form is associated with some type of interaction of the polar groups in adjacent polypeptide chains. A study of the three-dimensional gels of gelatine by this method reveals the fact that the surface phase has a different setting point from that of the bulk phase and is essentially lyophobic in character, but the spreading of fatty acids over sols can readily be followed. The change in the air-liquid potential occurring on the tryptic digestion of an albumen film on a water surface by means of trypsin in the substrate is relatively large, about 75 mv., and permits of closer analysis of such chemical reactions occurring at interfaces.

The dependence of the rate of tryptic digestion in a bulk phase on the acidity of the environment is likewise to be observed in the surface reaction, but with phosphate buffer solutions there appears to be a shift towards the acid side of about 1 *p*H in the optimum acidity. The characteristic curve of the reaction of trypsin and egg albumen shows that the digestion of the albumen apparently takes place in stages and that an inhibition of the reaction can occur by means of an addition of small quantities of already digested albumen solutions. The digestion of egg albumen by pepsin reveals a simpler mechanism and no final solution of the egg albumen film takes place.

Preliminary investigation holds out some promise of obtaining more precise information both as to the constitution and reactions—general and specific—of protein films by these methods.

ARTHUR HUGHES.
J. SCHULMAN.
ERIC K. RIDEAL.

Absolute Values of X-Ray Wave-lengths and the Fundamental Atomic Constants.

THE wave-lengths of the X-ray spectra are now known with a considerable degree of accuracy (in favourable cases to at least 1 in 100,000). But this means only that the ratio between the wave-lengths and a certain distance within a crystal lattice (for example, the distance between the atomic layers parallel to the cleavage faces of calcite) is measurable with this accuracy. The computation of the dimensions of the crystal lattice from the data involved (electronic charge, density of the crystal, and so on) give the absolute value of the atomic distance with only moderate accuracy (say 3 in 1000). It has therefore been necessary to fix an arbitrary value for the atomic distance in question and thereby for the scale of the X-ray wave-lengths, the *X units*. The agreement between this scale and the C.G.S. units is for this reason ascertained only within the last-mentioned limit. On the other hand, if we were able to fix the scale of the *X units* in *centimetres*, this gives us a possibility of determining in absolute values the atomic distances and, indirectly, the other fundamental constants (for example, the electronic charge).

A very direct method of determining the X unit in absolute value (centimetres) is to register on the same plate, and with the same spectroscopic outfit, some X-ray spectral lines which have been measured with crystal gratings, and some lines of ordinary spectra the wave-lengths of which are known in angstrom units (10^{-8} cm.).

For this purpose only spectral lines of very short wave-lengths of the same order of magnitude as the X-ray lines (less than 100 A.) can be used. From researches carried out in this laboratory on the spark spectra in the extreme ultra-violet of highly ionised atoms, a number of such lines are now available and may be used for the purpose. Independently of these lines, which have been measured in higher orders by comparison with well-known lines, there is also a second method available; namely, to use lines of short wave-length the value of which can be calculated theoretically for simply built atoms.

The hydrogen-like atoms of the lowest elements may be used with confidence for this purpose. Through the researches in this laboratory, the Lyman series, formerly known for H and He, has been found for the next elements [1] Li III, Be IV, and B V. The wave-lengths of the first member ($1\ ^2S - 2\ ^2P$) are respectively: Li III: 135·01; Be IV: 75·94; B V: 48·585 A.

The accompanying spectrogram (Fig. 1) shows,

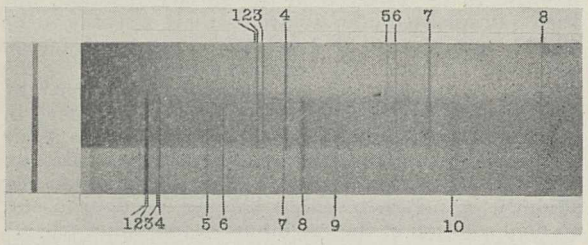

FIG. 1.—Above, spark spectrum of carbon; below, X-ray spectrum of copper and carbon.

KEY TO LINES.

Upper Spectrum: Wave-lengths in *Angstrom Units*.				Lower Spectrum: Wave-lengths in *X Units* × 10^3.		
1	C V : $1\ ^1S - 4\ ^1P$			1	Cu $L\beta$	13·00
2	C VI: $1\ ^2S - 2\ ^2P$	33·740	33·717	2	Cu $L\alpha$	13·31
3	C V : $1\ ^1S - 3\ ^1P$	34·97		3	Cu $L\eta$	14·87
4	C V : $1\ ^1S - 2\ ^1P$	40·28		4	Cu Ll	15·26
5		2×33·717		5	O $K\alpha$	23·56
6		2×34·97	II	6	Cu $L\alpha$ II	2×13·31
7		2×40·28		7	Cu $L\alpha$ III	3×13·31
8		3×40·28	III	8	C $K\alpha$	44·50
				9	Cu $L\alpha$ IV	4×13·31
				10	C $K\alpha$ II	2×44·50

below, a number of X-ray lines the wave-lengths of which are known on the X unit scale. Above is registered a spark-spectrum of carbon with wave-lengths covering the same region. These lines belong to carbon atoms with one and two electrons (C VI and C V). Their values are now known in angstrom units. The first line of the Lyman series of carbon (C VI), which is seen as a strong line on the spectrogram, may be calculated from the hydrogen atom model with more than sufficient accuracy (as $33{\cdot}740 \times 10^{-8}$ cm.). With the aid of all these lines in different orders it will be possible to establish the relation between the X unit and the angstrom unit (or the centimetre).

The spectrogram shown was taken with the spectrometer described by Siegbahn and Magnusson,[2] using a small plane-grating with 600 lines, the ruled surface being 1 mm. in width. Before giving definite values we wish to make exposures under varied conditions and using different gratings.

MANNE SIEGBAHN.
MARTIN SÖDERMAN.

Uppsala Physical Laboratory,
Nov. 17.

[1] Edlén, NATURE, **125**, 233, Feb. 15, 1930; **127**, 405, March 14, 1931.
[2] Siegbahn u. Magnusson, *Zeit. für Phys.*, **62**, 435; 1930.

Experimental Proof of the Spin of the Photon.

IN a paper under this title which has recently appeared,[1] we have described and discussed observations which have led us to the conclusion that the light quantum possesses an intrinsic spin equal to one Bohr unit of angular momentum. In the four weeks which have elapsed since that paper was put into print, the experimental technique has been much improved in the direction of attaining greater precision. It appears desirable forthwith to report our newer results, which confirm the conclusion stated above.

As mentioned in earlier communications,[2] the experiment we set before ourselves was to determine the extent to which the depolarisation of Rayleigh scattering of monochromatic light is diminished when it is spectroscopically separated from the scattering of altered frequency arising from the molecular rotation in a fluid. An important improvement on our previous arrangements is the use of a pointolite mercury arc, which enables an intense beam of monochromatic light to be obtained which is rigorously transverse to the direction of observation. In the case of the feeble scattering by gases, a serious source of error is the parasitic illumination from the walls of the containing vessel. We have succeeded in eliminating this by using the gas under pressure in a steel cross with suitable arrangements for securing a dark background. The depolarisation of the scattered light is determined photographically with a spectrograph and a large nicol placed in front of the slit. The use of Schwarzchild's formula for photographic blackening enables the ratio of the horizontal and vertical components of scattered light to be calculated from the times of exposure in the two positions of the nicol which give equal densities in the spectra.

Using alternately a fine slit and a very broad slit on the spectrograph, the depolarisations of the Rayleigh scattering and of the total scattering respectively are determined. The following table gives the values for the case of oxygen, carbon dioxide, and nitrous oxide gases under pressure.

TABLE: DEPOLARISATION PER CENT.

Gas.	Observed.		Calculated.	
	Total Scattering.	Rayleigh Scattering.	Kramers-Heisenberg Theory.	Spin Theory.
O_2	6·5	4·1	1·7	4·2
CO_2	10·3	6·3	2·8	6·7
N_2O	12·0	7·7	3·4	7·9

The depolarisations of the total scattering given in column 1 thus found spectroscopically are in good agreement with the best accepted values determined by other methods. Column 2 gives the observed depolarisations of the Rayleigh scattering, column 3 the values calculated from the Kramers-Heisenberg dispersion theory, and column 4 the values calculated from the theory of the spinning

photons discussed in our paper. It will be seen that the values given by the latter are strikingly supported by the experimental results.

C. V. RAMAN.
S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta, India,
Nov. 29.

[1] *Ind. Jour. Phy.*, vol. 6, p. 353, Oct. 1931.
[2] NATURE, **128**, pp. 576 and 727; 1931.

Wave-length of the Green Auroral Line Determined by the Interferometer.

SOME years ago Babcock [1] gave results of accurate measurements with an interferometer method of the green line which appears in the light from the night sky. We have reason to believe that this line is identical with the strong green line appearing in the auroral spectrum; but on account of the great interest attached to this line it will be of importance to measure accurately the wave-length of the green line from the aurora itself in order to settle the question as to the identity of the two lines.

As I mentioned in a report at the Congress of the Geophysical Union at Stockholm, I was preparing for such investigations to be carried out at the Northlight Observatory at Tromsø, recently built by grants from the International Education Board founded by Rockefeller.

The apparatus used consists of a Fabry-Perot etalon placed in front of the lens of a camera. Two silver-coated quartz etalons—about 2·5 and 5 mm. thick—

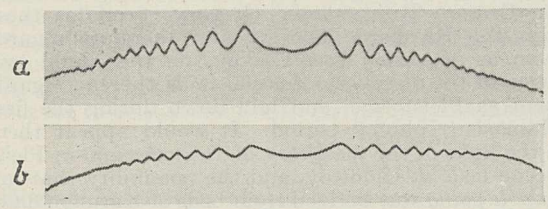

FIG. 1.

were made by Messrs. Adam Hilger, Ltd., London. Their optical thickness was measured by the National Physical Laboratory. The camera lens was an Ereman anastigmat of focal distance 10·5 cm. and of high light power F, 1 : 1·8. The part of the light having a wave-length shorter than about 5200 A. was removed by a Wratten filter placed in front of the etalon. The whole apparatus was put into an isolated box, where the temperature could be measured and kept fairly constant.

Recently two exposures of interference fringes of the auroral line were made with the 2·5 mm. etalon at the Tromsø Observatory, one on Sept. 14 and the second on Oct. 29. Both exposures showed a large number of fringes (on the original plate 18-20 could be counted), and no sign of doubling or dissymmetry of the line was to be seen. The neon line 5852·488 A. was used for comparison.

During the first exposures the regulation and measurements of the temperature were not satisfactory. During the exposures of Oct. 29, however, the temperature in the box on both sides of the etalon was measured at regular intervals.

Diagrams of the interference fringes corresponding to the exposures of Oct. 29 and obtained with a Moll microphotometer are shown in Fig. 1. The curves (*a*) and (*b*) correspond to the auroral line and the neon line respectively.

Details regarding standardisation of the plates and methods of calculation will be given in a subsequent paper. I will state here merely the results from the observations of Oct. 29, which may be considered as satisfactory.

The wave-length was calculated in the following two ways:

(1) The vacuum wave-length is found from the equation

$$\lambda_N = \frac{2e\mu}{P_N} \quad . \quad . \quad . \quad (1)$$

where μ is the refractive index and e the thickness of the etalon reduced to the temperature of observation, P_N is the order number for the centre of the auroral line ring-system. The true temperature was found by means of the neon line fringes.

(2) The comparison line was used directly and the wave-length found by means of the equation

$$\lambda_N = \frac{P_C \mu_N}{P_N \mu_C} \lambda_C (1 + \epsilon) \quad . \quad . \quad . \quad (2)$$

where P_C, μ_C, λ_C are order number, refractive index, and wave-length corresponding to the comparison line, ϵ is a small correction due to difference of temperature of the etalon at the exposure of the auroral line and that of the neon line. This temperature difference was measured directly.

Calculation according to (1) gave for the wave-length of the auroral line

$$\lambda = 5577{\cdot}340 \text{ A. (I.U.).}$$

The second method gave

$$\lambda = 5577{\cdot}345 \text{ A. (I.U.).}$$

The main error in our experiments is due to uncertainty in the temperature measurements, but should not exceed 0·01 A. We are improving our arrangements so as to obtain a higher constancy of temperature.

As an average of his measurements, Babcock found $\lambda = 5577{\cdot}350$. Thus, within the limit of error, the green line of the aurora is identical with that of the night sky luminescence.

L. VEGARD.

Oslo, Nov. 17.

[1] *Astrophys. Jour.*, **57**; 1923.

Some Effects of Turbulent Pressure.

IN a recent paper Ertel [1] has shown, at some length, that turbulent motion in the atmosphere reduces the pressure, recorded by a barometer, by $\rho w'^2$ dynes/cm.^{2}, where ρ is the density of the air and w' is the vertical component of the turbulent velocity. This result we can get quite simply from analogy with the kinetic theory of gases, as pointed out by McCrea.[2] Ertel estimates that a mean wind-speed near the ground of 10 m./sec. would lower the local pressure by 0·08 mb.; a calculation from the observations of Scrase [3] gives results of the same order.

It seems unnecessary that there should be equipartition of eddying energy in the three directions, *Ox* down-wind, *Oy* across, and *Oz* vertical; this, in fact, is shown from the observations of Scrase on pages 6 and 12 of the paper quoted. Considering in a general way the manner of formation of the eddies by friction at the earth's surface, one would suppose that the u' and w' components of the eddying motion would be of larger order than the v' (cross-wind) component, especially in observations taken over a short period, like one minute; but Scrase shows that the v' component is 30–50 per cent greater than the w', particularly near the ground (1·5 metres).

Now consider two points P and Q at the same *level* and at, for example, 100 metres from one another across wind; then the surface 'roughness' at P and

Q may well be different: or the immediate past history of the air: or P and Q may differ in height from the ground by perhaps 5-10 metres in undulating country. Any of these effects will cause a difference between the values of w'^2 at P and Q. But a difference of 0·001 mb. in pressure over a distance of 100 metres in latitude 55° requires an air-flow of about 8 m./sec. for stability. So the only way to avoid, maybe violent, readjustments is for the horizontal components of the turbulent energy to differ between P and Q by the same amount as the vertical components. This gives us at once that, for a steady state, the horizontal contributions to the eddy-energy at any point must differ from the vertical by an amount which is constant over a wide horizontal area.

When the mean wind velocity or vertical temperature gradients are varying every few minutes it will take time for the turbulent energy over some distance to readjust itself; this may account for the components of turbulent velocity measured by the standard autographic instruments being about three times as great, for the same mean wind-velocity, as those obtained from a light sensitive vane (Scrase, loc. cit.). On a larger scale this readjustment is very likely a cause of the 'wind-swinging' described in a letter by Johnson [4] some years ago; he says that it is accompanied by microbarograph oscillations of the order of 0·05 mb, with a period of 6-8 minutes.

This also has some bearing on the turbulent motion of liquid between two coaxial vertical rotating cylinders. Taylor [5] has studied this problem. The work of earlier experimenters showed him that the turbulence could not be two-dimensional; he calculated the disturbance, if restricted to symmetry about the axis of rotation, and verified his calculations by experiment. But why should there never be two-dimensional turbulence? Ertel's result may show us. With the usual cylindrical co-ordinates, r, θ, z, two-dimensional disturbances would be in r and θ only; this would reduce the mean static pressure at the level, z_0, considered; but as the average depth of the liquid is not changed, vertical, or z-, disturbances must occur at the same time as the r- and θ-disturbances in order to support the liquid above z_0. Two-dimensional turbulence is thus not possible in the motion of liquid between a pair of vertical coaxial rotating cylinders.

O. F. T. ROBERTS.

University of Aberdeen,
Nov. 27.

[1] *Met. Zeit.*, **47**, p. 22; 1930.
[2] *M.N.R.A.S.*, **89**, p. 721; 1929.
[3] *M.O. Geophysical Memoirs*, No. 52.
[4] NATURE, **115**, 263; 1925.
[5] *Phil. Trans. Roy. Soc.*, A, **223**, p. 289; 1922.

Deinotherium in the Pleistocene.

THE discovery made by the East African Archæological Expedition on Nov. 17 last, announced in the *Times* of Dec. 3 (see also NATURE, Dec. 12, p. 995, and Dec. 26, p. 1075), of *Deinotherium* remains in implementiferous Pleistocene deposits is extremely important. It is, however, not quite the first of its kind, for M. Delpierre, a Belgian geologist who had been working on the sediments of the Albertine rift near Ngeti, told me, a year or two ago, that he had discovered *Deinotherium* teeth and bones in beds which, on other evidence, he was convinced are of Pleistocene date. He affirmed, too, that these most unexpected fossils were not derived.

Now, at Kurungu in South Kavirondo, Kenya Colony, on Lake Victoria, there is a series of fossiliferous sediments, made known to geologists by the researches of Dr. Felix Oswald, which largely, though not entirely, because they yield *Deinotherium*, are regarded as Miocene, in spite of the fact that the contained Mollusca are all living species. In January 1930, I discovered large developments of these beds farther north, on Rusinga Island and on the mainland near it. The strata are there interbedded with lavas and volcanic tuffs which might well prove valuable for dating purposes over a limited area. Lying on these sediments I found a crude *coup de poing* which, judging from the appearance of its surface, seemed to have been derived from the underlying beds; but as these were to be dated as Miocene, I considered any such derivation impossible, and so regarded the artefact as a purely surface find and of little consequence. The Oldoway discovery, however, would seem to render the alternative explanation possible.

A study of the map is sufficient to show, apart from indisputable geological evidence, that Lake Victoria, with its drowned coastline and reversed feeders, is younger than the main river channels, the upper courses of which are submerged beneath it. Yet on the Kavirondo evidence, part of it at least dates back to the Miocene. Clearly, then, a difficulty would be solved if the deposits at Kurungu and Rusinga could be regarded as, say, Plio-Pleistocene, or lower to middle Pleistocene, and laid down, in part at any rate, during the first pluvial period—I long ago pointed out that if anybody wanted a pluvial period in the Miocene, the Kurungu could provide the necessary evidence—and from what has been said above, this interpretation is seen to be no longer out of the question. But there is more. Controversy has arisen between Prof. J. W. Gregory and the East African Archæological Expedition (1926–27 and 1928–29) concerning the age of the Kamasian beds in the Eastern Rift valley; Gregory correlates these with the Karungu deposits, and therefore regards them as Miocene; but Leakey, on the sound evidence of the discovery of stone tools therein, regards them as Pleistocene and laid down during the first (Kamasian) pluvial period. It would appear then, in the light of the discovery of *Deinotherium* in Pleistocene beds at Oldoway, and the possibility that my *coup de poing* was derived from beds of Karungu date, that Gregory's correlation is not unsound, as Leakey thought, and that the artefacts were in the Kamasian beds, which Gregory disputed. (In this connexion see NATURE, Dec. 19, p. 1019.) Moreover, if this contention is admitted, another riddle in the history of Lake Victoria is satisfactorily solved.

E. J. WAYLAND.

15 Westcliff Terrace Mansions,
Ramsgate, Dec. 10.

Ether-Drift and Gravity.

IT is well known that, by means of electrodynamic experiments, no one has yet succeeded in ascertaining the cosmic movement of the earth, which, particularly in relation to the spiral nebulæ, amounts to very high velocities. Apart from the still incompletely explained results obtained by Miller, which, from the work of Joos, should undoubtedly be considered as perturbations, Courvoisier at Potsdam and Esclangon at Strasbourg recently got positive results. These are interpreted by Courvoisier as indicating a Lorentz-contraction of the earth, in consequence of a movement of the earth towards the light-ether with a speed of 750 km./sec. and with an apex at $A = 60°$; $D = 40°$. In 1926 one of us (R. T.) demonstrated—by means of a very much refined repetition of Trouton's and Noble's experiments—that such a Lorentz-contraction is not obtainable electrodynamically; although 1/2,000,000 of the effect asserted by Courvoisier must have been detected in this way.

As to the existence of the periodic variations of gravity, which Courvoisier observed to be of the order $dg/g = 3 \div 6 \times 10^{-6}$, the problem is different. Up to the present we have so little experimental knowledge about gravity that such alterations through cosmic movement of the earth, which undoubtedly exists, cannot be ruled out as impossible.

For these reasons we have tried to study the tidal variations of gravity with all the exactness attainable. We succeeded in increasing the sensitivity and, above all, in reducing the perturbations to such a degree that we are now able to give certain proof of periodic variations of gravity of the order $dg/g = 10^{-8}$. We used a bifilar gravimeter which, by suitable choice of dimensions, could be made so sensitive as to record a variation of gravity of $10^{-7}g$ by a deflexion of about 2-3 mm. In order to prevent the apparatus from being disturbed by changes of atmospheric pressure and humidity, it was sealed up hermetically. In order to avoid vibrations of the ground, it was erected 20 m. inside a mountain, in a special room about 25 m. below the surface. Registration as well as exact adjustment was done from another room equally isolated. Thus the constancy of temperature during a measuring period of two to three days in each special case amounted to 1/1000°.

Even in the unreduced curves the results obtained did not show any greater variations than about $2\text{-}3 \times 10^{-7}$, as the order of the tide-effects of the sun and the moon.

Adjusting the curves to sidereal time, during the period of observation up to the present time (7 weeks), it appears that any cosmic influence on gravity cannot exceed the order of about $10^{-8}g$. Therefore the variation of gravity asserted by Courvoisier of about $10^{-6}g$ in consequence of the cosmic movement of the earth does not exist.

On account of their geophysical interest the experiments are to be continued with further improvements.

R. TOMASCHEK.
W. SCHAFFERNICHT.

Physical Laboratory of the University,
Marburg/Lahn, Dec. 1.

Artefacts of Upper Palæolithic Facies from Coombe Deposits underlying the Gravels of the Flood Plain.

I HAVE lately recorded in these columns [1] the occurrence, south of the Thames, of a 'floor' yielding flint implements of Upper Palæolithic types and fragments of coarse pottery inter-stratified between Coombe Deposits. The relation of these Coombe Deposits to the Gravels of the Flood Plain has been clearly demonstrated, north of the Thames, by the officers of the Geological Survey.[2] For there the Flood Plain Gravels may be seen overlying the Coombe Deposits; the latter, as at Greenhithe, consisting, in ascending order, of Coombe Rock, coarse gravel, brickearth, and stony loam containing 'rafts' of Coombe Rock.

I am now able to report that this brickearth or 'sandy loam' yields artefacts presenting the same characteristics as do those from the brickearth at Greenhithe.

It is generally accepted that the Magdalenian horizon occurs resting upon the surface of the Flood Plain Gravels, whilst the Solutrian level immediately underlies them; [3] so that on stratigraphical evidence the Greenhithe series must belong to a period even more remote, that is, Aurignacian-Upper Mousterian times.

Through the good offices of the managing director of the Associated Portland Cement Manufacturers Co., Ltd., I am conducting an examination of the deposits in question, and the results obtained will be fully published in due course.

J. P. T. BURCHELL.
30 Southwick Street,
Hyde Park, W.2, Nov. 27.

[1] NATURE, **128**, 548, Sept. 26, 1931; **128**, 909, Nov. 28, 1931.
[2] *Mem. Geol. Survey*, 1924, Dartford, pp. 107 and 109.
[3] Moir, J. Reid, *Proc. Prehist. Soc. E. Anglia*, **6**, 200; 1930.

Diamagnetism of Liquid Mixtures.

AN investigation of binary mixtures of diamagnetic substances (one of the substances being water) made in this laboratory has shown a small but definite departure from additivity. The measurements are made with an improved Curie-Cheneveau magnetic balance.[1] In view of the controversy concerning chloroform-acetone mixtures, it has been of interest to examine this system.

The susceptibility-concentration curve is not straight, but any departure from additivity is small—unlike that found by Trew and Spencer.[2] The curve is of the same type as found by Buchner [3] for alcohol-carbon disulphide. There is a flat maximum at equi-molecular proportions of the two substances, which shows the diamagnetic susceptibility at this point to be 3-4 per cent higher than additivity. The two minima on the curve show a departure from additivity of the same order. An interesting point is that at the two ends of the curve there is a slight rise in diamagnetism, showing, possibly, molecular dissociation when a small quantity of one liquid is added to the other. The departure from additivity is of the same order, three per cent, as that recorded by Ranganadham,[4] and slightly greater than the two per cent recorded by Buchner.[5]

Trifonov [6] has described a curve for chloroform-acetone concave towards the abscissæ. The values found here for the susceptibility of the pure substances are in agreement with other investigators, $-0{\cdot}60 \times 10^{-6}$ for acetone, and $-0{\cdot}498 \times 10^{-6}$ for chloroform.

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[1] *Phil. Mag.*, **12**, 283; 1931.
[2] *Proc. Roy. Soc.*, A, **131**, 204; 1931.
[3] *Zeit. für Physik*, **72**, 344; 1931.
[4] NATURE, **127**, 975, June 27, 1931.
[5] NATURE, **128**, 301, Aug. 22, 1931.
[6] *Ann. Inst. Anal. Physico-Chem.*, Leningrad, **3**, 434; 1926.

General Expression for Intensity of Hydrogen Lines.

I HAVE obtained a formula for the total intensity of hydrogen lines in the general case of the transition $n \rightarrow n'$. The calculation is based on the principles set out in Sommerfeld's "Wave Mechanics" for the determination of intensities.

The corresponding formulæ for the special cases of $n' = 1$, $n' = 2$ were published some time ago and are as follows:

$$n' = 1 \quad \frac{2^7(n-1)^{2n-1}}{n(n+1)^{2n+1}}$$

$$n' = 2 \quad \frac{2^6(n-2)^{2n-3}}{n(n+2)^{2n+3}}(3n^2-4)(5n^2-4).$$

I have proved that in the general case the total intensity can be expressed in terms of hypergeometric series in the following form:

$$\frac{2^4(n-n')^{2n+2n'-1}}{n^2n'^2(n+n')^{2n+2n'}}\left\{\left[F\left(-n+1, -n'; 1; -\frac{4nn'}{(n-n')^2}\right)\right]^2 - \left[F\left(-n'+1, -n; 1; -\frac{4nn'}{(n-n')^2}\right)\right]^2\right\}.$$

L. MCLEAN.
69 Gloucester Place, London, W.1, Nov. 15.

Research Items.

Jemdet Nasr.—An account by Mr. Ernest Mackay of the archæology of Jemdet Nasr, Iraq, excavated by the joint Field Museum–Oxford Expedition, is published as *Anthropological Memoirs*, vol. 1, No. 3, of the Field Museum of Natural History, Chicago. The site, which is situated about fifteen miles north-east of Kish, has now been identified as the ancient Kid-Nun-(ki). It consists of a chain of mounds running east-north-east by west-south-west, about 850 metres long by 180 metres wide, the largest mound being roughly 360 metres by 180 metres. The pottery and small antiquities point to a close kinship with the lower levels of Susa and Musyan. Thus, the identity or close similarity in the design of seals of unusual or curious type is explicable only as due to a close connexion; resemblances in methods of working vessels of stone, and in the shapes of several types of pottery, point in the same direction. The painted pottery of Jemdet Nasr is probably rather later than that of Musyan and Susa ii.; but, on the other hand, it is earlier than the time of Cemetery A, at Kish. Notwithstanding the absence of burials, the objects found prove the existence of an advanced chalcolithic civilisation in Babylonia at an early period. The system of writing had barely emerged from the pictographic stage, but weaving, fishing, agriculture, and pottery-making, in which the inhabitants excelled, were practised. The brick-making is superior to any other in pre-Sargonic times; but in size and shape the bricks are peculiar, being flat instead of plano-convex. Many objects from the Indus valley resemble those of Jemdet Nasr. It is concluded that the inhabitants were not Sumerian but a people conquered by the Sumerians. Prof. Langdon, however, relying to a certain extent on later evidence, says it is impossible not to regard them as Sumerians. Taking 3500 B.C. as the date of the destruction of Jemdet Nasr by fire, he thinks occupation of the site may go so far back as 4000 B.C.

Pneumonia on the Rand.—Pneumonia used to be a formidable disease among the native workers in the Rand mines of South Africa. Following the use of preventive inoculation with pneumococcal vaccine, a marked diminution in the pneumonia incidence resulted. However, we learn from the annual report for 1930 of the South African Institute for Medical Research, that since 1926 this vaccine has apparently been exerting a somewhat lessened influence in preventing the disease, the mortality rate per 1000 population rising from 2·52 in 1926 to 3·60 in 1930. A study of the disease shows that the original strain of infecting pneumococcus, the causative micro-organism, has been largely replaced by other strains against which the original vaccine is less effective, and these new strains are therefore being incorporated in the preventive vaccine. Further, in a large proportion of the cases the pneumococcus is no longer the principal infecting agent, various other micro-organisms taking its place.

Antlers of Deer.—In a new analysis of the weights of the antlers and the bodies of various species of deer, Prof. Julian Huxley carries further the comparison which he began in a former paper (*Proc. Zool. Soc.*, p. 820; 1931). In the mass, the 527 adult examples of red deer show that antler-weight bears to body-weight a constant relationship, which includes a steady relative increase in the weight of the antlers. Although a close analysis of individuals, grouped according to the regions of their origin, does not support this result, probably because the examples are extreme, it is confirmed by an examination of regional groups as a whole. On the other hand, roe deer definitely show a reverse correlation, for in them, judging from 405 wild adult individuals, relative antler-weight decreases with increasing body-weight. When we turn to New Zealand red deer, originally imported from Great Britain, we find exceptionally high relative antler-weights associated with exceptionally heavy body-weights, the former due to the latter, and the latter due to a particularly favourable environment. It seems probable, therefore, that diagnoses of species or sub-species of deer based upon absolute size or relative size of parts cannot be regarded as valid, until it has been shown that the characters selected as diagnostic are genetic and not direct environmental modifications.

Morphology of the Insect Abdomen.—Under the above title, Dr. R. E. Snodgrass of the United States Bureau of Entomology has published an important paper in the Smithsonian Miscellaneous Collections for 1931 (vol. 85, No. 6). It is generally accepted that the insect abdomen consists primarily of twelve segments, the first eleven of which are true somites and the last is the telson. The eighth and ninth segments are the genital segments and bear the gonopods. The genital opening in the female is located, typically, behind the eighth sternum and that of the male behind the ninth. The abdominal appendages of adult and larval insects are serially homologous with the legs and mouth-parts. Each consists of a basis and one or two movable appendicular processes. The basis appears to comprise the coxal and subcoxal regions of a typical appendage. The basis of an abdominal limb usually is incorporated as a plate of the body-wall or united with the sterna. The appendicular processes are very commonly (in the lower insects) the styli or their derivatives, including the clasping organs borne by the male gonopods of the higher insects. The other processes are the gonapophyses. No positive evidence can be adduced from the known facts of anatomy or embryology to establish the homology of either the stylus or gonapophysis. The author inclines to the view that the stylus is the telopodite of the appendage and that the gonapophysis is an endite process of the basis. The main objection to the view that the styli of *Machilis* are the homologues of telopodites is the fact that very similar organs are borne by the thoracic legs. The similarity in the two cases may be misleading, and there seems to be nothing to show that the leg styli are not merely coxal spines resembling in form the abdominal organs bearing the same name.

Effect of Ultra-Violet Light on Plants.—The production of a glass which allows the passage of ultra-violet light, and the discovery of the antirachitic properties of foods exposed to such radiations, has quickened interest in the effects of these rays on plant life. Experiments have been carried out by W. E. Tottingham and J. G. Moore (*Journal of Agricultural Research*, **43**, p. 133) to compare the development, and to some extent the composition, of twelve species of economic plants grown under ordinary and vita glass, and to determine whether the use of the latter is of any commercial advantage. The heating effects with vita glass, due to its relatively high transparency to infra-red rays, were largely compensated for by ventilation, but it is realised that some of the results obtained may be attributable to increased temperatures. Marquis wheat developed a darker colour and more erect habit under vita glass, and seed production also benefited. Such differences were not found with

all varieties of wheat, however, nor under all seasonal conditions. Maize and tomato attained a larger size, and in the case of tomato produced more succulent fruit under vita glass, but with both species these larger plants were less hardy towards frost. Soy beans showed an increase in reproductive activity, together with earlier maturation, than plants grown under ordinary glass. As regards the rooting of cuttings, the results were somewhat inconclusive, but the balance was slightly in favour of vita glass in the case of chrysanthemums. The lipide content of the dry matter was in many instances higher in the vita glass plants, but alterations in the protein also occurred in some cases. Although practical application of the results from the commercial point of view seems as yet distinctly limited, there are indications that further investigations along these lines may lead to enhancement of the medicinal potency of plants.

Cultivation of Mushrooms.—The application of scientific methods to the practice of horticulture proceeds slowly but surely. It is nearly thirty years since the idea of using a pure culture of mushroom spores propagated on sterile manure was introduced. The gardener is now beginning to use it. The introduction of Bulletin No. 34, "Mushroom Growing", by the Ministry of Agriculture and Fisheries, is therefore very opportune, especially as it describes the new processes in simple language and compares them with the old. The preparation of mushroom beds, spawning, 'casing', and other treatment are all dealt with fully, and there is a section on harvesting and marketing. Perhaps the most valuable section of the book is that on diseases and pests. The grower and the student have long waited for some authoritative collection of the information about these subjects, and in the book under review the latest work on the Mycogone disease is summarised. A list of the important works on cultivation and diseases is appended, and will be of great value to the advanced grower and the student.

Termites in the Formation of Spongy Ironstone in Africa.—Peculiar outcrops of brown ironstone (limonite) of a spongy texture form a feature of the higher regions of Central Africa, particularly of Angola. Livingstone was the first author to direct attention to them so far back as 1857, and white residents in these parts of Africa found them an excellent building material. Dr. Malcolm Burr and Mr. P. S. Nazaroff, who have recently travelled in Angola, came to the conclusion (*Geol. Mag.*, vol. 68, 1931) that the ironstones present nothing else than subfossil remains of termitaria. The process of ferruginisation of termitaria can be observed even now, being independent from the activities of insects themselves, and is clearly a process of deposition of iron from rain water soaked through soil. When nests are near rocks rich in silica, such as quartzose sandstones, an analogous process of silicification occurs, and the old termitaria are converted into a completely silicified but spongy rock.

Luminous Phenomena accompanying Earthquakes.—The luminous phenomena of earthquakes have been described as forming the darkest chapter of seismology. Though many writers have been sceptical as to their reality, their existence has been established by Mr. K. Musya, who collected about fifteen hundred observations during the Idu earthquake of Nov. 26, 1930 (NATURE, vol. 128, p. 155). Prof. T. Terada has recently studied about forty examples noticed in Japan (*Earthq. Res. Inst. Bull.*, vol. 9, pp. 225-255; 1931). They have indeed been seen with all recent great earthquakes in that country. In the Idu earthquake, they were observed to a distance of 50 miles east of the epicentre, 68 miles north, and 43 miles west. At some distance, as in Tokyo, the lights were not unlike sheet lightning. The first flash was seen immediately after the first shock, then three or four others followed at intervals of from one to ten seconds, but the duration of each flash was longer than that of sheet lightning. Close to the epicentre, the light assumed more definite forms, in one case of a straight row of round masses. The colour was usually pale blue or white, and, even in Tokyo, the lights were bright enough to illuminate the objects in a room. Prof. Terada concludes that the phenomena are real, and suggests several causes, such as landslides, to which they may be due.

Spectra of Negative Ions.—In a paper in the *Zeitschrift für Physik* for Oct. 14, Prof. R. Mecke makes the interesting suggestion that certain band spectra which appear when arcs are run in hydrogen between beryllium or magnesium poles, which had previously been supposed to be emitted from positive ions of the hydrides BeH and MgH, actually come from the negative ions of these compounds. His argument is based on the so-called displacement rule, which applies both to atoms and molecules, and states, for the latter, that molecules which possess the same number of electrons similarly arranged have closely similar spectra. If the bands of magnesium hydride in question were due to the positive ion, they should thus be similar to those of neutral sodium hydride, whereas they are in fact much more like those of neutral aluminium hydride. The beryllium hydride bands likewise resemble those of neutral boron hydride more closely than those of lithium hydride. The evidence presented is so striking that it seems that the only alternative to accepting these spectra as having their origin in molecules which have acquired an extra electron is to reject the displacement rule in relation to molecules. The importance of Prof. Mecke's discovery, if substantiated, is not merely spectroscopic, as it suggests that it may be profitable to investigate the quantum theory and chemical behaviour of negative ions, subjects which have received little attention.

Crystal Photocells.—The first November number of the *Physikalische Zeitschrift* contains an article by Prof. W. Schottky on the electrical properties of crystals of cuprous oxide held in contact with a metal. This system can be used either as a rectifier for small alternating currents or as a photoelectric device, but whilst the former effect has been widely employed in crystal detectors, it was not known until quite recently that the contact could be disturbed by illumination, and that a current would flow under the influence of light even without an applied potential difference. As is shown in a number of other papers in this and the following number of the same journal, the effect depends both upon temperature and the frequency of the radiation, and it appears that it is primarily due to properties of the crystal rather than to those of the metal. It is not entirely a contact action, since Prof. Schottky has shown that the active layer of crystal is probably not less than 1μ in thickness; the large free paths for electrons which this calls for are, however, also required by other crystal phenomena, and can be readily accounted for on the wave mechanics.

Viscosity of Nitrogen at High Pressure.—Some measurements of the viscosity of nitrogen are described by A. Michels and R. O. Gibson in the November number of the *Proceedings of the Royal Society*, which show how the properties of the gas approach those of a liquid when the density of the gas is made large compared with its atmospheric value. The measurements were made by the usual method of forcing gas through a capillary tube, but the apparatus was constructed so that it could be used at pressures

up to 1000 atmospheres. The results demonstrate immediately that the gas law (viscosity is independent of pressure) ceases to be valid at a few atmospheres pressure, the value of the viscosity changing by a factor of 2·5 over the whole range considered. Moreover, at pressures above about three hundred atmospheres the viscosity acquires the typical liquid property of increasing with decreasing temperatures if it is considered as a function of the pressure, although it continues to increase with increase in temperature if it is considered as a function of the density. A theory of the viscosity which has been proposed by Enskog can be tested from the results of these experiments, and leads to values for the diameter of the nitrogen molecule which lie consistently between $2{\cdot}9 \times 10^{-8}$ cm. and $3{\cdot}0 \times 10^{-8}$ cm.

Crystalline Rubber.—A short communication from E. W. Washburn in the first November number of the *Physical Review* contains the announcement that a group of workers at the United States Bureau of Standards have succeeded in obtaining a well crystallised hydrocarbon from typically colloidal rubber. This has been accomplished by dissolving purified rubber in a suitable solvent to form a dilute solution, and crystallising it out at rather low temperature. A photomicrograph is shown of some crystals which were grown at − 55° from a 0·05 per cent solution in ether. Their melting point has not yet been fixed definitely, but lies between − 35° and 0° C. The molten product has the appearance of ordinary rubber, and contains hydrogen and carbon with an atomic ratio closely eight to five. It has also been found possible to distil the rubber hydrocarbon, but fractionation by this process is relatively slow.

Stream Lining in Locomotives and Motor Cars.—Dr. O. G. Tietjens contributes an interesting paper on stream line locomotive and car design to the fourth quarterly issue for 1931 of the *Westinghouse International*. He is a research engineer to the company, and his experiments on small locomotives and cars, accurate to the minutest detail, bring out very clearly the importance of stream line design. He finds that an electric locomotive travelling at eighty miles an hour requires five times as much power as when travelling at forty miles an hour. Even higher speeds are contemplated because the competition of aeroplanes and motor cars makes high speeds imperative. In the case of a heavy locomotive and two heavy coaches, stream line design saves thirteen per cent of the power at a speed of 35 miles an hour and thirty-two per cent at a speed of 75 miles an hour. It requires 286 horse-power to drive an interurban street car at a speed of 80 miles an hour. Tests made in the Westinghouse wind tunnel indicate that the same type of car constructed with stream line design can be driven at 80 miles an hour with only 140 horse-power. The power required in the latter case is less than one-half that required in the former. A method is shown of converting the modern American tram-car with its blunt ends, sharp corners, and hundreds of air pockets into a stream line car. A new front and a new rear are given to it, the roof is made smooth, the sides are extended downwards, and the recesses for the windows are eliminated. This reduces the wind resistance to one-third its former value. The new styles of high-speed locomotives and cars will probably soon become common, revolutionising the appearance of the car and greatly increasing its economy and efficiency in operation.

Astronomical Topics.

Astronomical Phenomena for January.—Occultation of Pleiades Jan. 18; η Tauri disappears $17^h\ 4^m$, reappears $18^h\ 3^m$; 27 and 28 Tauri disappear at $17^h\ 45^m$ and $17^h\ 50^m$ respectively.

Venus is an evening star, with about five-sixths of the disc illuminated; its meridian passage changes from $14^h\ 5^m$ to $14^h\ 29^m$ during the month.

Jupiter is approaching opposition, and is observable for most of the night. Mutual eclipses of the satellites (visible in England) occur on Jan. 3, 5, 7, 10, 12, 23, 24: details are given in the B.A.A. Handbook.

Neptune is about 15° east of Jupiter, so it is also observable: it reaches opposition late in February.

Minima of Algol, at convenient hours of observation, occur on Jan. 4, at $22{\cdot}7^h$; Jan. 7, $19{\cdot}6^h$; Jan. 27, $21{\cdot}3^h$; Jan. 30, $18{\cdot}1^h$. Each eclipse begins about $4{\cdot}7^h$ before these times, and ends $4{\cdot}7^h$ after them. The interval between minima is $2^d\ 21^h$.

Moving Pictures of Celestial Objects.—When the cinematograph was invented it was seen that it might be usefully applied to celestial phenomena. Mr. Maskelyne took a film of the total solar eclipse of 1900, which was exhibited at the Royal Astronomical Society, and the idea has been repeated at some later eclipses, especially at that of 1927.

The University of Michigan has founded an Observatory, known as the McMath-Hulbert Observatory, at Lake Angelus, Michigan, which devotes itself to the production of moving pictures of celestial phenomena. Vol. 4, No. 4, of the *Publications* of the University gives a description of the methods and results. The driving clock of the equatorial has a very accurate electrical control; there are arrangements for varying the speed of the film within large limits, as the objects photographed range from sunspots to faint variable stars. There are devices for varying the clock drive, and giving motion in declination for films of moving objects such as the moon. These are also available for correcting for the variation of refraction as the altitude changes; some tables for this purpose are given in the report.

The possibilities of the method were well brought out in a film that was exhibited at the Royal Astronomical Society a few years ago, in which Jupiter was shown in rotation, and the approach of a satellite to the planet was also recorded. It would seem that a comet like that of Morehouse of 1908, in which the tail showed rapid changes, would afford a fruitful field for work with the instrument; unfortunately, such comets are rare.

"Annuaire" of the Belgrade Observatory for 1932.—This volume is issued by Dr. V. V. Michkovitch, the director of the Observatory, being the fourth of the series. It has the honour of anticipating by a year the British Nautical Almanac in the introduction of the nutation terms of short period in the ephemeris of sidereal time at Greenwich midnight; the time is also given to the third decimal of a second: these changes are consequential on the great improvements in clocks that have been made in recent years. The volume also contains ephemerides, at intervals of ten days, of 189 stars from Eichelberger's standard catalogue; these are not contained in other almanacs, and were calculated at Belgrade. Another feature, which must have been troublesome to compile, is a list of the 169 minor planets discovered between Nov. 2, 1929, and June 30, 1931; the dates and discoverers are given, also the dates of subsequent observations, and indications of those for which orbits have been computed.

Principles of Field Experimentation.

THE science of field experimentation has developed rapidly during the last decade, and its ever-widening importance justified a Rothamsted conference devoted entirely to its principles and technique.[1] As was only fitting, the first paper was contributed by Dr. R. A. Fisher, who detailed the three principles of modern field experimentation—replication, randomisation, and local control—and showed how these three are necessary in order to reduce, and to give a valid estimate of, the error which must always loom largely in this type of inquiry. Following this, Dr. J. Wishart illustrated the calculations appropriate to randomised blocks and Latin squares, which have proved the most serviceable forms of lay-out.

Later speakers enlarged on a variety of subjects. It is clear from a perusal of the papers that the need is often felt for inquiries carried out at a number of centres simultaneously, so that different conditions of soil and weather may be encountered, and hence that the conclusions may be of general applicability; if each centre adopts the same form of lay-out (though with separate randomisation of treatments) then it is possible to combine all the results in one calculation and attain considerable precision, and still not lose the individuality of the results. Details were given of the methods which experience has shown to be the best for experiments located at a distance from the research station. In these cases a sampling method has proved satisfactory, not only as a means of making developmental studies but also to provide a reliable estimate of the final yield.

Particular cases necessitate special technique. Horticultural experiments introduce difficulty through the longevity of the plants concerned, with the concomitant danger of accident, and the problem of measuring the vigour of the plant. In the case of variety trials, the National Institute of Agricultural Botany still prefers the well-known 'Beaven's half-drill strip' method. The only paper on grass experiments was contributed by Prof. Stapledon, who described the methods adopted at Aberystwyth: he laid much less stress on the statistical adequacy of the technique than on botanical analyses and the problem of how the result should be measured and converted into terms of nutritive value. The papers deal fully with all the working details, and together they provide a most valuable compendium of experience.

A number of examples of the precision and type of results which may be expected from modern field experiments is contained in the Rothamsted Report for 1930.[2] The majority of problems attacked are manurial ones, and the complex lay-outs used give very detailed information. The response of the crop to two or three plant foods, each in varying amounts, can be tested in one and the same experiment, and, if occasion arises, this can be combined with inquiry into the different forms in which any nutrient can be supplied, or the responses of different varieties of the crop plant.

The reader is soon convinced of the necessity for complex experiments, for it is evident in nearly all cases that incomplete inquiry might give misleading results. As an example, it was found that potatoes only responded appreciably to potash and to large doses of nitrogen when a sufficiency of phosphate was supplied, and that superphosphate provoked more than three times as much response in the presence of plenty of nitrogen and potash as it did in the absence of dressings of these two nutrients. Relations of this type appear again and again, making the conclusions difficult to state in a simple manner: there is always a danger in these intricate cases that the reader may 'miss the wood for the trees', but in general the report is admirably and lucidly expressed.

The height of complexity is reached in two rotation experiments which were initiated in 1930: these will yield results year by year, but for their full completion they need twenty years and thirty years, respectively. The Report also contains a brief description of the work proceeding in the laboratory, and summaries of papers recently published by the staff; it is a valuable volume to workers in agriculture and the allied sciences.

H. G. SANDERS.

[1] "The Technique of Field Experiments": being the Report of a Conference held at Rothamsted on May 7, 1931, under the chairmanship of Sir A. D. Hall; with contributions by Sir A. D. Hall, Sir John Russell, Dr. R. A. Fisher, Dr. J. Wishart, Prof. R. G. Stapledon, S. F. Armstrong, A. H. Lewis, T. N. Hoblyn, H. V. Garner, D. J. Watson, T. H. J. Carroll, and others. Pp. 64. (Harpenden: Rothamsted Experimental Station, 1931.) 1*s.* 6*d.* net.

[2] Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust Report for 1930. Pp. 172. (Harpenden: Rothamsted Experimental Station, 1931.) 2*s.* 6*d.*

The Coal Measures of Belgium.

IN several Continental countries the geology of the coal measures has for long received great attention. This is especially true of those coalfields where the rocks are highly disturbed and the interpretation of the geological structure is often a matter of great difficulty.

In Belgium a succession of brilliant workers has applied palæontological methods to the elucidation of the sequences and structures in the coalfields. Lately this work has been carried out under the direction of Prof. A. Renier, of Brussels, whose contributions to the geology of the Carboniferous of Belgium have been widely known for many years. In a recent memoir, Prof. Renier has summarised the development of these investigations, and has given a concise account of his views concerning the mode of deposition of the rocks and of their correlation, while Prof. Pierre Pruvost, of Lille, has contributed to the memoir a very valuable account of the fauna.*

* Considérations sur la stratigraphie du terrain houiller de la Belgique, par Armand Renier; La Faune continentale du terrain houiller de la Belgique, par Pierre Pruvost. *Mém. Mus. Roy. d'Hist. Nat. de Belg.*, No. 44, 1931.

Prof. Renier asserts that in the coal measures of Belgium the floor of every seam is full of the rootlets of *Stigmaria*. The plant remains of these fossil soils are of very monotonous aspect, *Stigmaria ficoides* being present at every horizon throughout the sequence. Renier emphasises that the tracing and recording of such fossil soils, even when they are, locally, not overlain by coal seams, is of great assistance in the investigation of the strata. This is in marked contrast with the general practice in many mining areas in Britain, where frequently there have been no records of any of the strata passed through excepting the coal seams.

Renier directs attention to the wide lateral extent of many coal seams, while at least one marine bed in the coal measures he recognises in areas so far apart as the Pas de Calais, Holland, and Westphalia. This wide extent of at least some beds in the Upper Carboniferous strongly supports the view that there was at times continuous deposition over wide areas. The views formerly held by some geologists regarding the deposition of the coal measures in small isolated basins,

more or less co-extensive with the present coalfields, receive no support from Renier's work.

In contrast with the uniformity of the floors of the coal seams, the roofs yield extremely varied faunas and floras. These have been examined and recorded with great precision. Renier quotes approvingly the words of Crépin, who laid down two rules for palæontologists working on the coal measures so long ago as 1878. Palæontologists, he advised, should never confine their researches to material collected from the rubbish tips of collieries, but should themselves descend the mines and study the Carboniferous vegetation *in situ*; further, they ought not to leave the collecting exclusively to workmen and others ignorant of the science, but to undertake some of the labours themselves.

The neglect of this advice—not only in Belgium—led for many years to serious errors in regard to the palæontology of the coal measures. Thus, Prof. Renier shows that certain palæontologists who have studied the coal measures of Belgium since Crépin's time based their conclusions almost entirely on museum collections, and decided that the flora was uniform in character from top to bottom of the sequence; recent work, on the other hand, based on the actual examination of each horizon, has made it clear that distinct floras can be recognised and used both in the identification of seams and in the correlation of the coal measures over western Europe.

Prof. Pruvost's account of the non-marine faunas makes a fitting sequel to his monumental work on the faunas of the coal measures of the north of France. A beautiful series of plates is devoted chiefly to the fossil insects and other arthropods and to the fishes. A number of remarkable fossils is described, and this part of the memoir will be indispensable to all students of coal measure palæontology. It is much to be regretted that no illustrations of any of the Mollusca are included (except in relation to their supposed borings); the Mollusca are much more frequent than other fossil animals at most horizons, and Pruvost relies on them to a great extent in his correlation.

Pruvost is not prepared, however, to accept any of the refinements in nomenclature which have been made in recent years. To a large extent he has followed the late Dr. Wheelton Hind, who was very conservative (and sometimes, unfortunately, rather inaccurate) in his interpretation of these species. But whereas even the latter was willing to recognise some twenty-five species of non-marine lamellibranchs in the coal measures of Belgium, Pruvost admits no more than twenty. In his 'lumping' of species he places *Anthracomya librata* Wright as a synonym of *Carbonicola similis* Brown, and *Naiadites elongata* Hind as a synonym of *Anthracomya phillipsi* Will. It is probable that his discrimination of the faunas is much more precise than the nomenclature which he uses, but his method must make it difficult for other palæontologists to make full use of his labours.

A. E. TRUEMAN.

Dyestuffs and Enzymes.

MANY dyes and related compounds have a specific toxic effect on certain micro-organisms which has been utilised in the treatment of the diseases caused by them. The mode of action of the dyestuff is not known, but it is probable that it poisons some particular system in the cell, without which the latter cannot carry on its metabolic activities.

Some recent researches by J. H. Quastel on the action of dyes upon enzymes may throw light not only on the nature of the toxic effect, but also on the constitution of the enzymes employed (*Biochem. Jour.*, vol. 25, p. 629; 1931 (with A. H. M. Wheatley); and *ibid.*, vol. 25, pp. 898 and 1121; 1931). In the first paper it was found that basic, but not acid, dyes inhibited the oxygen uptake by *B. Coli* in the presence of glucose, lactate, succinate, and formate. The degrees of inhibition varied both with the dye and the substrate used, so that the effect could not be due to a general lethal action. Since it is the basic dyes which are active, it appears that the cell dehydrogenases are essentially acidic in character; but basicity is not the only factor in toxicity, since the basic Bismarck brown has little action. The inhibitory action of the dye was less marked in phosphate than in veronal buffer. Similar results were obtained with muscle enzymes, but no inhibition was observed with any dye when brain tissue was used, probably because the dye failed to reach the enzyme.

In the second paper, the behaviour of fumarase from micro-organisms or from brain or red-blood cells was studied. This enzyme converts fumarate to *l*-malate, which can be estimated polarimetrically. It was found that both acid and basic dyes were toxic, but a marked specificity was apparent; of the former, the Congo red series was the most toxic, of the latter, the triphenylmethane series. It was also observed that fumarate combines with its enzyme and prevents the combination, and hence the toxic action, of both acid and basic dyes; that proteins exert a protective action, and that the protective action of phosphates is less than in the case of the dehydrogenases.

The most recent experiments have been carried out with certain naphthylaminedisulphonic acids and fumarase, after observing that trypan red and Bayer 205, like Congo red and trypan blue, are toxic. None of the six acids tested were toxic, nor were their first *s*-carbamide derivatives. The second and especially the third *s*-carbamide derivatives were, however, very toxic, that is, the *s*-carbamides of *m*-aminobenzoylnaphthylaminedisulphonic acid and of *m'*-aminobenzoyl-*m*-aminobenzoylnaphthylamine-disulphonic acid. The importance of this observation lies in the fact that there is a definite, though not strict, parallelism between the toxic action of these carbamides on fumarase and their trypanocidal potency, as determined by Balaban and King. It is possible that this method of investigating the toxicity of dyestuffs on enzymes may prove suitable for preliminary tests in the preparation of compounds likely to be of chemotherapeutic value.

Carbonisation of Coal.

GREAT expectations have been placed upon coal carbonisation at low temperatures as a source of motor spirit. Fuel Research Technical Paper No. 34 (H.M.S.O., 6*d.* net), on the "Light Spirits from the Low Temperature Carbonisation of Coal", shows that the experience with benzole production cannot be directly transferred to low temperature products. The proportion of tar acids and unsaturated compounds is higher, necessitating greater consumption of chemicals in refining. The refined products were found by actual tests in petrol engines to be good motor fuels at least equal, when fresh, to commercial petrol. They still contained considerable quantities of unsaturated compounds which were liable to polymerise

on storage and they show increased gum and peroxide formation, accompanied by decrease in the highest useful compression ratio (H.U.C.R.). The report suggests the need for caution in assessing the value of low temperature processes as sources of motor fuel.

The pioneers of low temperature carbonisation seemed to take it for granted that the tars and oils produced would find markets ready for their absorption. Even now, this idea is still widespread. Experience brought disillusion, and it became clear that only after long research could one expect to develop uses for these novel products. Among other institutions the Fuel Research Station has studied systematically the influence of conditions on the general character of the tars and liquors. A more detailed chemical study of the tars was undertaken by the National Chemical Laboratory at Teddington with the view of discovering, if possible, new industrial applications for these products.

Much of this work has been published in periodicals and is now included in a Fuel Research Technical Paper No. 32, entitled "A Study of the Tars and Oils Produced from Coal" (H.M.S.O., 2*s*. net). This is in four parts: statistics, the treatment of low temperature tars from a commercial retort, the carbonisation of three British coals at varying temperatures, and the influence of temperature on the properties of tars. Perusal leads to the conclusion that in the development of low temperature processes too much capital has been spent on large scale plant, and too little on laboratory investigation of the chemistry of the processes and their products.

One branch of the work of the Fuel Research Board is the physical and chemical survey of national coal resources, which now covers practically the whole of the British coalfields. The reports hitherto published have dealt with the detailed survey of seams of coal. Paper No. 20, which has just appeared (H.M.S.O., 1*s*. 3*d*. net), entitled "The Yorkshire, Nottinghamshire and Derbyshire Coalfield, Analysis of Commercial Grades of Coal, Part I.", breaks new ground by giving the analyses of the commercial products of about forty important collieries in the district. It can scarcely be doubted that the information will be of great use to those concerned with the selection and purchase of coal, whether at home or abroad. The report should also be of great value to the collieries concerned, and will excite envy in other industries not so fortunate as to have their products so examined and certified. Perhaps the most striking impression which the reader can gain from the figures is the high quality of the fuel marketed in this area. Most of the samples contain less than five per cent of ash.

High Speed Flying.

AT an evening discourse delivered before members of the British Association on Sept. 29, Mr. H. E. Wimperis, Director of Scientific Research to the Air Ministry, gave an interesting résumé of accomplishments, and speculations as to future advances, in high speed flying. The very high accelerations set up have given rise to various problems, both structural in the aircraft and physiological in the occupant. A rate of three times that of gravity can be obtained in starting by the use of catapults. These are necessary for obtaining the minimum speed for flight for fast machines in a reasonable space. It is interesting to note that this rate of increase of speed is about a hundred times that of a steam-engined railway train. Even greater accelerations are experienced in curved flight—up to five times gravity—and as the machine is only designed to withstand a load of 8*g*, care has to be exercised, in making rapid turns of small radius, not to approach this. The centrifugal force on the pilot in such turns drives the blood from his brain to the more distensible parts of his body, and this is accompanied by a loss of sight, although not of mental clarity.

Such high speed machines are necessarily built as seaplanes, as it is impossible to make aerodromes with sufficiently flat surfaces, or large enough, to allow of reaching the very high minimum flying speed with safety. Even on smooth water, handling requires considerable skill, as the angle at which the floats will leave the water due to hydro-planing is greater than the machine can maintain when it becomes air borne. Another peculiar trouble arises from the fact that at speeds of above 360 m.p.h. the rush of air actually heats a body passing through it, instead of cooling it. This complicates the question of cooling both the engine and the pilot's cockpit.

With regard to future progress, while there is no theoretical limit to speeds higher than 407·5 m.p.h., the present record, there are many practical difficulties to be overcome. Better streamlining would give up to another 60 m.p.h. for the same power, but some excrescences which spoil this, such as the undercarriage, tail, etc., appear to be inevitable. At the velocity of sound, namely, about 700 m.p.h., there is a doubling of the head resistance, which would appear to be an insurmountable barrier to aircraft of the present form, but with other aerodynamic outlooks this may be passed.

Another method of reducing resistance would be to fly at altitudes of, say, 100,000 feet, where the reduced density of the air would offer less resistance to motion. This would probably need some form of rocket propulsion, as the present-day engine would not function without a sufficient supply of oxygen, neither would the propeller have enough bite on the thin air to transmit the necessary thrust.

Hardening of Metals in a Magnetic Field.

MR. E. G. HERBERT, of Manchester, contributed a paper to the Royal Society in January 1931 and two articles to *Metallurgia* in May and June of last year on the hardening of metals in a magnetic field. The Royal Society paper describes the fluctuations in the hardness of steel, duralumin, and brass caused by rotation in a magnetic field. Mr. Herbert shows that the time element is an important factor in the hardening produced magnetically. He has found that the hardness changes are sometimes very rapid, and in hard steel, freshly treated, changes may sometimes be observed from minute to minute.

Later research has shown that the effect produced in steel by the magnetic treatment is periodic in character, generally extending over many hours subsequent to treatment. In some experiments there were a sequence of six alternate increases and decreases of hardness occupying gradually lengthening periods of time. It was found that when a rotary magnetic field was used the maximum hardening effect could be produced by a single turn in the magnetic field at a suitable temperature followed by a period of ageing. The cloud-burst process of hardening by steel ball bombardment could be superimposed on the

rotating field method, the processes being apparently independent of one another.

Mr. Herbert adopts as a provisional theory that the rotating magnetic field gives rise to a fluctuation of a periodic character in the systems of electrons, which in turn causes periodic fluctuations in molecular cohesion. A very interesting possibility of a practical nature follows from these investigations, namely, the stabilisation of the metal at a selected phase in the fluctuations set up mechanically, magnetically, or otherwise. For example, the stabilisation of steel wire in a condition characterised by greatly increased ductility with undiminished tensile strength.

In *World Power* for October, Mr. Herbert describes some work in connexion with high-speed tools. At present the results obtained seem very anomalous; in some cases the magnetic field has a hardening effect on the metals experimented on, and in other cases it softens them. The results suggest that the magnetic effects have been merely superimposed on the normal age-hardening process. They may be quite different in character. A softening magnetic process added to age hardening might be expected to slow down the hardening process, while a hardening magnetic treatment added to the normal hardening might be expected to accelerate it. It was observed that an increase of hardness equivalent to an increase of 13 per cent on the Brinell scale was induced in high-speed steel by a single turn of the magnetic field, occupying about a minute and applied at a temperature of only 100° C. Such a treatment could easily be given to finished tools of the most complicated character as well as to drills, sawblades, and dies in which a high degree of hardness is desirable. It is probable that further experiments, especially as to what is the best temperature to employ, will give even better results. As no metal hitherto subjected to magnetic treatment has failed to react, it is possible that these effects are common to all metals. In the non-magnetic metals the hardness changes hitherto produced have been relatively slight, but research in this direction seems very promising. It has been suggested that these changes may not be confined to metallic or even to inorganic substances.

University and Educational Intelligence.

LONDON.—Dr. F. A. von Hayek has been appointed for the session 1931–32 to the Tooke chair of economic science and statistics tenable at the London School of Economics.

The following titles have been conferred in respect of posts held at the Colleges indicated: *Professor*:—Dr. Charles Singer (history of medicine, University College); Mr. E. F. D. Witchell (mechanical engineering, Imperial College—City and Guilds College). *Reader*:—Mr. R. J. Tabor (botany, Imperial College—Royal College of Science); Dr. W. G. Bickley (mathematics, Imperial College—City and Guilds College); Dr. G. F. J. Temple (mathematics, Imperial College—Royal College of Science); Mr. B. W. Holman (mining, Imperial College—Royal School of Mines); Dr. Herbert Dingle (physics, Imperial College—Royal College of Science); Dr. H. S. Gregory (physics, Imperial College—Royal College of Science); Dr. S. G. Paine (plant bacteriology, Imperial College—Royal College of Science); Mr. J. P. Ross (surgery, St. Bartholomew's Hospital Medical College); Dr. L. C. Martin (technical optics, Imperial College—Royal College of Science); Dr. Elizabeth A. Fraser (zoology, University College).

The title of emeritus professor in the University has been conferred on the following:—Prof. E. J. Garwood, on his retirement from the Yates-Goldsmid chair of geology at University College; Prof. C. Spearman, on his retirement from the chair of psychology at University College; Prof. W. E. Dalby, on his retirement from the chair of civil and mechanical engineering at the Imperial College—City and Guilds College.

The degree of D.Sc. in biochemistry has been conferred on Bireschandra Guha for a thesis entitled "Investigations on the Factors of the Vitamin B Complex and on the Newer Factors necessary for the Normal Nutrition of the Rat" (*Brit. Med. Jour.*, 1931, and *Biochem. Jour.*, 1931).

FOR the session 1931–32, the Department of Coal Gas and Fuel Industries with Metallurgy of the University of Leeds has arranged a series of evening courses, with practical work. The courses comprise studies in the manufacture of coal gas, refractory materials, the coke fire, and metallurgy. Further information can be obtained from the Registrar, University, Leeds.

THE professional education of teachers in the United States of America during the past ten years is reviewed in *Bulletin*, No. 30, 1931, of the Office of Education, Washington. One of the most striking changes brought to notice is in the relationship between the demand for and supply of certificated teachers. The number of students in training for teaching increased from 135,435 in 1919–20 to 274,348 in 1927–28; the number of students completing one-, two-, and three-year curricula during the same time increased from 21,012 to 49,627, whilst those graduating after a four-year course increased from 1296 to 8179. The over-supply of teachers in many places and the over-crowding in a few teachers' training institutions have led to the raising of the standard of requirements for admission to teacher-training courses. There has been also rapid progress in raising standards of certification. The average number of students per training institution has grown from 439 to 877, necessitating better facilities for their social and physical welfare. Of the strictly professional courses, student teaching is coming to be recognised as one of the most important, and it is much more frequently provided than formerly, but probably fifty per cent of teachers enter upon their duties without having been through such a course. Training colleges are increasingly concerning themselves with the careers of their graduates, and recognising an obligation not only to see them placed but also to help them in overcoming their inevitable difficulties during the first year or two of teaching.

COMMONWEALTH Fund fellowships will be available early in 1932 for British students who desire to continue their studies in American universities. Last year there were 121 candidates (99 men and 22 women) for ordinary and Dominion fellowships, and 29 fellowships were granted; 56 candidates applied for service fellowships (open to those in government service only), and 6 appointments were made. Of the 35 fellows appointed, 20 came from faculties of science. These fellowships are available to research graduates and also to students who have just taken their first degree. There is no fixed stipend attached to a fellowship, but each is of the approximate annual value of 3000 dollars. Each fellowship includes provision for an equipment allowance of 200 dollars, and a travel allowance, tuition fees, etc., 150 dollars per month for living expenses, allowance for travel during the Christmas recess, and allowance for three months' travel (which is compulsory) at the end of the first academic year. A fellowship is tenable for two years, with possible extension to a third year. There is very little limitation to the subject of study which a fellow may choose. Applications for fellowships must be

sent to the authorities of the college or university of which the candidate is, or has been, a member, and must reach the Secretary by Feb. 8, 1932. Further information can be obtained from the Secretary, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

Calendar of Geographical Exploration.

Jan. 1, 1841.—The Antarctic and the Ice-Barrier.

Under the direction of Capt. J. Clark Ross, R.N., an expedition consisting of two ships, the *Erebus* and the *Terror*, crossed the antarctic circle to prosecute surveys for the British Government. From the point of view of geographical discovery, this was the most fruitful of all antarctic voyages. Ross was an experienced arctic traveller and had located the north magnetic pole in 1831. Under his direction, ships for the first time deliberately pushed their way into the pack ice. This ice, previously thought to stretch on indefinitely to the remote land, proved to be a belt about a hundred miles wide, and the *Erebus* and *Terror* passed through it to open waters now known as Ross Sea. By Jan. 11, Ross had sighted the rocky coast of South Victoria Land and had noted the Admiralty Range running north-west along the coast, and a further range going southwards. Unable to reach the mainland, he landed on Possession Island and claimed the newly discovered land for Britain. Later he sighted an active and an extinct volcano, named respectively Erebus and Terror after the vessels. The great ice barrier, with peaks 200 ft.-300 ft. in height and extending for 250 miles, seen for the first time, checked his farther southward progress. Like the Frenchman, Dumont d'Urville, who had set out from Hobart on Jan. 1 of the previous year, he was compelled to give up the dream of reaching the south magnetic pole, though he penetrated nearer to it than any previous explorer.

Sixty-one years later, on Jan. 1, 1902, the *Discovery*, with Lieut. R. F. Scott, R.N., as its commander, and with E. H. Shackleton, R.N.R., as one of its lieutenants, met the pack ice and thence penetrated to Ross Sea. The ice-barrier had retreated 30 miles since Ross was there. Scott found that the land which Ross had believed to lie east of the ice-barrier, but which he had cautiously charted as an "appearance of land", was plainly visible, its higher summits rising 2000 ft.-3000 ft. above the sea. It was further discovered that McMurdo Bay, charted by Ross, was in reality the opening of a strait leading southwards between Ross Island and the mainland. Mt. Erebus proved to be not on the mainland, but on what is now mapped as Ross Island.

Jan. 2, 1923.—The Libyan Desert.

A. M. Hassanein Bey left Sollum, a small port on the Mediterranean near the western frontier of Egypt, on his difficult journey southward through the Libyan desert to Darfur. As a result of his work important new facts about the orography and geology of the region were recorded. His discovery of the rock basin oases of Arkenu and Owenat makes possible further desert travel in the still unexplored regions of the Libyan desert. His route linked up with Tilho's explorations in the French Sudan and confirmed the latter's conclusion that Lake Chad has no possible drainage outlet in an easterly direction.

Jan. 7, 1830.—The Murray River.

Charles Sturt launched a boat on the Murrumbidgee and sailed thence along the Murray to the sea. He had previously discovered a portion of the Darling River; this second "bold and desperate" venture solved the nature of the inland river drainage of south-eastern Australia.

Societies and Academies.

CAMBRIDGE.

Philosophical Society, Nov. 23.—**T. M. Lowry** and **C. B. Allsopp**: Refractive dispersion and the problem of 'optical exaltation'. A thin film of liquid is placed between the plates of a quartz etalon and the interference bands are focused on the slit of a spectrograph. The order of the interference bands is deduced from pairs of refractive indices determined with a refractometer. Refractive indices can then be deduced to four places of decimals in the visible or ultra-violet regions up to the limit of transparency of the film.—**T. M. Lowry** and **H. K. Gore**: Optical rotatory power of vapours. Measurements have been made of the rotatory dispersion of camphor and of camphorquinone as vapour and in solution. In the region of absorption, camphor gives a curve with a composite maximum. This is explained by the composite character of the ketonic absorption band, as evidenced by the fact that the curve of circular dichroism covers a smaller range of wave-lengths than the absorption curve.—**T. M. Lowry** and **H. Hudson**: Absorption and circular dichroism of optically active substances. Measurements have been made of the absorption, circular dichroism, and rotatory dispersion of a series of bornyl xanthates. The two absorption bands are optically active but of opposite sign. The curve of circular dichroism therefore crosses the axis, as is observed experimentally in the methyl xanthate.—**C. P. Snow**: Fine structure of absorption bands in crystals. The absorption bands of compounds of the rare earths in the crystalline state show well-marked discontinuities similar to the line spectra of the atoms. This has recently been shown to be due to the 'shielding' of an inner incomplete electronic group throughout the series of the rare earths. There is a marked sharpening of the lines when the crystals are cooled to liquid air temperature and below. Reasons for this have been discussed (see Snow and Rawlins, NATURE, **125**, p. 349; 1930).—**R. G. W. Norrish**: Predissociation in relation to photochemical activity. A large group of primary photochemical effects may be correlated with the condition known as predissociation in the molecular absorption spectrum. With aldehydes and ketones, however, although photodecomposition coincides with predissociation, it is difficult to envisage the mechanism of the change, since the chemical data for some fifteen examples indicate that no free radicals are produced. It would appear that molecular rearrangement involving more than one bond occurs within the molecule.

PARIS.

Academy of Sciences, Nov. 23.—**H. Vincent** and **L. Velluz**: The immunigenic properties of the diiodosalicylic cryptotoxin. From experiments on guinea-pigs, it has been proved that the diiodosalicylic cryptotoxin, the preparation of which is given, is capable of rapidly conferring immunity against pure tetanus toxin. This cryptotoxin neutralises the tetanus toxin, the latter not being destroyed but converted into a harmless complex. This non-toxic complex rapidly immunises animals.—**C. Sauvageau**: The third kind of plurilocular organs of *Ectocarpus secundus*.—**Paul Montel**: The upper limit of the moduli of the zeros of polynomials.—**Eduard Čech**: The theory of dimensions.—**Maurice Janet**: The minimum of the ratio of certain integrals.—**J. A. Lappo-Danilevski**: The decomposition of the normal integral matrix of a system of linear differential equations and the construction of the primitive

matrix.—**Jacques Devisme**: Some partial differential equations.—**Abramesco**: The Leja factor of uniform convergence of a series of polynomials.—**R. Mazet**: The unicity of the solution of problems of friction.—**Constantin Woronetz**: Lines of slip on a cylinder.—**J. Baurand**: Periodic waves at the surface of water.—**Louis Bréguet**: Aerodynamic suspension of the aerial vehicle.—**J. Dufay** and **R. Gindre**: o-Herculis, a variable star of very small amplitude. Previous observations on this variable star have given discordant results. The photometer used in these observations gives an accuracy of about a hundredth of a magnitude, and 136 photometric comparisons were made. The results are given in the form of a curve, showing a period of 22 days. The form of the curve corresponds to a double star with eclipses.—**F. Link** and **J. Devaux**: The photometric and actinometric study of the moon during the eclipse of Sept. 26, 1931.—**Paul Woog, Jean Givaudon**, and **Mlle. Emilie Ganster**: Neutralising varnishes; properties of orientation of their superficial molecules. Molecular polishing. By the application of certain varnish coatings, lubricating oil can be prevented from spreading out over solid surfaces. The composition and mode of treatment of such a varnish are given, and the theory of the process is discussed.—**Guy Emschwiller**: The mechanism of the photolysis of the alkyl iodides. Either of the two theories, dissociation or activation, affords an explanation of the phenomena observed in the photolysis of the alkyl iodides.—**D. K. Yovanovitch** and **P. Savitch**: The calorimetric study of the absorption of the γ-rays of radium. Instead of the usual ionisation method, the authors use a microcalorimeter. A null method is used, the heat produced by the radium being balanced by electrical heating. Curves are given showing the heat developed by absorption in lead, silver, and copper.—**Mlle. M. Th. François**: The anomalies observed when using benzene and nitrobenzene in cryoscopy. It is usually held that benzene and nitrobenzene possess two K constants, one normal and applying to most organic substances, the other abnormal (hydroxyl compounds), practically half of the first. The author's experiments cited do not confirm this.—**Augustin Boutaric** and **Charles Tourneur**: The study of colloidal solutions by the polarisation of the light diffused by them. For extremely small spherical particles, the theory of Lord Rayleigh shows that the diffused light should be totally polarised: if the particles increase in size, the proportion of polarised light should be reduced. Hence the study of the polarisation gives interesting information concerning the changes in a colloidal solution approaching the condition of flocculation.—**G. Austerweil**: The preparation and purification of salts by the use of zeolites.—**J. Golse**: The reduction of mercuric cyanide by tin in the presence of certain metallic salts. Although tin is without action upon neutral solutions of mercuric cyanide, when sodium chloride (or certain other salts named) is added, hydrocyanic acid is set free, and the mercury is reduced to metal in accordance with the equation

$$Hg(CN)_2 + Sn + 2H_2O = Sn(OH)_2 + Hg + 2HCN.$$

—**Ernest Kahane**: The possibility of destroying considerable quantities of organic substances by means of perchloric acid. After a preliminary treatment with a mixture of nitric and sulphuric acids, and driving off water and excess of nitric acid, the perchloric acid is added drop by drop, the liquid being maintained at 190° C. The oxidation is rapid and complete.—**E. M. Bellet**: The reaction between esters and alcohols in a slightly alkaline medium.—**André Kling** and **Daniel Florentin**: The mode of action of hydrogenating and mixed catalysts in the hydrogenating cracking of phenols.—**Dalloni**: The geological constitution of Tibesti. The pre-Cambrian substratum.—**H. Le Breton**: The coast-line of post-neolithic age in Xu-Nghé and in Trois-Quang of the north (Annam, French Indo-China).—**Chadefaud**: The morphological signification of the stigma of the zoospores and the zoogametes in the Heterokontæ and Phæophyceæ.—**Théodureto de Camargo**: The influence of the potash-nitrogen ratio on the development of the coffee plant during the first period of growth.—**Emile F. Terroine** and **Mlle. Germaine Boy**: The distribution of the nitrogen compounds of the urine in the minimum endogenous nitrogen consumption and in protein nutrition: the problem of existence and of the magnitude of the albuminoid reserves.—**Mlle. Marcelle Lapicque**: Chronaxy of subordination in an invertebrate.—**Mme. H. Heldt**: Observations on the laying, fertilisation, and the first stages of development of the egg in *Penæus caramote*.—**Maurice Piettre**: Remarks on the physical state of the calcium phosphates in milk: the fractionation of their micelles leads to the existence of free calcium caseinate and of a calcium phosphate compound. By physical means, centrifugation, freezing, and especially by dialysis against water, glycerol or saccharose, increasing proportions of calcium phosphate can be separated, and by using sodium citrate a casein can be obtained containing only traces of lime. Hence it is concluded that in milk the colloidal lime exists as the triphosphate.—**Bordier**: A new helioactinometer. The amount of iodine set free from a solution of iodoform in chloroform under the influence of the solar photochemical rays is taken as a measure of the light received.—**J. André Thomas**: The production of tumours of sarcomatous appearance in the annelid *Nereis diversicolor* by inoculation with *Bacterium tumefaciens*.

GENEVA.

Society of Physics and Natural History, Nov. 5.—**P. Rossier**: The spectral sensibility of photographic plates. The author gives an analytical expression for the sensibility curve of the photographic plates used at the Geneva Observatory. This expression allows the study in some detail of certain applications of these plates to astronomical photometry.—**E. Briner, H. Paillard**, and **R. Zurcher**: Attempts at supplying an internal combustion motor with air mixed with ozone. In spite of the very low concentrations (about 1 in 10,000) in which it was introduced into the gas, ozone produced 'knocking'. On account of the peroxidising properties of ozone, the effect noted appears to support the theory attributing detonating combustion to the formation of very unstable intermediate peroxides.—**R. Wavre**: The small vibrations of liquid stars. The author applies the 'uniform method' to the study of the small movements of stars composed of a nucleus and a fluid envelope. Assuming the solid nucleus, he arrives at the results of Lord Kelvin concerning the oceanic tides. The contrary assumption of a liquid nucleus is a new problem which he has succeeded in solving. He develops also the influence of the terrestrial tide on the oceanic tide and gives the principal results.

LENINGRAD.

Academy of Sciences—*Comptes rendus*, No. 7, 1931.—**N. Tagejeva** and **F. Starik**: The radium content of the petroliferous waters of Tcheleken island. The water contains from $6{\cdot}75 \times 10^{-11}$ to $4{\cdot}37 \times 10^{-11}$ gm. of radium in 100 c.c. of water.—**L. Kurbatov**: The radioactivity of the mineral water of Nefte-dagh and Tcheleken.—**V. Baranov** and **L. Kurbatov**: The radium

content of the petroliferous waters in the Grozny district. The radium content of water in July–September proved to be considerably less than in March of the same year.—**L. Komlev**: The radium content in the water of oil wells in the Novo-Grozny district. Beginning with July 1929, a marked reduction on the radium content was observed, although the general chemical content of the water remained practically unchanged.—**V. Ignatovskij**: Functions which are orthogonal to the hypogeometrical series (1).

Comptes rendus, No. 8, 1931.—**A. Fersman** (1): A geochemical diagram of the Chibin mountains.—(2) The geochemistry of gold.—**D. Prianishnikov**: The formation of ammonia during the reduction of nitrates by the higher plants. Normal plants absorb ammonia more energetically than nitrates.—**A. Popov**: A new genus of fish, *Davidijordania* (Zoardidæ), from the Pacific Ocean. *Lycenchelys lacertinus* Pavl. is made the type of a new genus, to which *L. ornatus* Sold. and *L. pœcilimen* Jord. and Fowl. are also referred. *Lycenchelys brachyrhynchus* Schm. belongs to the genus *Hadropareia*, and *L. fasciatus* Schm. is a synonym of *Lycodes fasciatus* Schm.—**V. Scherbina**: Chemical constitution of the nepheline from the Chibin mountains.

SYDNEY.

Royal Society of New South Wales, Sept. 2.—**H. Finnemore** and **C. B. Cox**: The amount of hydrocyanic acid in *sorghum* sudan grass and some hybrids. *Sorghum* contains a higher amount of prussic acid than has been hitherto recorded, and it loses this acid as the plant develops, but even on cutting and wilting the young plant by no means becomes innocuous. Of the results obtained, it was shown that the variety *Feterits* is the most poisonous. Contrary to opinions held in some quarters, it was found that sudan grass contains an appreciable amount of prussic acid.—**F. R. Morrison** and **R. Grant**: A contribution to the chemistry of the fruit obtained from the White Cedar tree (*Melia Azedarach*, L. var. *australasica* C. DC; Syn. *Melia australasica*, A. Juss) growing in New South Wales, with notes on its reputed toxicity. Proximate analyses of the fruit were obtained from trees growing at Grafton and Dubbo, New South Wales, respectively. The ripe fruit obtained from Grafton trees contains a sticky pulp, consisting of a starchy meal, a resin, an oil, and dextrose, with acid and other water-soluble substances. Feeding tests using guinea-pigs showed the Grafton fruit to be non-toxic, whilst fruit from trees growing at Dubbo and Parramatta, respectively, proved in some cases to contain a toxic constituent, which was found to be present in the resinous portion of the fruit. A very small quantity of basic material was extracted from an ether solution of the resin by means of 0·5 per cent sulphuric acid solution. Neither the basic extract nor the resin from which it was extracted produced toxic symptoms when administered alone, but a mixture of both produced fatal results.

Oct. 7.—**J. C. Earl** and **C. H. Wilson**: The condensation of α-β dibromocarboxylic acids with benzene in the presence of aluminium halides. Cinnamic acid dibromide and crotonic acid dibromide when treated with aluminium chloride and benzene give the corresponding derivatives of dihydrophenanthrene. By the use of ferric chloride or aluminium bromide, instead of aluminium chloride, linking between the two phenyl nuclei does not take place, $\alpha\beta\beta$-triphenylpropionic acid and $\alpha\beta$-diphenylbutyric acid being formed from the cinnamic and crotonic acid dibromides respectively.

Diary of Societies.

FRIDAY, JANUARY 1.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 3.30.—E. R. Jarrett: Christmas Juvenile Lecture on Architecture.
ROYAL PHOTOGRAPHIC SOCIETY, at 7.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.

SATURDAY, JANUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: The Universe of Light (Christmas Lectures) (3): Light and Colour (1).

MONDAY, JANUARY 4.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales—Liverpool—Centre) (at Liverpool University), at 7.
INSTITUTION OF RUBBER INDUSTRY (at Engineers' Club, Manchester), at 7.
WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY (at Victoria Hotel, Wolverhampton), at 7.30.
BRITISH KINEMATOGRAPH SOCIETY (at Gaumont Theatre), at 7.45.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.

TUESDAY, JANUARY 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: The Universe of Light (Christmas Lectures) (4): Light and Colour (2).
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.

WEDNESDAY, JANUARY 6.

ROYAL SOCIETY OF ARTS, at 3.—Prof. E. N. da Costa Andrade: The Vacuum, or the Importance of Nothing at All (Dr. Mann Juvenile Lectures) (1).
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.
INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Queen's Hotel, Birmingham), at 7.30.
INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester).
ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B.M.A. House, Tavistock Square).

THURSDAY, JANUARY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: The Universe of Light (Christmas Lectures) (5): Light from the Sky.
LINNEAN SOCIETY OF LONDON, at 5.
INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.
INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.

FRIDAY, JANUARY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—Mrs. Murray Chapman: Through Lapland in Winter with Sledge and Reindeer (Christmas Lecture for Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.
ROYAL ASTRONOMICAL SOCIETY, at 5.
ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5.30.
MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—S. B. Freeman: Modern Types of Propelling Machinery for Mercantile Marine Use (Thomas Lowe Gray Lecture).
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.
ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. W. F. Whittard: An Expedition to East Greenland, 1929 (Lecture).
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Institute of Chemistry) (at Newcastle-upon-Tyne).

SATURDAY, JANUARY 9.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: The Universe of Light (Christmas Lectures) (6): Light from the Sun and the Stars.

Public Lectures.

MONDAY, JANUARY 4.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—The President: South and East (Christmas Lecture for Young People).

WEDNESDAY, JANUARY 6.

UNIVERSITY COLLEGE, at 3.—Sir Richard Gregory, Bt.: Comets and Shooting Stars.
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape (Swiney Lectures) (1). (Succeeding Lectures on Jan. 8, 11, 13, 15, 18, 20, 22, 25, 27, 29, and Feb. 1.)
BELFAST MUSEUM AND ART GALLERY, at 8.—Mrs. H. Richardson: Costume and History.

Conferences.

JANUARY 4 AND 5.

MATHEMATICAL ASSOCIATION (at London Day Training College).

Monday, Jan. 4, at 3.30.—Sir Arthur Eddington: The Decline of Determinism (Presidential Address).

At 5.—Prof. S. Brodetsky: Modern Dynamics in Astronomy, Relativity, and Quantum Theory.

Tuesday, Jan. 5, at 10 A.M.—Discussion on The Report of the Association of University Teachers on Entrance Tests and Initial Degrees.

At 11.15 A.M.—Dr. S. Verblunsky: The Foundations of Mathematics.

At 12.15.—Prof. A. Lodge: Interpolation by Central Differences.

At 2.30.—G. Frecheville: The Application of Mathematical Methods to Research Work in Agricultural Economics.

At 3.30.—Discussion on Calculus and Co-ordinate Geometry at the School Certificate Stage, with special reference to the Additional Mathematics Syllabus of the Joint Matriculation Board of the Northern Universities.

JANUARY 4 TO 11.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Monday, Jan. 4, at 3.—Sir William Rothenstein: Presidential Address.

At 5.—Dr. E. Miller: The Difficult Child: Sociological *v.* Individual Interpretations (Lecture) (British Psychological Society—Education Section).

Tuesday, Jan. 5, at 2.30.—Discussion on The Film as an Instrument of Humane Education (University of London Animal Welfare Society).

At 3.—J. H. Whitehouse: Public Schools and the Public Life (Lecture) (Society for Experiment and Research in Education).

Wednesday, Jan. 6, at 3.—Sir Richard Gregory, Bt.: Comets and Shooting Stars (Lecture) (School Nature Study Union).

At 5.30.—Prof. D. Laurie: Biology in Schools (Lecture) (Association of Assistant Mistresses).

Thursday, Jan. 7, at 2.30.—Mrs. C. B. S. Hodson: Desirability of including Simple Biology and Heredity Teaching in the School Curricula (Lecture) (Eugenics Society).

Friday, Jan. 8, at 2.—Discussion of Physical Education in Schools (Medical Officers of Schools Association).

JANUARY 5 TO 7.

EXHIBITION OF SCIENTIFIC INSTRUMENTS AND APPARATUS (at Imperial College of Science and Technology), 3 to 6 and 7 to 10.

Tuesday, Jan. 5, at 8.—C. C. Paterson: Photocells: The Valves which operate by Light (Lecture).

Wednesday, Jan. 6, at 8.—T. Smith: Photographic Shutters and their Properties (Lecture).

Thursday, Jan. 7, at 8.—Sir Oliver Lodge: Reminiscences (Lecture).

JANUARY 6 TO 11.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Wednesday, Jan. 6, at 9.30 A.M.—Opening of Publishers' Exhibition and Address by Miss E. H. McLean.

At 11 A.M.—Discussion between the Historical Association and the Geographical Association: What is Historical Geography?

At 2.—Sir Leslie Mackenzie: A Health Administrator's Attitude to Geography (Presidential Address).

At 5.30.—S. A. S. Hozayen: The Expansion of the Arabs and their Contribution to Geography (Lecture).

Thursday, Jan. 7, at 11 A.M.—Mrs. H. Ormsby: The Part played by the Limestones in the Human Geography of France (Lecture).

At 12.—J. Fairgrieve: Demonstration Lesson with Films.

At 2.—Demonstration of Amateur Films.

At 3.—J. Fairgrieve: The Use of Films in Teaching.

At 5.—Prof. P. F. Kendall: How Britain became an Island (Lantern Lecture).

Friday, Jan. 8, at 10.30 A.M.—Brigadier H. S. L. Winterbotham: New Developments of the 1″ Map (Lantern Lecture).

At 11.30 A.M.—Prof. Gerhard Schott: The Humboldt Current in Relation to Land and Sea Conditions on the Peruvian Coast (Lantern Lecture).

At 2.45.—Discussion on The Difficulties of using the Lantern in Primary Schools.

Discussion on The Scope and Content of the Geography of the 'rest of the world' in the First School Certificate Examination.

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