Nature

A WEEKLY

JOURNAL OF SCIENCE

VOLUME CXXV

JANUARY, 1930, to JUNE, 1930

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

London
MACMILLAN AND CO., LIMITED
NEW YORK: MACMILLAN COMPANY

INDEX

NAME INDEX

TITLE INDEX

ASTRONOMICAL NOTES.

CORRESPONDENCE.

DEATHS.

REVIEWS AND OUR BOOKSHELF.

Agriculture, Forestry, and Horticulture :

Anthropology and Archaeology :

Biology :

Chemistry :

Engineering :

Geography and Travel :

Geology and Mineralogy :

Mathematical and Physical Science :

Medical Science:

Metallurgy:

Miscellaneous:

Philosophy and Psychology :

Technology :

The various Supplements should be collated and bound with the numbers with which they were issued.

Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh.*

NATURE

A WEEKLY JOURNAL OF SCIENCE

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

SATURDAY, JANUARY 4, 1930.

CONTENTS.

Science and Administration.

IN several recent pronouncements relating to widely different fields which touch administration, the importance of the acquisition of scientific knowledge and of the adoption of scientific methods have been strongly emphasised.

On Nov. 30, in the course of the Sidgwick Memorial Lecture on "Democracy", delivered by him at Cambridge, General Smuts directed attention to the fact that science is necessary to the modern State and should have its functional relation to the State; he stressed the point that to-day not only is a scientific spirit needed in human affairs, but also that above all it is this spirit which is called for in the administration of human affairs. A few days previously, dealing with matters relating to a narrower field, the Secretary of State for the Colonies sounded a similar note when paying a tribute to the value of anthropology in the administration of the affairs of a backward people; he urged the importance of the acquisition of a knowledge of this branch of science by young men proceeding to British Dependencies to take part in administrative work.

Again, there has just been published the valuable Interim Report of the Committee on Education for Salesmanship (H.M.S.O., price 4*d*.). Salesmanship is, as this Committee understands the term, "a prime function of direction and supreme management" and "embraces the study of the fundamental principles of commerce and the planning of policy based upon them". Consequently, the matters discussed in this Report cover an important area of the administrative field in commerce; where weakness has been shown to exist in this field it has been traced to "a detached and insular attitude

and unscientific practice" on the part of our business community. Not only does this Committee recommend that a "scientific study" should be undertaken of our commercial problems, but it also states that "the evidence of the Associated Chambers of Commerce emphasises the absolute necessity of expert knowledge by the salesman of goods of a technical description".

However, it is apparent that the views of the Associated Chambers of Commerce are not universally accepted in commercial circles, and that old-time prejudices are still alive therein. In some quarters, the view continues to be held that "too much knowledge may be a dangerous thing"; the expert has not yet come into favour there. Indeed, in such quarters, it is feared that in the field of salesmanship the technical dissertations of the expert may prove wearisome to the customer, and hence do more harm than good. It is perhaps for this reason that another way of meeting the situation has been suggested. It has been proposed to the Committee that where a machine, appliance, or article requiring specialist knowledge is being sold, the maker should attach his own expert to the staff of the agent, "so that the technical advice and service may be available on the spot": that is to say, it is seriously recommended that our manufacturers should employ two men to sell their products, where the shrewdest and most resolute of their foreign competitors employ but one, and that a highly qualified expert.

In view of the foregoing proposal, it cannot be a matter for surprise that, in the course of the remarks which he recently addressed to business men at a meeting held in London, the president of the Canadian National Railways should have felt himself compelled to point out that if Great Britain is to recover its industrial pre-eminence there must be an entire 'scrapping' of present-day commercial policies, methods, machinery, and appliances with the object of reducing the costs of production—he might very appropriately have added: and *above all of reducing the costs of distribution.*

It is a general question which the foregoing pronouncements raise directly, namely, that relating to efficiency in administration and the best form of staff organisation by which it can be attained under modern conditions, whether in the public services, industry, or commerce. Indirectly, these pronouncements point to the necessity for a thorough investigation into matters affecting the functions which should be assigned to the man of science and the technical expert, so that the boundaries of their spheres of responsibility may be readjusted with the view of meeting the new conditions which have arisen in all branches of human activity owing to the applications of science on every battle-front.

A study of administrative and management methods is a matter of supreme importance at the moment, because they are vital factors in the progress and welfare of our public services, which are increasing in many directions. It must be remembered that for many decades now a gradual change has been taking place in the character of the ownership of our industrial and commercial undertakings. With the growth in their size and the extension of their activities in relation both to the kind of business for which they are responsible and also the considerable area of the territory in which they often operate, individual and partnership ownership has been giving place to collective and corporate ownership. Where undertakings and enterprises have been incorporated under the provisions of statutes they have, for practical purposes, lost the status of a private business, in the strict sense of the term, and have instead thereof become in effect public services. Questions, therefore, affecting the methods of administration and the type of organisation adopted in them can no longer be considered to be merely matters of their own domestic concern: questions in relation to their control and management possess for the public an importance to-day which is only very slightly less than do questions connected with the similar aspects of administration bearing upon governmental and municipal activities and enterprises. In this connexion it is interesting to note that very careful consideration has been given in Germany to the problems of management and organisation in the case of the State-owned concerns which have been set up in that country since the termination of the War. The significant fact stands out that the directors who have been appointed by the German Government to control and manage these concerns are men who have been selected for these positions from among those possessing *expert and specialised knowledge*, and have full executive authority within the limits of the general policy laid down. The practice referred to provides a useful lesson and might with profit be imitated in Great Britain.

There are signs that there is an awakening in Great Britain, and there exists a readiness on the part of progressively minded men to overhaul our old-fashioned and out-of-date methods and practices. In order to stimulate this feeling into action, it seems to be alone necessary for some authori-

tative body to set the ball rolling by indicating the nature of the reforms which will best suit the new conditions which have come into existence with the invasion of science into every domain of human affairs.

The question which perhaps most immediately requires close and attentive examination is that connected with the proper constitution of the controlling bodies responsible for the management of government departments and of industrial and commercial undertakings and enterprises. These bodies are sometimes appropriately referred to as the 'directive organ', and, as is well known, it is in them that reside the power and authority for deciding not only what shall be the character of the administrative methods and practices to be employed in the organisations for which they are responsible, but they have also the final word on questions of even greater importance, affecting, as they do, the whole well-being and success in every sphere in which combinations of knowledge and effort are required, namely, on questions relating to the recruitment of the staff. On these rests the ultimate responsibility for determining what type of men shall be selected for particular positions, technical as well as administrative, and also what shall be the character of the qualifications which shall be sought for in the various classes of officials.

Non-technical administrators and directors cannot, obviously, be so well equipped for dealing with problems of the kinds referred to above as those who have been 'through the mill', and, owing to their scientific and technical training and practical experience, have therefore acquired an intimate personal knowledge of all the essential factors which are severally involved in the solution of particular problems coming under their jurisdiction, and, what is equally important, as to the nature of the qualifications required in those to whom should be entrusted the duty of providing the most satisfactory solution of any particular problem. Hitherto, a disinclination has existed in Great Britain to give men with scientific and technical qualifications—and also possessing other essential qualifications—seats on boards of directors, or to appoint them to the more important administrative positions.

The crippling influence of the harmful traditions and prejudices associated with a narrow policy of the kind here indicated requires to be got rid of; only if a change of spirit can be brought about in this matter is there any likelihood of effecting a real improvement in matters of the deepest concern to the nation. Desirable economies and other beneficial results would follow suitable reforms carried out in the administrative sphere; they can alone be secured by widening the scope of responsibility of the man of science and the technologists. It is essential that in the case of every 'directive organ' a due proportion of those forming it shall be men possessing scientific knowledge and technical experience, and further, that men with the qualifications here indicated shall be chosen more frequently than in the past for responsible administrative posts.

It has been suggested that the failure in the past to employ, to a sufficient extent, men of science and technologists in the directive and administrative spheres may have been due to the reluctance that these types of men have shown to undertake work in those spheres, or possibly to the absence of aggressiveness on their part in seeking for positions therein. If this has been the case, it is imperative in the national interest that such reluctance or passivity should be overcome by them; they should pay heed to the exhortation of Sir William Bragg, who, on the occasion of the opening of the new science building of St. Edward's School, Oxford (on Dec. 8), made a pointed reference to the needs of the day in the following terms: "There is a certain type of man who is badly wanted in this country at this moment. It is the scientific man who is also an administrator. We need men to-day who are not merely scientists, but who are also willing to take responsibility, to mix in the affairs of men, and to know something of the world."

There is another and an exceedingly important reason why men of science and technologists should play a larger and more important part than in the past in the directive and administrative spheres of responsibility. It is recognised by many who have studied the problem that one of the most pressing requirements of the day is that of narrowing the zone of separation between the workmen on one hand and those responsible for the directive and administrative aspects of the work on the other. Attempts have been made to secure this end. In the governmental sphere officers of the administrative branch have in some cases established direct contact with the workers, and in some industrial enterprises committees of directors have been appointed to preside over departmental operations.

However, there is evidence that the results in such cases have not been altogether happy. Non-technical administrative officers cannot hope to, and, as a rule, do not, hold their own in arguments

exchanged with workers in a technical field, and in these discussions there is often an unwillingness on their part to admit the errors in their views, and this necessarily still further strains the relations between these two groups instead of improving them; the workers naturally derive small comfort when, having got the best of an argument, they are told: 'But there is no logic in administration'. Similarly, interference with details of departmental operations by directors, particularly on the part of those who have no technical knowledge, can but be, and, indeed, has proved to be, harmful; it leads in the long run to inefficiency and loss. In situations of the kind referred to, experienced technical men would carefully avoid saying or doing anything mischievous.

Obviously, it is practically impossible to secure a proper bond of sympathy between the two groups, the directive and the workers, under modern conditions, where the control and management are vested entirely in the hands of non-technical men who are either ignorant of technical considerations or act without regard to them. On the other hand, there is every reason for supposing that the risks of misunderstandings between the several groups in an organisation would be reduced to vanishing point were technical experts who have prepared themselves for the rôle called upon to play a more prominent part than hitherto in the directive and administrative spheres. It is the development of a policy to secure these ends that will provide what is so essential to-day: a strong and effective link between science and administration.

History of Science.

A History of Science and its Relations with Philosophy and Religion. By William Cecil Dampier Dampier-Whetham. Pp. xxi + 514. (Cambridge: At the University Press, 1929.) 18*s*. net.

MR. DAMPIER-WHETHAM, in writing a general history of science, has undertaken what is, strictly, an impossible task. It is therefore very easy for any critic who cares to spend a day or two in a library to that end to pick holes in matters of detail. Taking the book as a whole, as in the first instance it should be, it is a fine and bold piece of work. The narrative is always clear and concise and the sequence orderly; it never degenerates into the dismal catalogue of names and dates which sometimes masquerades as the history of science. The mutual relations between scientific discovery and other phases of contemporary thought are generally well brought out, particularly the relations between science and philosophy.

For the early history of science Mr. Dampier-Whetham is in a more favourable position than his predecessor Whewell, thanks to the recent labours of scholars who have worked out special developments in special periods. But for the later history the task is much harder than in Whewell's time, when physics seemed to be advancing quietly and steadily on proved foundations and biology scarcely existed. Up to the end of the nineteenth century, discoveries and developments of thought can still be seen in perspective in relation to what came before and has come after; the wood can be distinguished from the trees. It is when the present century comes under review that the historian's task becomes really alarming because of the abundance and confusion of material. Yet the historian cannot stop earlier than the present day without cheating the reader of the most interesting part of the story. It is significant that 105 pages suffice for all the time before the fifteenth century; from the fifteenth to the end of the eighteenth, 111 pages; 130 pages for nineteenth century; while 150 are devoted to the present century. This division not unfairly represents the rate of advance.

Modern developments in physics are well and simply described. The story is of course the most exciting episode in the whole history of science. It seems at the moment as though the three main lines of modern research, field-physics, atomic structure, and cosmogony, are all tending towards a final synthesis which will lay bare the ultimate nature of the physical universe. We can all hear the mathematical hounds in full cry, and even as we run panting far in the rear, can share in the excitement of the chase. But with all the excitement it is hard to suppress a haunting fear that the end of this hunt may be like that of the 'Hunting of the Snark'. However this may be, the history of modern physics can be made intelligible; the task needs knowledge and skill but is not impossible, for certain main lines of advance are clearly marked out. It is when the other sciences come to be considered that the historian's task becomes really impossible. There is at present abundant activity in detail, but there are no clear lines of advance, so that we can only guess which discoveries are the important and fruitful ones and which are destined to be sterile, though at the moment they may loom large. The writer is bound to be guided by his interests and prejudices, and the reader in his turn will approve or disapprove according to

whether his own interests and prejudices coincide or not. A few examples will illustrate the difficulties.

The author does not mention chemistry, apart from its biological applications, in his review of the present century. This omission will undoubtedly offend the chemists, but I believe it to be reasonable. Twentieth century chemistry has been concerned with the use of nineteenth century methods for the application and development of nineteenth century theory. New methods and new theories have been left in the hands of the physicists. On the other hand, I should be inclined to dispute the prominent place given in the section on physiology to the recent work on hormones and vitamins. It is true the results are striking and have caught the public eye; nevertheless, there is reason to think that the ideas involved are too crude to have a permanent place in scientific thought and that existing methods of investigation are also very crude relative to the problems. It is pioneer and not classical work. Future generations will probably extend to present-day notions the same pitying tolerance we extend to the notions of 'caloric' and 'phlogiston'. In contrast with this work, I believe the work of Sherrington and his school, which is no more than mentioned, to be classical. Sherrington's methods are completely adequate for his purpose, and his ideas, though clothed in difficult language, are both simple and subtle. These ideas now dominate the physiology of the central nervous system and are likely to do so for a long time to come; the subject, moreover, is the central or key subject of the whole of physiology. This, of course, is a personal opinion; it is introduced merely to emphasise the extreme difficulty of dealing historically with modern work. Not only is an incredible diligence in accumulating detailed knowledge needed, but also superhuman powers of criticism and prophecy. In parenthesis, it seems necessary to protest against the omission of Sörensen's name from the paragraphs on colloid chemistry and ionic equilibria.

The author is to be congratulated on including a survey of those subjects, embryonic perhaps but still sciences, that lie on the borders of the physical sciences, such as psychology and anthropology. His choice of subjects and the views he expresses on certain controversial topics will be objected to by many, but in these regions controversy cannot be avoided except by silence.

There is one aspect of the history of science which is strangely neglected in this book as in others, but which is not without interest; that is, the effect of practical human needs on the course of scientific discovery. A few examples will make my meaning clear: first a minor one and then two more speculative but more important cases. It is a commonplace that the progress of physics depends upon the design and use of instruments of precision. But apparently no physicist realised either the possibility or the value of galvanometers for measuring small currents until Kelvin devised his mirror galvanometer in response to a purely practical demand, namely, for use with the trans-Atlantic cable when existing telegraphic methods had failed. Once the instrument was made, it was quickly applied to laboratory purposes, and innumerable discoveries have been made with it and its successors. Of course, the development would ultimately have taken place, as would the theory of gravitation without Newton, but it would have been delayed. Given an instrument or method, scientific men are quick to apply it to existing problems, but the existence of a problem does not always call forth a method for solving it; the method may come from some quite unexpected quarter.

The second example is the peculiar position that medicine occupied in the early stages of scientific discovery. As Mr. Dampier-Whetham points out, the enormous success of geometry, which seemed to provide a means for obtaining genuine knowledge about the external world by *a priori* methods, blinded the Greeks (and many others until recent times) to the necessity of observation and experiment. Even apart from this, it seems that human beings are naturally reluctant to start the labour of accurate and disinterested observation. Once a start has been made, the work may be found interesting for its own sake, but some powerful ulterior motive is generally needed at the beginning. In the ancient world the desire to cure disease, in spite of the hocus-pocus that always surrounds the practice of medicine, seemed to provide one of the few motives for precise observation. The best of the Greek medical workers realised that for their purpose *a priori* reasoning led nowhere and only the slow method of observation was any use. In this way were laid the foundations not only of human anatomy and physiology, but also of zoology and botany (it must be remembered that Aristotle was the son of a physician before he was a pupil of Plato), and in later times of chemistry. It is remarkable that while medicine and the studies underlying it were well launched on their scientific career, agriculture still remained for centuries dependent on tradition and superstition, as though hunger was a less powerful motive for research

than compassion. Perhaps it is nearer the truth to say that the stomachs of the intelligentsia have usually been sufficiently well filled to turn their thoughts away from such gross considerations as food supply. But they could not shut their eyes to disease and death, which might come to anyone at any time.

Lastly, consider the case of astronomical observation. The astronomical observations of the Babylonians and Egyptians were dictated by practical considerations, for determining the seasons and for astrological prediction. Astrology was still a leading motive for astronomical observation almost until modern times. The Greeks, who were free from the superstitious motive, seem to have done little in the way of observation. Their contributions were of unique value but were theoretical—the application of mathematics to astronomy and the rudiments of a 'mécanique céleste'. But from the fifteenth century onwards there was a new stimulus to observation with more exacting requirements: this again was a practical need—the art of navigation. For casting a horoscope it was useful to have numerous observations, but they did not need to be precise; the seaman was not so easily satisfied. What is most characteristic of modern physics is the design and use of instruments of precision and exact numerical calculation for purposes of prediction. These characteristics first appeared in connexion with the compilation of the "Nautical Almanac" and map-making. Greenwich Observatory was founded for this purpose. More than two centuries earlier, before western Europe had made any contributions to science, Prince Henry the Navigator had founded at Sagres the very first school of technology.

There is another aspect of the voyages of discovery of the fifteenth and sixteenth centuries, a result this time that seems to deserve more notice than it usually gets from the historian of science. Mr. Dampier-Whetham emphasises the fact that at this period the early men of science had to rid themselves of the incubus of the medieval outlook, an incubus from which the Greeks were mercifully free. He does not, however, mention what was possibly the greatest single factor in the process of liberation, the discovery of the New World and the circumnavigation of the globe. These facts proved, in a way which the most thick-headed were compelled to understand, that the traditional cosmology was not infallible, that ancient authorities could be wrong, and that even the thunders of the Vatican could not put Humpty-Dumpty together again.

A. D. RITCHIE.

Man's Ancestry.

Man's Place among the Mammals. By Prof. Frederic Wood Jones. Pp. xi + 372 + 12 plates. (London: Edward Arnold and Co., 1929.) 21*s.* net.

EARLY in 1918, Prof. F. Wood Jones gave a popular lecture in King's College, London, on man's origin. This lecture, when published by the Society for Promoting Christian Knowledge under the title "The Problem of Man's Ancestry", met with a mixed reception. Anatomists treated it with neglect or contempt; those of an anti-Darwinian bias hailed it with delight. As the little book of 1918 is really the parent of the large work which has just appeared under the title "Man's Place among the Mammals", it is worth while to seek for an explanation of the diversity of feeling evoked by the original publication. The antagonistic attitude of most anatomists is understandable. They were told that man, far from being as they thought the most changed, the most specialised, the most highly evolved of all primate animals, was, when his structural characters were rightly analysed, essentially a very ancient and primitive type. They learned that they had laboured in vain, because in construing the evidence relating to man's origin they had been dominated by a heresy for which Darwin, Huxley, and Haeckel were conjointly responsible, namely, that there had been an anthropoidal stage in man's evolution. Prof. Wood Jones summarily dismissed the anthropoids living and extinct; at no time had they any lot or part in man's ancestry.

The opposition offered to this thesis by anatomists can be understood; but the welcome extended to it by those of a 'fundamentalist' turn of mind is less easily accounted for. Prof. Wood Jones is a convinced evolutionist; man, he declares, has been evolved, but not from an anthropoidal form. He contends now, as he did in 1918, that man's independent origin has to be sought for among the small Tarsioids which appeared during the Eocene period of the earth's history. It may seem to the ordinary reader that it matters little whether we include or exclude anthropoids from man's ancestry, but at the conclusion of his original lecture Prof. Wood Jones made clear to his audience that a deep ethical significance was involved. He said:

"Were man to regard himself as being an extremely ancient type, distinguished now, and differentiated in the past, purely by the qualities of his mind, and were he to regard existing Primates as misguided and degenerated failures of this ancient stock, I

think it would be something gained for the ethical outlook of humanity—and it would be a belief consistent with present knowledge."

Herein I think Prof. Wood Jones reflects unfairly on anthropoid apes. Prof. Elliot Smith is convinced of man's anthropoid ancestry, and yet he finds that natural man is peace-loving and virtuous.

The lecture of 1918 was prepared and delivered in a war atmosphere. No doubt the author suffered unfairly from the fact that he was unable in the course of a brief hour to deal fully with the proofs which his critics expected him to produce. He has now had ample opportunities of meeting the demands of his critics. In a series of forty brief chapters, brilliantly written, illustrated by his own excellent drawings and illuminated by happy touches which reveal the author as naturalist as well as anatomist, he expounds his conception not only of man's place among mammals, but also the places which should be given to Lemurs, the Tarsiers, monkeys of the New World, monkeys of the Old World, and to anthropoid apes, both great and small. It is not until we reach the thirty-eighth chapter that we find what we have been waiting for—the author's conception of the evolutionary changes which converted a primitive small-brained Tarsioid into a human being. We particularly want to know how and when man's body underwent the structural revolution which fits it for an orthograde posture and for bipedal progression.

It is just when he approaches these problems that our author, usually so precise and definite, becomes tantalisingly elusive and non-committal. We are told that the " proto-human " stock was the first to break away from that line of Tarsioids which ultimately became separated into anthropoids and Old-World monkeys. Man's ancestry broke away while the basal phylum still retained all its ' primitive ' features and was adapted in body and limb for life in the trees. Having broken away, the proto-humanoids took to walking on their hind limbs, and their bodies and feet underwent the structural revolution which fitted them for an upright posture and for bipedal progression. Then the brain began to grow.

" Everything would point to the fact that enlargement of the brain came in the proto-human or progressive stock at a time when that stock was in possession of a very primitive type of cranium, and that enlargement of the brain-case occurred at a stage in which no other evolutionary trends, save those of mere enlargement, had been initiated " (p. 341).

It would be fair to presume from this statement that Prof. Wood Jones attributes man's big brain to the fact that it began to grow when his skull was in a still plastic state. A paragraph on another page, however (p. 340), makes us hesitate in drawing this inference, for there we are informed that " Man . . . enlarged his primitive chondrocranium by his early phylogenetic development of a large brain " ; here the large chondrocranium is attributed to the large brain. Clearly, the explanation given by Prof. Wood Jones of man's structural adaptation to bipedal progression and of his large brain cannot be regarded as satisfactory. No evidence in support of such speculations is afforded by any fossil discovery made hitherto ; still, as Prof. Wood Jones rightly maintains, the geological records of man's evolution are still very imperfect.

Having thus postulated an independent origin for man, Prof. Wood Jones has to face a multitude of very difficult problems. How are the long list of intimate structural resemblances which bind man to anthropoid apes to be explained ? He admits these resemblances. " It must be realised at the outset ", he writes, " that of all animals the giant apes show the nearest structural affinities with man. This fact has always been realised, and it remains an uncontrovertible truth." He regards these resemblances not as an inheritance which man and anthropoid have derived from a common ancestor, but as independent acquisitions. Now, in the order of Primates we do meet with surprising and definite examples of parallel or convergent evolution. Nevertheless, Prof. Wood Jones under-estimates and under-states the many and intimate structural and biological resemblances which link man to the great anthropoids. He has to presume that man and anthropoids came independently by the same form of uterus, the same elaborate process of placentation, the same tendency to prolong the fœtal and infantile periods of growth and development. He attempts to minimise the resemblance of the anthropoid brain to the human brain ; if we did not know of the stage of evolution represented by the anthropoid brain, we should have to presume its existence ; without such a presumption, it would be impossible to explain how the small and simple brain of a Tarsioid could become transformed into the elaborate brain of man.

Every bone and muscle of man's body have undergone profound structural alterations to fit him to his orthograde posture. The same bones and muscles have undergone similar changes in anthropoids, but to a less degree. If we suppose that adaptation to an orthograde posture is a common inheritance, then we get light on how man came by his postural adaptation, for in their bodies anthropoid apes preserve stages which lead towards

the specialisations found in the human body. Our author rejects such an interpretation; he supposes that man and anthropoids have independently acquired their orthograde posture, and in the process of evolution come by the same structural modifications. He regards all such postural modifications as 'adaptations', and therefore useless as indications of relationship. Relationship, he holds, must be determined on inborn, non-adaptative structural characters. He gives lists of such characters, but a careful analysis of his lists reveals the fact that the structures cited are those the functional significance of which is not apparent. Is there any structure in the animal body which is devoid of functional significance and therefore free from adaptative changes?

The truth of a hypothesis is measured by the ease and naturalness with which it explains the multitude of facts which lie within a field of investigation. When Prof. Wood Jones rejects an anthropoidal stage in man's ancestry, he has to explain away a tremendous number of facts. That the blood of man and anthropoids gives the same reactions when submitted to similar tests our author admits, but denies that similarity of reaction indicates a true 'blood relationship' of man to anthropoid. Man and anthropoids have very similar susceptibilities to disease—a fact which is not discussed. In recent years the existence of 'blood-groups' has been demonstrated in all races of mankind. The only other animals which possess corresponding group reactions are the anthropoid apes.[1] Prof. and Mrs. Yerkes, in the great monograph recently published on "The Great Apes", demonstrate that of all animals the mental reactions of the great anthropoids are the nearest to those of man. All these facts Prof. Wood Jones has to explain away. He has also to meet the fact that the further we trace man backwards in time, the more accentuated do his anthropoid characters become. The skull cap of *Pithecanthropus* has been mistaken for that of a large gibbon; the lower jaw of Piltdown man had been claimed to be that of a chimpanzee; the molar teeth of Neanderthal man reproduces the dental pattern of the extinct anthropoid *Dryopithecus*; Rhodesian man rivalled the gorilla in the development of his supra-orbital ridges. All these facts run counter to Prof. Wood Jones's scheme of man's evolution.

The main criticism which must be made of this work is that it is not a full or fair statement of the great mass of evidence now available for determining man's evolutionary history and his relationship to anthropoid apes. Nevertheless, it is a brilliantly written book, one which will serve a great and useful purpose in stimulating profitable discussion and further research. A. KEITH.

[1] See "Anthropology and Blood Grouping", by Profs. Woollard and Cleland. *Man*, 1929. Vol. 29, p. 181.

Geology of Albania.

Geologica Hungarica. Fasciculi ad illustrandam notionem Geologicam et Palaeontologicam Regni Hungariae. Series Geologica, Tomus 3: Geographie und Geologie Nordalbaniens, von Baron Fr. Nopcsa; mit einem Anhange von H. v. Mžik: Beiträge zur Kartographie Albaniens nach orientalischen Quellen. Pp. xiv + 703 + 35 Tafeln. (Budapestini: Edidit Institutum Regni Hungariae Geologicum, 1929.)

NORTHERN Albania is a complex mountainous area which rises above the eastern coast of the Adriatic, where it bends abruptly from its course from north-west to south-east parallel to the grain of the country, and runs south, cutting across both the strike of the rocks and of the mountains. Northern Albania occupies a critical position in the geology and geography of the eastern borderlands of the Adriatic and of the much-debated Dinaric Mountains. The geology of the country, according to the first accounts, appeared perplexing owing to the puzzling sequence of the rocks, which has now been explained by Baron Nopcsa, after field work extending from 1905 to 1925, as due to great overthrusts. This view he has now established in a ponderous monograph, which is published as the third volume of "Geologica Hungarica" by the Geological Survey of Hungary, of which the author was until recently the Director. The most important previous contributions were those of Cvijic, whose work is dealt with briefly, and one of his misunderstandings is described as "catastrophal".

The oldest rocks in northern Albania are the Upper Carboniferous, as during all the preceding part of the Palæozoic, Albania was included in a great South Balkan land which was traversed by ancient mountains trending east and west. This influence is still seen in the maintenance of that direction by some of the ranges and by the Curzola-Lesina archipelago in the Adriatic. The description of this land begins with the Upper Carboniferous, as marine rocks of that date occur on the North Albanian block (or Tafel). These beds are shown to be Uralian by their fossils, for example, *Productus cora* and *P. uralicus*, and they are followed by Permian Neoschwagerina limestones. The Trias

was marked by a wide extension of the sea, and the deposition of dolomitic and massive limestones ranging from the bottom of the Trias to the Rhætic; these limestones are well represented in both the North Albanian block and the Cukali mountain complex to the south. In the Ladinian (Middle Trias), volcanoes discharged sheets of tuff, a material which is now jasper, and ophiolites, which are well known from Steinmann's view of their formation by abyssal eruptions.

The Jurassic is less well developed owing to extensive earth movements. In the Lias, marine limestones and marls were deposited over much of the country, and after a break in the Middle Jurassic, more limestones were formed in the Upper Jurassic on the North Albanian block, and red flaggy limestones and radiolarite in Cukali. In the south-eastern part of the area the Jurassic is doubtfully represented by the basic igneous rocks which range from serpentine and peridotites to diabase, and cover most of the Merdita overthrust sheet.

The Cretaceous is represented in the North Albanian block by massive limestones; but land still lay close on the south, for the system begins in the Merdita with a basal conglomerate, followed by sandstones and shales, and later, owing to the widening subsidence, by flaggy limestones and the massive Hippuritic limestones, which extend throughout North Albania.

At the end of the Cretaceous, further earth movements reversed the conditions. In the Eocene the clearer sea lay to the south and south-west, for the coastal ranges are formed of Nummulitic limestone, while in the North Albanian block are shales with fucoids and beds of flysch. The coastal hills contain Oligocene conglomerates, with granite pebbles from the east, and clays with corals. Then follows an important gap, and the presence in the mountains of highly disturbed Oligocene beds and of undisturbed Lower Pliocene shows that the main Dinaric folding was in the Miocene. It extended the South Balkan land, which was reduced in the Pleistocene by widespread subsidences in some places to the amount of thousands of feet. These movements broke up the land between Greece and Asia Minor into the Ægean Archipelago, enlarged the Adriatic, and produced the poljes in the Dinaric Mountains and the fiords on the Dalmatian coast.

In a volume, "The Nature and Origin of Fiords" (1913), I described the adjacent parts of the Adriatic coastlands as a fractured belt, and interpreted most of the basins or 'poljes' as due to subsidence along faults, and claimed the Gulf of Cattaro as a true fault-formed fiord. This conclusion was supported by a photograph (*op. cit.* Pl. vi.) of the block opposite Cattaro, which was described as of a fault-block, from evidence seen in a surreptitious visit, as the front of it was closed by military regulations. This explanation has been denied, and the Gulf claimed as due to normal erosion. Baron Nopcsa, however, marks a great fault along the very line shown in my illustration. He fully proves the tectonic origin of many of the poljes and of features along this coast, and says that the faults are of such recent origin that the fault scarps are in many places very little worn.

The Pliocene beds include in southern Albania the huge bituminous limestones in the Voyusa valley, near Valona, which are worked for asphalt, and, in association with some traces of petroleum, have encouraged the hope that among the folds of the Dinaric limestones may be a still hidden oilfield.

The volume contains a detailed description of the geography and geology of North Albania, with a coloured map on the scale of 1 to 200,000, numerous sketch maps and diagrams which illustrate the complex tectonics due to overthrusts generally from north-east to south-west. The volume is well printed, and is accompanied by twenty-five clearly explained photographs of the scenery and geological structures, by a bibliography which deals with the literature on the Albanian problems in other parts of the Balkans and Asia Minor, and an article by Hans v. Mžik on Oriental contributions to Albanian cartography.

J. W. GREGORY.

The Polarity of Molecules.

Polar Molecules. By Prof. P. Debye. Pp. 172. (New York: The Chemical Catalog Co., Inc., 1929.) 3.50 dollars.

Polare Molekeln. Von Prof. P. Debye. Pp. viii + 200. (Leipzig: S. Hirzel, 1929.) 14 gold marks.

THE name of Debye is associated with many new and important theories in physics, but none of his theories has more successfully suggested, directed, or stimulated experiment, than his theory of dielectrics. Since Debye's first paper on this subject in 1912, so many advances have been made, and so many new facts established, that an authoritative account of these developments from the pen of Prof. Debye himself is particularly welcome.

The English book is the outcome of a recent visit of Prof. Debye to America, where he gave courses of lectures on the dielectric properties of matter and was induced to put the substance of

his lectures in more permanent form. The book is concerned principally with the molecular interpretation of the dielectric constant and the correlation of dielectric properties with other physical properties such as dispersion and absorption, particularly in the infra-red. At present, theory can deal adequately only with vapours, because, in fluids, the interaction of neighbouring molecules is too important to be neglected and cannot be estimated. Methods of dealing with dilute solutions have, however, been developed recently, and these are described in some detail.

In the simple theory it is assumed that dielectric phenomena are due to two causes: first, to the distortion of the electronic structure of the individual molecules in the presence of an electric field; and secondly, to the fact that the electrical distribution of many molecules is unsymmetrical even in the absence of a field; such molecules are said to possess a permanent electric moment. The magnitude of this electric moment is a molecular constant, which is as important, if not more important than other known molecular constants such as the size of a molecule, as it exercises a controlling influence on many physical phenomena. The methods of determining this constant by a comparison of theory and experiment are described at length and, for the first time, the magnitudes of all known electric moments are brought together in accessible form; in fact, the German book, which is a revised and extended edition of the English book, contains a list of the electric moments of about two hundred molecules. This table is to be extended still further and issued later as a special supplement.

The table of electric moments is instructive. Molecules which consist of two different atoms are non-symmetrical and possess a permanent moment, while molecules like hydrogen and nitrogen, which are symmetrical, have none. Nearly all triatomic molecules have permanent moments, and this result leads to important deductions as to the arrangement of the atoms in a molecule. It shows that the atoms of the water molecule, for example, cannot be situated symmetrically along a line. A chapter is devoted to a discussion of the possible forms of this and other molecules, and it is shown that the arrangement of H_2O is most probably triangular, while that of NH_3 is pyramidal. This conclusion will not surprise the organic chemist, as, on other grounds, he has long ago postulated that the three valencies of the nitrogen atom are not directed in a plane.

Considerable work is now being done on the relation between the dissymmetry of molecules (as reflected in their electric moments) and their chemical formulæ. Recent advances are reviewed in the English edition, and more fully in the later German edition. The effect of the substitution of two equal molecular groups in a carbon chain or in the benzene molecule depends essentially on the relative positions of the groups. The trans-form of dichloroethylene and the para-form of dinitrobenzene both have small or zero electric moments, but the unsymmetrical isomers have large moments. If the two substituted groups are not equal, a moment remains even in the para-compound, as is illustrated by the three nitrotoluenes. Appropriate measurements of the polarity can therefore be used to determine the electropositive and electronegative character of various molecular groups. It seems likely that it will be possible soon to estimate the polarity of a complicated compound by adding up vectorially the moments of the different groups which constitute the molecule.

The later chapters are devoted to an account of the new wave mechanics in so far as it affects the theory of the dielectric constant and the theory of dispersion. The first formula given by Debye for the dielectric constant was deduced from the classical theory and had to be modified when the quantum theory was first introduced, but the more recent forms of the quantum theory, expressed by the matrix and wave mechanics, have returned the formula to its original form, so that the older determinations of electric moments deduced from the classical formula still stand. The book concludes with a theoretical discussion of the dispersion and absorption of polar gases, with special reference to rotating molecules of the HCl type. It is shown that anomalous dispersion should occur in the region of long wave-lengths, approaching radio frequencies, though experimental results in this region are, of course, still lacking. The notation used is unusual and unfortunate (the rotational quantum number, for example, being denoted by n) and might with advantage be brought into line with that already used in molecular spectra.

This book not only brings together for the first time the accumulated information on electric dipoles, but also points out the gaps which still exist in theory and experiment. It is thus of great value to all physicists and chemists who are interested in molecular structure, and, in suggesting new fields of work, is of the greatest possible value to research workers in this and allied subjects. J. E. LENNARD-JONES.

Our Bookshelf.

(1) *The Future of the Earth.* By Dr. Harold Jeffreys. (Psyche Miniatures: General Series, No. 24.) Pp. 72. (London: Kegan Paul and Co., Ltd., 1929.) 2*s.* 6*d.* net.

(2) *Earthquakes and Volcanoes.* By Prof. J. W. Gregory. (Benn's Sixpenny Library, No. 97.) Pp. 80. (London: Ernest Benn, Ltd., 1929.) 6*d.*

(3) *The Restless Earth: An Introduction to the History of the Rocks.* By Prof. Herbert L. Hawkins. (Routledge Introductions to Modern Knowledge, No. 10.) Pp. iv + 76. (London: George Routledge and Sons, Ltd., 1929.) 6*d.* net.

THE first of these "little books on great subjects" is considerably shorter than the other two and costs five times as much. But in view of the facts that it will appeal to a much smaller circle of readers, is well bound and is printed on good paper, it cannot be regarded as overpriced; it is rather the others that are extraordinarily cheap.

(1) Dr. Jeffreys entertainingly summarises some of the theories more technically discussed in his larger book, "The Earth". He deals with the history of the sun, and the age and origin of the solar system; the cooling of the earth and the 50,000 million years of cooling still before it; and the past and future of the moon. The title of the booklet indicates only a point of view.

(2) Prof. Gregory's contribution to Benn's inimitable Sixpenny Library is tightly packed with good things. In eighteen short but intensely interesting chapters, he surveys every important aspect of volcanoes and earthquakes, and it is safe to say that there is no better short account of these subjects available in English. The book should have a big sale, and its influence on teaching in schools, as well as directly on the reading public, should go far to remove many current misconceptions. The chapter on "The Inner Structure of the Earth" is, however, less up-to-date than it might be; it is certainly not in accordance with modern evidence to describe the shell between the rocky crust and the iron-nickel core as consisting "mainly of the rigid nickel-iron mass of the earth". It is much more likely to have a composition akin to that of stony meteorites.

(3) Prof. Hawkins is not altogether happy as a popular writer, despite the attractive vitality of his style. The use of metaphor and analogy is sometimes far-fetched and undignified. Denudation is "grinding the dust"; the interior of the earth is "beneath the dust"; earthquakes are "shivering fits"; and volcanic activity is "feverishness". When the author writes: "the earth is bleeding to—perfection", or "water is more obedient [than the wind] to the call of gravitation", he runs the risk of irritating some of his readers. Apart from this occasional defect of manner, the matter of the book is excellent, and the name of the author is a sufficient guarantee of its trustworthiness as a popular introduction to geology.

Royal Agricultural Society of England. Agricultural Research in 1928. Pp. viii + 193. (London: John Murray, 1929.) 1*s.*

THE Royal Agricultural Society has issued its fourth annual summary entitled "Agricultural Research in 1928". As in previous years the publication is divided into a number of reports, each written by an acknowledged expert in the particular subject.

Fruit and vegetable canning, though a comparatively new industry, appears to have made a promising start and should provide excellent new markets for farm produce provided suitable organisation, including standardisation and grading, is built up. The importance of obtaining a full and even plant in cereals and sugar beet is emphasised if the best yields are to be secured.

Progress is being made in the production of tuberculin-free herds of dairy cows, and the importance of progeny rather than ancestral performance in estimating the worth of a breeding animal is becoming more clearly recognised. Farm costings of all kinds, including questions concerning marketing and co-operation, are being thoroughly investigated. The effect of the Agricultural Credits Act on insurance and credit is also dealt with. Among engineering problems, drainage is receiving considerable attention, and recent trials in other countries, notably France, are described. Of the newer implements, the combine harvester seems to have proved its usefulness in the English climate, provided that a drier is regarded as a necessary part of the equipment. Methods for drying grain, grass, and sugar beet are also being developed.

No outstanding new discovery is mentioned in the animal nutrition section, but the most recent views as to the nutritive value of grass, sugar beet pulp and tops, silage, and milk are fully discussed. As regards fertilisers, nitrogen occupies the most important position, its world production and consumption having enormously increased during 1927–1928. Potash, on the other hand, shows only a small increase over previous years, and phosphorus none at all. The success of Danish agriculturists in the production of feeding stuffs is attributed to their large increase of acreage under root crops. In England, on the other hand, the reverse is the case. The major portion of the report on veterinary science deals with vaccination against tuberculosis, and it is shown that the different types of tubercle bacilli are capable of infecting species other than those from which they take their name. To each report a large number of references are appended, and the publication should prove useful to farmers, agricultural organisers, and students.

The Theory of the Gyroscopic Compass and its Deviations. By Dr. A. L. Rawlings. Pp. x + 191. (London: Macmillan and Co., Ltd., 1929.) 10*s.* 6*d.* net.

IT was about eighty years ago that Foucault carried out his ingenious experiments with the gyroscope, but for half a century the apparatus had no practical application. It has now, however, been applied

to the automatic steering of torpedoes, to the mono-rail car, to the reduction of the rolling of ships, and to the steering of ships. Of the gyroscopic compasses now in use, the Anschutz was the first, and this was followed by the Sperry and Brown compasses. H.M.S. *Invincible* was navigated to the Falkland Islands, and the British Submarine *E11* found her way up the Dardanelles into the Sea of Marmora, by Sperry compasses, and such compasses are to be met with in every ocean.

Handbooks on the gyroscopic compasses have been issued by the firms making the various types, but these do not deal fully with the mathematical theory involved. Dr. Rawlings has therefore attempted to place this theory in the reach of anyone with an elementary knowledge of the differential calculus. His book is written primarily for those engaged in the construction of compasses and for navigators, to whom it should prove most useful. The opening chapters are devoted solely to the explanation of the action of the compass, the restraints imposed upon the gyroscope so that it shall be of use, and the problems involved in its oscillation, its damping, and its stability. After this there are descriptions of the Anschutz, Brown, and Sperry-Rawlings-Harrison compasses, while the later chapters deal with compensating weights, rolling error, damping error, and gimballing error, and the accuracy of the gyro-compass at sea.

The Court of Burgundy: Studies in the History of Civilisation. By Otto Cartellieri. Translated by Malcolm Letts. (The History of Civilisation Series.) Pp. xv+282+25 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1929.) 21*s.* net.

THIS volume in the History of Civilisation Series is one of peculiar interest for English readers. The Burgundian court was a great formative influence in the history of European culture. The four dukes who united Burgundy and Flanders under their rule in the period extending from the middle of the fourteenth century to the end of the fifteenth, gathered around them sculptors, painters, scholars, and poets from all parts of Europe, while their court was the last school of the dying order of chivalry. The rivalry of the houses of Burgundy and Armagnac gave England the opportunity of intervention. But the alliance between the English kings and the Burgundian dukes, which was a dominating factor in the troubled politics of France, had an abiding effect on English culture. By ensuring an outlet for our wool trade in the great commercial centres of Flanders, it confirmed the development of English rural life and industry along the lines which ended in the formation of the great pastoral estates, with subsequent economic and social consequences known to all. Prof. Cartellieri here deals with a subject which he has made peculiarly his own. His book is no mere recital of political events, but in a very real sense a social history in which every aspect of life, art, and literature is followed in detail. One chapter deals with the famous witchcraft persecution at Arras.

Exact Colour Matching and Specifying. By L. Blin Desbleds. Pp. 116. (Paris: Technological and Industrial Service, n.d.) 25 francs; 4*s.*

IN this work the industrial method of accurate colour measurement, and consequently of matching colours, made possible by the use of Toussaint's photo-electric photo-colorimeter, is set forth, with many practical examples, in a clear way. It will generally be dyers and those dealing with fabrics who will find it useful.

The uncertainty that must always be associated with eye observations, because of the variations of colour sensitiveness even in the same eye, is eliminated by the use of a photo-electric cell through which an electric current is passed and upon which impinges the light reflected by or transmitted through the substance the colour of which is to be measured. The readings therefore are of the position of a spot of light on a scale, as customary in the use of a reflecting galvanometer. The light that impinges on the sample passes through one or other of (generally) six Wratten-Kodak monochromatic filters transmitting known wave-lengths. Violet, blue, green, yellow, orange, and red are appropriate colours, and the results are plotted on a prepared form of wave-lengths as compared with the same light as reflected from a white surface of plaster of Paris, or better, as more uniform, barium sulphate, which is taken as 100. From these curves all the information required for practical purposes can be found by simple calculations, and these are fully illustrated. The volume is a manual for use in the works' laboratory.

In the Land of the Lion. By Cherry Kearton. Pp. 256+60 plates. (London: J. W. Arrowsmith, Ltd., 1929.) 10*s.* 6*d.* net.

MR. KEARTON is probably our oldest and best-known African picture shikari. Having given us "Photographing Wild Life Across the World", in which he recounts many 'hairbreadth escapes' and exciting incidents with denizens of the wild, the actions of which he tried to portray, he now presents us with a book to gladden the heart of the Nature lover, dedicated by the by to his wife, herself an author of repute. In its twenty short chapters the author has something to say about most of the animals of the African bush and many birds and insects. The best, perhaps, is his chapter on the white ant. Systematic natural history is not his strong point, but his light sketches of the doings, family life, and frolics of the larger animals, lion, elephant, giraffe, hippopotamus, rhinocerus, and many more, are excellent reading, and conjure up fascinating pictures of wild life in sun-scorched bush, river, and swamp.

The eighty-eight illustrations are mostly photographs from the author's film "Tembi", in our opinion one of the best Central African films yet produced. The magnificent photograph of equatorial glaciers and snowfields up in the clouds and far away is alone worth the cost of the book, which is tastefully got up and supplied with an efficient index.

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.*]

Grating Errors and Electronic Charge.

AN investigation of the focal properties of small plane gratings has led to a discussion concerning the influence of grating errors on X-ray spectra obtained by means of plane gratings. It may be of some interest to give here a brief account of the results, as they are of some importance with respect to the accuracy of the value of the electronic charge deduced from X-ray measurements.

As is well known, a linear change of spacing along the grating gives rise to focal properties. Thus, the incident beam being parallel, the diffracted beam will be convergent or divergent according to the direction in which the spacing varies and the location of the spectral line with respect to the central image.

If, now, in the portion of the grating effective in the formation of the spectrum the spacing varies linearly only in *one* direction, this will be of no influence on the wave-length measurements, as the diffraction pattern (in the Fraunhofer case) is symmetrical and the principal maximum is in its proper position, that is, in the same position as the principal maximum of a perfect grating with a spacing equal to the mean spacing of the

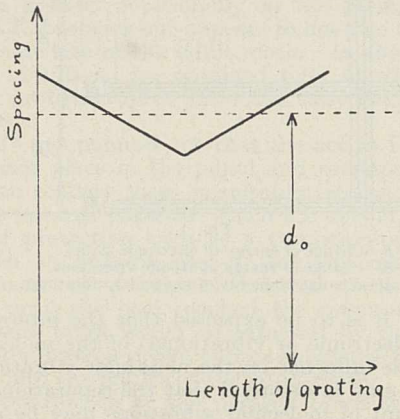


FIG. 1.

defective grating (see, for example, Sparrow, *Astrophys. Jour.*, **49**, p. 65 ; 1919).

When, however, the effective portion of the grating contains certain regions where the spacing increases and other regions where it decreases along the grating, this may cause asymmetry and misplacing of the spectral lines.

A simple mode of demonstrating this is the following. We may, for example, assume that the spacing of the grating varies as in Fig. 1. Thus there is one portion of the grating where the spacing decreases linearly, and another, adjacent and equal in width, where it increases at the same rate along the grating. The diffracted beam from one portion will therefore converge to a real focus, and that coming from the other portion will diverge from a virtual focus behind the grating (see Fig. 2). Thus the maximum intensity will be shifted in relation to the central beam of the bundle. A more detailed communication, where this point of view will be more closely discussed, will be published in *Zeitschrift für Physik* shortly. In each case the only method which is without doubt entirely free from objections is the *exact* calculation of the diffraction pattern, but this is a work of some difficulty for the less simple geometrical conditions of the X-ray spectrographs.

Now all gratings ruled with the aid of a screw are affected with periodical errors, where the period of the error is equal to the pitch of the screw. When the number of periods in the effective portion of the grating is large, we know from theory and experiment that ghosts will occur in the spectrum ('Rowland ghosts'). When, however, the number of periods is *small*—this

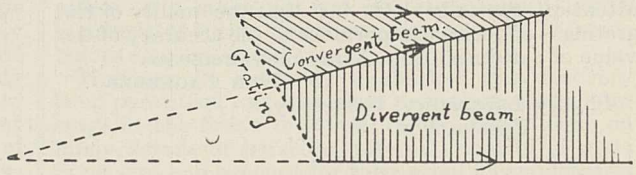


FIG. 2.

being the essential point in this account of the conditions—we may anticipate asymmetries of the kind above described.

As the pitch of the screws used in the common grating machines is about 1-2 mm. and the length of the effective portion of the grating is about 2-3 mm. in the case of the experimental arrangements of the X-ray measurements considered, it is clear that the number of periods is small and that the risk of asymmetry of the spectral lines really exists. (As a matter of fact it is *necessary* to work with small portions of the grating in order to avoid the correction originating from lack of parallelism of the beams. See Porter, *Phil. Mag.* (7), **5**, p. 1067 ; 1928.)

In order to get some quantitative account I have calculated the diffraction pattern (in the *Fraunhofer case*) for the case shown in Fig. 1. The result is given in Fig. 3. The total number of lines in the grating is about 160. The *maximum* misplacing of a line (the misplacing at the ends and in the middle of the grating) in reference to the lines in a *perfect* grating of grating-constant d_0 is $0{\cdot}12\,d_0$, where d_0 is the mean spacing of the defective grating. Fig. 3 gives the amplitude as a function of wave-length. The vertical line denotes the position of the principal maximum for a perfect grating of grating-constant d_0. Thus the principal maximum of the defective grating is shifted (in this special case about $0{\cdot}0015\ \lambda$), and the distribution of intensity in the total diffraction pattern is asymmetrical.

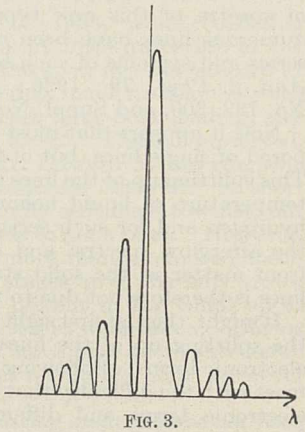


FIG. 3.

A general calculation of the shift of the principal maximum (in the conditions illustrated in Fig. 1) gives the following result:

$$\text{Error of wave-length } (\dot{a}) = \frac{2\,m_{\max}}{l}\,.\,\lambda$$

where m_{max} is the *maximum* misplacing of a line in the grating and l is the length of the grating.

For $l = 1$ mm. we get :

if $m_{max} = 0{\cdot}0005$ mm.	$a = 0{\cdot}001$ λ
„ $= 0{\cdot}00025$ „	$a = 0{\cdot}0005$ λ
„ $= 0{\cdot}0001$ „	$a = 0{\cdot}0002$ λ

The X-ray measurements considered are, as said above, of considerable interest on account of their importance as regards the value of the electronic charge (e). Now a certain error in the wave-length gives rise to an error in e three times as large. From the above discussion it appears that the error in e originating from the grating errors is very likely to amount to values comparable to the total error in e stated by some authors. The object of this paper is thus to direct attention especially to the fact that the quality of the grating is of decisive importance to the accuracy of the value of e deduced from X-ray measurements.

SVEN FAGERBERG.

Physics Laboratory, University,
Upsala, Nov. 15.

New Types of Emission Spectra.

THE emission spectra which we observe in the visible and ultra-violet region are divided into line and band spectra, of which the first type corresponds to electronic changes of state of single atoms either in neutral or in an ionised state. The band spectra originate from molecules, and the energy quanta emitted in a certain spectral line draw their energy from three sources : (1) change of electronic orbits, (2) change of vibrational energy, and (3) change of rotational energy.

The study of the luminescence from solidified gases at very low temperatures has revealed a new type of spectra, which is a combination of electronic jumps and atomic oscillations, and we obtain a type of vibrational band spectra free from the influence of rotational energy. Since their discovery in 1924 (*Comm. Lab. Leiden*, No. 175) a considerable number of spectra of this new type has been studied, and numerous lines have been classified into vibrational series and systems of such series. (See, for example, *Ann. d. Phys.*, **79** ; 1926 ; and *Comm. Lab. Leiden*, No. 183, 200, and Suppl. No. 59.)

Now it appears that most of the series are not composed of single lines, but of two or more components. This splitting up of the lines is more pronounced at the temperature of liquid helium than at that of liquid hydrogen and for such series which appear strong in the afterglow spectra, and are undoubtedly emitted from matter in the solid state. The multiplicity of lines is therefore not due to rotational energy.

It might, then, at first sight seem reasonable to ascribe the splitting up of the lines to a multiplicity of the electronic terms. Following up this idea, however, we meet with the difficulty that series with quite different electronic terms and different principal vibrational frequencies show very nearly the same frequency difference between successive components. Thus the series called C, D, and E show a separation of about 45 cm.$^{-1}$, and about the same difference is found for the doublets of the ϵ-system. In the case of the principal series of the ϵ-system (the η-series), we find, under certain conditions, that the ' lines ' are split up into 4-7 components, with an approximately constant difference between successive components of about 40 cm.$^{-1}$. The α-series gives a separation of 69 cm.$^{-1}$. A multiplicity of this type cannot be accounted for by the theory of electronic terms.

Now the α-form of solid nitrogen was shown (*Zeits. f. Phys.*, **58**, 497 ; 1929. NATURE, Aug. 17, 31 ; 1929) to have a pronounced molecular structure, and the atomic distance and dissociation energy of the molecular elements of the lattice were found to be approximately identical with those of the gaseous molecules. The ordinary oscillatory series correspond to atomic oscillations of the atoms of molecular elements in various states of electronic excitation. The strong binding between the two atoms of a molecule corresponds to the high principal vibrational frequencies of the order of magnitude 1200-2400 cm.$^{-1}$. But a molecule with vibrating atoms may itself be vibrating on account of the forces which bind the molecules in the crystal lattice, and which are closely related to the elastic forces of the crystal.

As the distance between the molecules is much greater than that between the atoms of a molecular

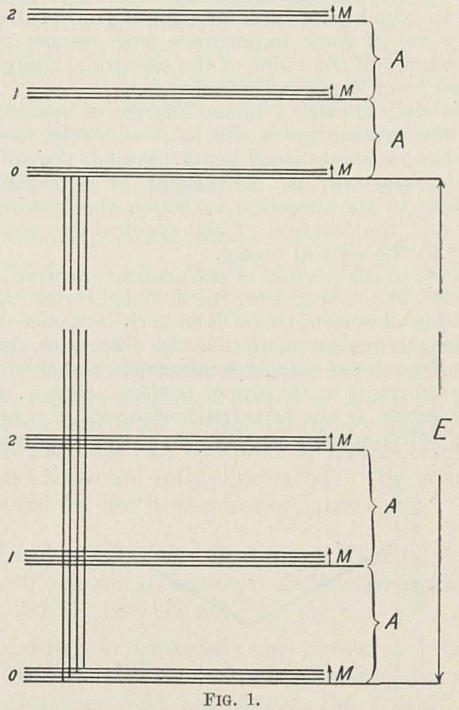


FIG. 1.
E—Change of energy of electronic states.
A—Change of energy of atomic vibrations.
M—Change of energy of molecular vibrations.

element, it is to be expected that the internal state (either electronic or vibrational) of the molecule will have little influence on the molecular vibrations, and thus we may understand that the separation of lines on account of molecular vibrations may be approximately the same for series corresponding to different internal states of the molecular elements.

Thus we are dealing with a type of spectrum where the frequencies are modified from the following three causes : (1) Change of electronic states. (2) Change of vibrational energy of the atoms of a molecular element. (3) Change of vibrational energy of the molecular elements in the crystal lattice.

The formation of a spectrum of this type is shown in Fig. 1.

L. VEGARD.

Physical Institute,
University, Oslo, Nov. 28.

Recovery from Parasitism.

THE pine shoot moth, *Evetria buoliana*, Schiff., one of the best known Lepidopterous pests of young Scots pine in Europe, has during the past decade been causing much concern by its increasing prevalence in the numerous young pine plantations in East Anglia. Just over a year ago a thorough study was begun of

the biology and forest relations of the species, the first results of which have been worked out. Amongst other things it has been found that a slight check is exercised on the increase of the insect by a number of different species of parasites which oviposit in the newly hatched caterpillars and the flight periods of which correspond roughly to that of the moths, and in this connexion an interesting fact has already been brought to light.

Caterpillars collected from different areas were bred out either to the adult moths or to parasites, and it was found that those which came from areas in which the percentage internal parasitism of the caterpillars was high, yielded some fertile moths which were much smaller than the 19 mm. wing-span given by Meyrick[1] as the minimum for the species. From others which came from areas in which the percentage parasitism was low, such small moths were extremely rare. For example, from 300 caterpillars parasitised to the extent of 80 per cent, 7 per cent of the emerging moths had a wing-span ranging from 13 mm. to 17 mm., while caterpillars parasitised to the extent of 70 per cent only gave about 2 per cent moths of the small type; and from caterpillars with a percentage parasitism of less than 60 per cent, only two small moths were bred out as against more than 400 of the normal type.

In considering the significance of these results, it has occurred to me that the prevalence of these small moths may be connected in some way with the high percentage of internal parasitism and that they may possibly be the results of a recovery from parasitism.

Recovery from parasitism by phagocytosis of the parasites' eggs or newly hatched larvæ has been described in detail by Timberlake,[2] and such recovery has been noticed occasionally in the young caterpillars of *E. buoliana* but appears to have no effect on the ultimate size of the adult moth. In the present case the results so far obtained tend to show that recovery probably takes place at a later stage in the life-history.

Tothill[3] has pointed out that the active histolysis which takes place in the pupal and prepupal stages of a moth renders them unsuitable feeding grounds for those internal parasites which are devoid of some means of protection such as a trophamnion. It is easy then to imagine that if for any reason the development of a normal internal parasite was delayed until the host reached the prepupal stage, the parasite larva would be attacked by the active phagocytes, broken down, and its substance probably built up into the tissues of the adult moth.

Such retardation of the parasite larvæ was often noted when super- or multiple parasitism occurred. Caterpillars containing two or more living first-stage parasite larvæ which would have taken well over a month to develop, were found less than three weeks prior to the date of the last recorded emergence of the parasites. That these parasites would have emerged is highly improbable, and one must suppose, therefore, that in such cases there would be either a recovery from parasitism, or that total death by mutual exhaustion of the complex would have taken place.

The caterpillars are, however, only slightly retarded in their development by the presence of internal parasites, but after the first instar are invariably found to be smaller both in general bulk and in the measurements of the head capsule than unparasitised specimens of the same stage. This makes it impossible to apply Dyer's law for the separation of the stages, to any but unparasitised individuals. From the above evidence it seems probable that a recovery from parasitism has taken place in the prepupal or pupal stage of the moth.

The type of small pupæ from which these moths emerged also showed a greater percentage mortality than the normal type, and if the hypothesis advanced is correct, it is natural that after a severe drain of blood plasma from the feeding of the parasite larvæ their vitality should be lowered.

No direct evidence of this recovery has been noted in the small amount of preserved material yet examined, but this need not be taken as negative evidence. The actual process may be very rapid, and as it only occurs in a small percentage of the caterpillars at a stage not yet definitely known, many hundreds of futile dissections may have to be made before one can expect results.

If it can be definitely established that recovery from parasitism can take place as suggested at a later stage in the host's life-cycle, it may throw light on many details of parasitic (internal) control of pests in general and account for their usual incompleteness in exterminating a host. It is generally considered that 100 per cent parasitism brings about total extinction, but such a percentage would involve a large proportion of supernumerary parasites which, causing mutual retardation, would allow a large percentage recovery of the host. In all probability the maximum mortality will occur when the host has a percentage parasitism of less than 100, but this maximum will never be 100 per cent in hosts in which such recovery occurs.

C. CRAWSHAW BROOKS.

Imperial Forestry Institute,
University of Oxford,
Dec. 6.

[1] E. Meyrick. "Revised Handbook of British Lepidoptera", 1927.
[2] P. H. Timberlake. "Experimental Parasitism", U.S. Department of Agriculture. Bur. Ent. Tech. Ser., No. 19, Pt. 5, 1912.
[3] J. D. Tothill. "Natural Control of the Fall Webworm." Dom. Can. Dept. of Agric., Ottawa, Bull. 3, 1922.

Occurrence of *Craspedacusta* (*Limnocodium*) *Sowerbii* in the Exeter Ship Canal.

DURING the summer of 1928, while collecting Crustacea and other forms of fresh-water life in the Exeter ship canal, I had the good fortune on July 21 to find in a hand-net gathering, made midway between the Turf Hotel and Topsham ferry-boat landing, two small medusæ quite new to me. These I preserved, and later sent them to Mr. Edward T. Browne, who identified them as *Craspedacusta Sowerbii*. A short time later, Mr. Browne kindly sent me a tow-net, but the great difficulty then was to get a boat. However, I succeeded in obtaining more than a hundred specimens, ranging from early stages up to the fully grown adult. The medusa was present in the canal up to Sept. 8, when some early stages were taken. During the past summer (1929) I have been more successful, and have been able to get a suitable punt whenever I wanted one.

My studies in this interesting medusa have not been so complete as I could have wished, but I have published these notes in the hopes that others younger than I will be attracted to study the fresh-water life in this interesting canal.

According to Mr. P. C. De la Garde—"On the Antiquity and Invention of the Lock Canal of Exeter" in a letter from Philip Chidwell de la Garde, to Sir Henry Ellis, F.R.S., Secy.: Read Jan. 11, 1838. From *Archæologia*, 5, 28—the Exeter ship canal was completed about the year 1698 so far as Topsham. "In the year 1829", writes Mr. de la Garde, ". . . it was extended to Turf. It is now upwards of five miles and a half in length. It has two entrance locks, one at Turf and another opposite Topsham. Between these and Exeter it has only one lock, the old double

lock altered and improved. . . . The Canal is 34 feet wide at the bottom, and 94 feet at the surface of the water, with 15 feet of water throughout. . . ."

This fresh-water canal, which receives its water from the River Exe, teems at certain seasons of the year with an abundance of microscopic life. Besides fish of various species, *Paludina vivipara* and *Dreissena polymorpha*, two most interesting molluscs, are always present; while *Cristatella mucedo* can be found in the higher parts of the canal; *Plumatella repens* and *Cordylophora lacustris*, near the Topsham lock gate.

It is interesting to record that, up to the present, I have been unable to make one addition to the lists of fresh-water Crustacea recorded by Canon Norman and Thomas Scott in "The Crustacea of Devon and Cornwall".

Owing to ill-health, I was unable to commence my fresh-water collecting until July 8 last, when no medusæ were to be found. My next collecting trip was made two weeks later, when I found the medusæ plentiful. Surface temperature 65° F. From that date until Oct. 14, medusæ were present in varying numbers. On Sept. 5 the surface temperature was 72° F. and the canal was found swarming with medusæ; they were so abundant that one could see them with the naked eye. From that day until the fall of the year, the medusæ gradually decreased in numbers. On Oct. 1 not more than twenty medusæ were caught, surface temperature being 60° F., and on Oct. 14 they vanished for the year, surface temperature being 57° F. Although I have collected at various points along the whole canal, I have not found any medusæ above the double lock.

According to my observations there appear to have been at least four distinct broods of medusæ in the canal during the past summer on or about the following dates: July 20, Aug. 24, Sept. 5 and 19.

All the specimens taken were males, and a special search was made for its hydroid, known as *Microhydra*, without success, but it must be somewhere in the canal.

Both the hydroid and its medusa have been found in streams and ponds in the United States, but this is, so far as I know, the first time the medusa has been taken under natural conditions in Europe, where it has been found under artificial conditions; usually in warm water tanks belonging to botanical gardens.

RUPERT VALLENTIN.

12A Alexandra Terrace,
Bath Road, Exeter.

Magnetic Moments of Atomic Nuclei.

THE hyperfine structures of atomic spectra are considered as due to the interaction of the nuclear spin with the electronic orbital and spin moments. A theoretical calculation of this interaction enables one to obtain information on the magnitude of the magnetic moments of the nuclei from the separation of the hyperfine structures. This can be done for the case of the alkali atoms. Hargreaves (*Proc. Roy. Soc.*, **124**, 568; 1929) has calculated the separation due to a nuclear moment $h/4\pi$ for the case of atoms with only one electron. In his calculations, however, the interaction between the electronic and nuclear spins, which is of the same order of magnitude as the other terms, has been neglected. I have therefore carried out the calculations with the following improvements. For the s-terms, which is the most important case, since they give the largest contribution to the separation, I have used Dirac's theory of the electron, since the simpler Pauli's theory gives a wrong result. For the p-terms I have used Pauli's method, taking into account the interaction of the nuclear and electronic spins. For the p-terms it is not necessary to evaluate numerically the eigenfunctions, since the constants involved in the formulæ can be derived from empirical data on the separation of the electronic spin doublets. For the s-terms this is of course impossible, and I have calculated the eigenfunctions by the statistical method.

If the mechanical and the magnetic moments of the nucleus are respectively $kh/2\pi$ and μ_0, one finds that the s-terms split into two components with a separation

$$(1) \quad . \quad . \quad . \quad \Delta = \frac{2k+1}{k}\frac{8\pi}{3}\mu\mu_0\psi^2(0),$$

where μ is Bohr's magneton and $\psi(0)$ is the value of the normalised eigenfunction at the origin. The separation of the p-terms is much smaller. Each line of the principal series of the alkalis splits, therefore, into two components with the separation Δ, each of them having a finer structure, which is not resolved, and gives rise to small differences in the observed separation for the different lines. The ratio of the intensities of the two components is $(k+1)/k$, the weaker component being shifted towards the violet. The ratio of the intensities is also 3, 2, 5/3 . . . 1 for $k = 1/2, 1, 3/2 \ldots \infty$.

For cæsium one finds, in wave numbers,

$$\Delta = 146\frac{\mu_0}{\mu}\frac{2k+1}{k},$$

and for sodium

$$\Delta = 13{\cdot}4\frac{\mu_0}{\mu}\frac{2k+1}{k}.$$

The observed values are, for cæsium (D. A. Jackson, *Proc. Roy. Soc.*, **121**, 432; 1928) $\Delta = 0{\cdot}3$, and for sodium (H. Schüler, *Naturwiss.*, **16**, 512; 1928) $\Delta = 0{\cdot}06$ wave numbers. From this, on the assumption of the values 1/2, 1, 3/2, . . . , ∞ for k, we obtain the following values for the ratio μ/μ_0 of the Bohr magneton to the magnetic moment of the nucleus:

$k =$	1/2	1	3/2	∞
Cæsium	1950	1460	1300	980
Sodium	890	670	600	450

From the observed ratio of the intensities in sodium one should expect a probable value for k of 1 or 1/2.

The uncertainty of the given values arises from the lack of precision of the empirical data and from the application of the statistical method to the evaluation of the eigenfunctions. This latter source of error might be evaluated to within 20 or 30 per cent.

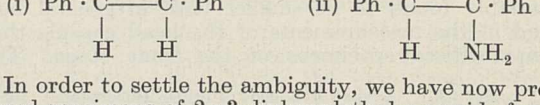
Further details will be published later.

E. FERMI.

Physical Institute of the University,
Rome, Dec. 4.

Optically Active Diphenylethylene Oxide.

WE have recently been able to obtain optically pure *d*- and *l-iso*hydrobenzoin, Ph · CH(OH) · CH(OH) · Ph, by the action of nitrous acid on *d*- and *l-iso*diphenylhydroxyethylamine (*Jour. Chem. Soc.*, 1929, 2305). This result might be considered to point to configuration (ii), rather than (i), for *iso*diphenylhydroxyethylamine, except for the circumstance that *l-iso*hydrobenzoin is furnished in this way by *d*-diphenylhydroxyethylamine as well as by the *l-iso*base:

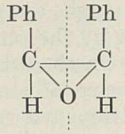


In order to settle the ambiguity, we have now prepared specimens of 2 : 3-diphenylethylene oxide from each of these bases, through the quaternary ammonium hydroxides, Ph · CH(OH) · CH(NMe_3OH) · Ph. The

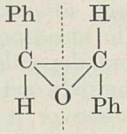
optically active and externally compensated forms of the *iso*base yielded an identical optically inactive diphenylethylene oxide, which therefore corresponds to the *cis*-configuration (iii), with a plane of symmetry (indicated by the broken line). *d*-Diphenylhydroxyethylamine, however, gave a strongly lævo-rotatory oxide, to which the *trans*-configuration (iv) must be assigned. It follows that the relative molecular configurations allocated to the above bases by Erlenmeyer in 1899 must be reversed, the base and the *iso*base being represented by (ii) and (i), respectively. We propose to explore further this valuable general method for determining the relative molecular configurations of such substances.

The stereoisomeric diphenylethylene oxides present several features of unusual interest:

(iii)



(iv)



The *trans*-form (iv) is an example of the simplest type of cyclic structure which can give rise to dissymmetry of molecular configuration: it will be noticed that the assemblage of five single atoms carrying two identical radicals still displays axial symmetry, although a plane of symmetry is no longer present. These simple structural constituents may be compared instructively with the four single atoms and one group of the simplest known acyclic dissymmetric compound, chloroiodomethanesulphonic acid, that is, $CHClI \cdot SO_3H$. The specific rotatory power of the *l*-form of the above oxide (iv), observed in absolute alcohol for sodium light, exceeds $-300°$, while the corresponding value for *l-iso*hydrobenzoin (its configurational analogue) is only $-92°$: thus, the optical effect of the 3-membered ring is strikingly apparent. The extraordinary stability of these well-defined crystalline oxides is in keeping with the views of Thorpe and Ingold on the effect of substituents in relieving the strain inherent in small rings.

Other compounds of the same general type which we are at present investigating exhibit an equally pronounced stability; among them, the *cis*-form of 2:3-dianisylethylene oxide has been obtained by the direct interaction of nitrous acid and the corresponding dianisylhydroxyethylamine, as well as from the same base by the general method indicated above. Details of these studies and of further work directed towards the preparation of optically active ethylene oxides, containing aromatic or aliphatic substituents, will be published elsewhere.

JOHN READ.
ISHBEL G. M. CAMPBELL.

The University,
St. Andrews.

Do Oceanic Plankton Animals Lose Themselves?

RECENT researches into the behaviour of plankton animals in the sea as to their vertical movements from day to day indicate that light intensity is an important factor. The animals appear in Nature to be brought around an optimum intensity by some tropistic mechanism and, assuming this, there seems likely to be a lower limiting or threshold intensity below which no stimulation takes place. Such, indeed, appears to be the case at night with animals living in our shallower offshore waters, when, with the release of the light stimulus in darkness, they are free to roam anywhere and become evenly distributed throughout the water layers, within the limits of other controlling factors such as temperature and salinity. This lower threshold intensity idea receives support from a paper published in 1926 by two Japanese workers, M. Tauti and H. Hayasi (*Jour. Imper. Fisher. Instit.*, Tokyo, vol. 21, No. 4, p. 42), who found that if a light be projected at night vertically downwards into the water, fish swimming in numbers deeper in the water are only attracted individually to the light when by random movements they swim upwards into a certain threshold intensity.

In view of these observations, the suggestion arises whether certain plankton animals which normally live in light of moderate intensities near the surface, but are to be found also in the deep, dark layers of the open ocean, are not, so to speak, lost in these latter layers. Have they moved out of their normal light zone, perhaps at night, and reached layers at which the intensity is below the threshold, thus to be doomed to everlasting night until perchance by random movements one bright day they swim once more into the threshold intensity zone and are attracted upwards to their optimum intensity?

F. S. RUSSELL.
Marine Biological Association,
Plymouth.

Magic Square of Fifth Order.

I VENTURE to send you what I believe to be a very rare magic square of fifth order. Although there are more than 260,000 bordered squares of fifth order with the number 13 in the centre of the square, it seems a very rare thing indeed for any other number than 13 to be in the centre. I have not found any with the usual proportion (39/26) between the Row of the Heart and the rest of the Row, and it was not until the proportion 36/29 arrived that I found it was possible to make one. I append the square. Subtracting each number from 26 will give the proportion 42/23. I believe there are only two (not including inversions) with 17 in the centre of the square.

23	20	10	4	8
22	2	16	18	7
14	13	17	6	15
5	21	3	12	24
1	9	19	25	11

36/29. Magic number 65.

J. C. BURNETT.
Barkston, near Grantham, Dec. 2.

Legitimate Uncertainty.

ADVANCE of inquiry into fundamental tracts of Nature is often perforce conducted by means of symbolism. The comprehensive character of the symbols counts for increase of knowledge, even though their physical interpretation is still shrouded in uncertainty. Thus it is that, for example, Prof. Eddington, on page 291 of "The Nature of the Physical World", amusingly sums up our present knowledge of electronic operations inside atoms by saying: "*Something unknown is doing we don't know what*—that is what our theory amounts to". Similarly the sentences quoted from one of my books, at the end of a review on page 942 of NATURE for Dec. 21, should be understood, not as a hopeless and helpless admission of ignorance but as a scrupulously fair and cautious stage in the advance of knowledge; for it is no gain to science to attempt the formulation of a nascent theory prematurely.

OLIVER LODGE.
Lake, Salisbury.

Cycles in Natural Phenomena.

IN December 1922, Dr. Merriam, president of the Carnegie Institution of Washington, called a conference to discuss the question of 'cycles'. The report of this, and of a second conference held in December 1928, have now been published by the Carnegie Institution,[1] and the two reports form a stimulating contribution to the subject. The members took a very broad view, which was set out by F. E. Clements in an introductory paper as follows: "It seems desirable to use cycle as the inclusive term for all recurrences that lend themselves to measurement, and period or periodicity for those with a definite time interval, recognising, however, that there is no fixed line between the two. On this basis there can be no question of the existence of climatic and other cycles, though there may be the gravest doubt of the reality of periodicities in climate beyond that of the year."

The greatest emphasis naturally falls on cycles of climate, which underlie most known cycles of other terrestrial phenomena, such as crops and prices, growth of plants, and fluctuations in numbers of animals, while climatic cycles are themselves most probably reflections of cycles of solar activity. Unfortunately, however, the systematic observation of climate is of comparatively recent growth, and very few homogeneous series of meteorological records exceed one hundred years. This is sufficient for the accurate study of weather periodicities of a few years in length, but is quite inadequate for the determination of longer cycles, from twenty or thirty years upwards. The meteorological records, for example, have hitherto proved insufficient to determine the real nature and extent of the well-known Brückner cycle of about 35 years.

On the other hand, there exist several natural agencies which have the power to integrate the meteorological conditions during a period of a few months or a year, and register the results in some permanent form. The two most notable of these agencies are trees, which by the width of their annual rings show their rate of growth during each of a long succession of years, and melting glaciers, which leave behind them records of the volume of thaw water.

The investigation of the annual rings of trees has found its home in the United States, where it is associated especially with the name of A. E. Douglass, who in 1922 was able to present conclusions based on the dating and measurement of more than 110,000 rings in nearly 500 trees, all carefully collated and compared. It has been generally accepted that in the dry climate of Arizona and California the redwood, *Sequoia*, grows most rapidly in relatively rainy seasons, but the nature of the relationship between tree-growth and weather is examined more closely in a paper read at the 1928 conference by O. T. MacDougal. Since 1918, MacDougal has been obtaining measurements by means of the 'dendrograph', an instrument which makes a continuous record of the diameter of a tree between two contact points on opposite sides of the trunk.

The trees chiefly examined were the Monterey pine and the coast redwood. From the records illustrated, it seems that the pine grows most rapidly in late spring; the tree forms no reserve of starch, and in a dry situation the growth is closely related to the rainfall of the preceding winter. If abundant soil moisture is available, however, growth is greatest in dry years with few fogs, abundant sunshine, and high temperature. The meaning of the record made by the pine, therefore, depends on its situation. On the other hand, the redwood accumulates a reserve of starch, and moreover, it grows only in situations where the soil moisture does not fall below a certain percentage. Hence the correlation between the width of the annual rings and the rainfall in individual years is smaller than with the pine, but the redwood gives an excellent measure of the long-period fluctuations of rainfall. It also seems probable that temperature plays a more important part in the growth of the redwood than that of the pine.

On the whole, the pine is probably the better index of rainfall, but it is relatively short-lived. Four of the Sequoias measured began their existence more than 3000 years ago, but few pines go back more than 500 years, the oldest covering a period of 640 years. This difficulty has been partly overcome by the use of historic and prehistoric material, and the available pine records now cover two nearly equal periods, totalling about 1255 years, but unfortunately separated by a gap of unknown duration. When this gap has been filled, the whole series will become a continuous climatic record of the highest value.

The harmonic analysis of a very long series of data is a laborious occupation, and for the purpose of studying the variations of his tree measurements, in 1913 Douglass invented an ingenious optical instrument for determining the lengths of periodicities. A large instrument with photographic attachment was constructed with a fund given by Mr. Clarence G. White, and the instrument has been termed the 'White Cyclograph'. The earlier form suffered from the disadvantage of a rather limited range, the longest periodicity which could be determined being only seven times the shortest, but in an improved form described at the 1928 conference a device is incorporated which more than doubles this ratio. The principal result obtained up to the present is that most of the cycles of growth shown by the western tree-rings are probably simple fractions of a Brückner cycle of 34 years.

Another series of data which may prove of value is that relating to waves of infectious diseases, discussed by Dr. W. C. White. These may be related to cycles of solar radiation of various wave-lengths, but very little is yet known as to the nature of the relationships, and the conclusion

[1] "Reports of the Conferences on Cycles." Pp. 83. (Washington, D.C.: Carnegie Institution, 1929.) Free on request.

reached is that there is a greater likelihood that a knowledge of weather cycles will help the study of preventive measures against disease than that a knowledge of the history of epidemics will further the study of weather cycles.

The view has often been expressed that by far the greater number of weather cycles will prove to be intimately related to cycles of solar variation. Unfortunately, only one of the latter can be regarded as fairly established, namely, the double sunspot period of 22½ years. The shorter cycles which are believed to exist in solar radiation are not well shown by the sunspot numbers, and reliable measurements of solar radiation do not yet cover a sufficiently long period to give conclusive results. At the second conference, C. G. Abbot presented the results of the harmonic analysis of 100 months of data ending in October 1928, but probably the only periodicity so found which has any claims to reality is that of 25 months (an inspection of the author's diagram suggests that the real periodicity is slightly longer, perhaps 26 months). It seems that we shall have to wait many years for a full study of the periodic variations of solar radiation based on a sufficiently long series of observations.

The greatest mass of material awaiting systematic periodogram research is to be found in the deposits left by the waters issuing year after year from the ends of the glaciers. These waters deposit a fine clay, but the winter deposit, when the glacial streams are at a minimum, differs in colour and texture from that of the streams swollen by the summer thaw. Hence the layer added each year can be readily detected and its thickness measured, giving what is essentially a representation of the average summer temperature. These glacial deposits have been carefully studied by de Geer, Antevs, and others in Scandinavia, Finland, North America, the Argentine, and the Himalayas, and in Scandinavia it has proved possible to connect up the deposits with those forming at the present day and so obtain an accurately dated series of measurements covering a period of more than 20,000 years.

Hitherto, statisticians have quailed before the immense task of analysing this record for periodicities, and in his paper Antevs quotes only two determinations, both rather casual. In the Argentine series periodicities of 5·1, 10·4, and 51 years were found, while in the North American series there is a strongly marked periodicity of two years, besides others of three to eight years. Neither investigation discovered the eleven-year sunspot cycle, a remarkable result which is at variance with the claim of de Geer, embodied in his title "the solar curve", that the series of clay thicknesses is a measure of the variations of solar radiation from year to year.

This does not exhaust the possibilities of wresting from Nature detailed evidence of her past vicissitudes. Peat bogs in many countries enshrine the history of post-glacial vegetation, and though by its nature this record cannot be made to give numerical annual values comparable with those from the trees or the glacial clays, it should—when it is fully understood—provide valuable information as to the longer sweeps of climate, which will form a base-line for the variations of shorter period revealed by the more detailed sources.

From the reports as a whole, it appears that on all sides forces are being marshalled for a combined attack on the weather changes in post-glacial times, which cannot but throw much light on the changes in process at present. As Dr. White phrased the problem in the discussion, "Surely it should be possible by careful planning and co-ordinated study to construct relatively complete records from the present year backward into Pleistocene time, though that is but a beginning of the baffling if not insuperable task of constructing a continuous record that will reach back into the Tertiary". C. E. P. B.

Recent Work on Yellow Fever.

THE opening address of the Cambridge Philosophical Society on Nov. 11 last was delivered by Prof. E. Hindle, the Beit research fellow in tropical medicine, who gave an account of recent work on yellow fever. The paper for the most part was a description of experiments on yellow fever which have resulted in his discovery of a method of vaccination against this disease.

West Africa is now the main endemic centre of yellow fever, although serious epidemics have occurred in Brazil during the year 1929. A new era in the study of the disease was opened by the discovery in 1927 by Stokes, Bauer, and Hudson, that Asiatic monkeys, and especially *Macacus rhesus*, can easily be infected with yellow fever. Afterwards, Dr. Adrian Stokes working at Lagos, and also Drs. Young and Noguchi at Accra, died of yellow fever acquired in the course of their investigations. Prof. Hindle described how he succeeded in getting the virus of the disease brought back to London. Pieces of the liver of an infected monkey in Senegal, killed at the height of the disease, were kept frozen during the voyage to London, a period of 12 days, and with this material the disease was reproduced in England at the end of March 1928. Since that date, the strain has been maintained by Prof. Hindle at the Wellcome Bureau of Scientific Research and has been distributed to laboratories in Paris, Berlin, and Amsterdam. The method consists of keeping the virus frozen, in which form it will survive for three to four weeks, or preferably to dry infected blood or tissues *in vacuo*, and keep it in the presence of a desiccating agent, when the virus will survive for 3-4 months. Monkeys can easily be infected by the inoculation of blood or liver from an infected animal, and 1/1000000 c.c. of infected blood has been found sufficient to produce infection.

Transmission experiments with both Indian and West African races of *Aëdes ægypti* (*Stegomyia fasciata*) reared in England have shown that the disease can easily be transmitted from infected monkeys to normal animals by the bites of these insects, on condition that an interval of at least 9 days at 28° C. is allowed to lapse after the infective feed. During this incubation period the virus has been found to be constantly present, not only in the gut, but also in the cœlomic fluid, as determined by inoculation experiments into susceptible monkeys. Once infected, a mosquito remains infective for the duration of its life, and, moreover, it was found that this infectivity persists even if the temperature is continually below 18° C. Formerly, it was supposed that the distribution of the disease was restricted by the mosquito being unable to transmit the infection below a certain temperature, but Prof. Hindle's experiments show that this view can no longer be maintained. The results of experiments with the Indian race of *Aëdes* constitute the first proof that they are capable of transmitting yellow fever, and it is evident that if, by any ill chance, this disease ever reached the Orient, the local race of mosquitoes could serve as efficient carriers.

It has been know from early times in the history of the disease that an attack is followed by a high degree of immunity, and the serum of convalescent patients, if inoculated into monkeys, will protect them against infection for a period of about one month. The presence of active immune bodies in the blood of recovered patients furnishes a means of finding out whether a person has had the disease, for it is only necessary to inoculate a rhesus monkey with the serum of a suspected case and at the same time with yellow fever virus. Employing these methods in West Africa, the Rockefeller Commission had detected the existence of yellow fever in villages where no obvious signs of the disease were present.

Employing these methods, the nature of two atypical cases of yellow fever contracted in the laboratory in London was discovered. In both patients (Prof. Hindle and his laboratory attendant), the symptoms, a sharp fever of short duration, closely simulated, and at the time were attributed to, influenza. After the fever, however, in both cases the blood contained immune bodies against yellow fever, as tested by inoculation into monkeys, and therefore there can be no doubt that they had both had an attack of this disease.

It may be added that jaundice and albuminuria, although looked for, were not detected, and the only characteristic symptom was hyperæsthesia of various parts of the body in one patient which persisted for 3 to 4 weeks. These results, combined with the production of immunity by the inoculation of sub-lethal doses of virus, furnish additional evidence in support of the view that mild cases of yellow fever may occur which present none of the ordinary symptoms of the disease. These cases would never be recognised in the ordinary course of events, but would be capable of infecting mosquitoes that fed on them and thus maintain the infection in a latent or hidden form.

An interesting case of tissue immunity was described. The liver and spleen of monkeys that have recovered from yellow fever, when inoculated into normal monkeys in 1 gm. doses, immunised them against subsequent inoculations of fresh virus. The brain, kidney, and lymphatic glands of convalescent monkeys did not possess this property. The inoculation of hyperimmune serum into infected monkeys, after the commencement of fever, had no obvious effect on the course of the infection, and consequently there is doubt as to the value of serum treatment in human cases of yellow fever.

Great hopes had been placed on Noguchi's vaccine prepared from *Leptospira icteroides*, erroneously supposed by him to be the causative organism of yellow fever. It is now known that this organism is identical with that of spirochætal jaundice, therefore the vaccine prepared from it can have no value in yellow fever prophylaxis and its use has been abandoned.

Prof. Hindle decided to apply methods of vaccination which have proved successful in the production of vaccines against such diseases as fowl plague, dog distemper, etc. In June 1928 (*Brit. Med. Jour.*, June 9, 1928) he showed that a phenol-glycerine emulsion of the liver and spleen of infected monkeys confers a very high degree of protection against very large amounts (10,000 to 100,000 lethal doses) of the virus. A formalinised suspension shows the same vaccinating property. During the past eighteen months these experiments have been extended and full details were given of the method of preparing this vaccine. The earlier phenol-glycerine vaccine has been replaced by a formalinised one, as the infection of glycerine is painful.

The present method of preparing the vaccine is as follows : The liver is removed from an infected monkey killed in the last stage of the disease, when the temperature begins to fall. The organ is weighed and ground up in a mortar with fine sand. A measured quantity of 9 per cent salt solution, equal to half the original weight of the tissue, is added and the mixture allowed to stand for a few hours. Then distilled water is added equal to nine times the volume of the strong salt solution. As a result, all the cells are cytolised liberating the contained virus, and one obtains a 20 per cent suspension of tissue extract in normal saline. This suspension is allowed to sediment, then filtered through muslin. Part of it is tested for virus content, and a 1 in 10,000 dilution of the original tissue should produce a fatal infection in a monkey.

The virus suspension is killed by the addition of 1 to 2 per 1000 formaldehyde, and after twenty-four hours can be used as a vaccine, if it passes the usual sterility tests.

Both phenol-glycerine and formalinised vaccines, when kept in the ice chest, have been found to preserve their properties for some months. The first has also been dried *in vacuo*, after removing

the glycerine by dialysis, and found to retain its properties.

Monkeys inoculated with these vaccines show a high degree of protection against yellow fever, and this protection has been tested against the inoculation of fresh virus and the bites of infected mosquitoes up to 4½ months after vaccination, without showing any signs of diminution. In the majority of cases, about ten days after being vaccinated the monkeys were inoculated with 0·1 gm. infected liver material, equivalent to 1000 to 10,000 lethal doses, and in some instances with very much greater quantities of virus.

These results have been confirmed by Pettit and his collaborators working in Paris, and Aragão in Rio de Janeiro, who used a Brazilian strain of yellow fever. Aragão obtained constant protection in monkeys, and therefore tested the vaccine in human beings, using a 20 per cent suspension of liver, spleen, brain, and kidney containing 2 per 1000 formaldehyde and 0·5 per cent phenol. This vaccine was administered subcutaneously in 2 c.c. doses to the laboratory workers at the Institute Oswaldo Cruz, with no ill effects, and afterwards used in a small epidemic of yellow fever. Between three hundred and four hundred people were vaccinated, including the health officers working in the infected neighbourhoods, and people living either in the same house or the vicinity of yellow fever cases. Although no unwarranted conclusions were drawn, none of the vaccinated contracted the disease, although some of them must have been exposed to infection.

The use of this modification of Hindle's vaccine has now been adopted by the Public Health Department of Brazil, and during the epidemic in Rio de Janeiro early in 1929 approximately 30,000 persons were vaccinated against yellow fever.

In West Africa, there is urgent need for some additional method of protection against yellow fever, as evidenced by the number of past epidemics, for at present there seems to be no likelihood of anti-mosquito campaigns succeeding in eradicating all chance of infection. Accordingly, the British Colonial Office, and also the French and Belgian Governments, have decided to test this vaccine in their West African colonies.

Prof. Hindle is of opinion that, by the general use of a vaccine of this nature of proved efficiency in monkeys, there is every hope of yellow fever ceasing to be a source of danger in the world.

Scientific Centenaries in 1930.

THOUGH the year 1930 will not see the commemoration of any scientific centenary of such widespread interest as that of Faraday's discovery of electromagnetic induction, which will be celebrated in 1931, the year will recall a number of eminent men who have made notable contributions to many departments of science.

The most famous name which appears among the centenaries for 1930 is that of Kepler, who died on Nov. 15, 1630, at the age of fifty-eight years. Kepler forms a link between the sixteenth and seventeenth centuries. Among those born in 1630 were the German chemist, Kunckel (1630–1703), who assisted in emancipating the literature of chemistry from the mysticism of alchemy, and Isaac Barrow (1630–1677), Gresham professor of geometry, first Lucasian professor at Cambridge and master of Trinity College, teacher and predecessor of Newton and one of the greatest religious scholars of his time. Another name, also associated with Cambridge, is that of Thomas Plume (1630–1704), vicar of Greenwich and archdeacon of Rochester, whose preaching appealed to Pepys and Evelyn, and who, through reading Huygens' "Cosmotheoros", recommended to him by Flamsteed, left funds for erecting an observatory at Cambridge and for maintaining a professor of astronomy and experimental philosophy. The first to become a Plumian professor was Roger Cotes, while the first observatory founded through Plume's generosity was over the King's Gate of Trinity College.

The work of the eighteenth century is recalled by the names of Bezout (1730–1783), a mathematician of distinction; of Bochart de Saron (1730–1794), one of the first astronomers to suggest that Herschel's newly discovered body was a planet, and one of the French men of science who perished beneath the guillotine; of Messier (1730–1817), Louis XV.'s 'comet ferret', regarded at one time as the leading practical astronomer in France; and by that of Bossut (1730–1814), friend of Condorcet, D'Alembert, Bailly, and Lavoisier, a pioneer in the study of hydrodynamics and one whose work contributed to the improvement in the sailing qualities of the ships of the French Navy.

Other scientific workers also born in 1730 include the English amateur astronomer, Aubert (1730–1805), the intimate of Smeaton, Banks, and Herschel; Josiah Wedgwood (1730–1795), the Boulton of the pottery industry; Ingenhousz (1730–1799), the Dutch physicist who spent the latter part of his life in England; and Duhamel (1730–1816), to whom France is indebted for improvements in steel-making.

Of men of science who died a hundred years ago, Fourier (1768–1830) was the most famous. His "Théorie analytique de la chaleur" appeared in 1822, and it was Comte who predicted that when Fourier's doctrine was better known much use of it would be made in other branches of physics. If Fourier recalls the golden age of French mathematics, the name of Cremona (1830–1903) brings to mind one who, last century, reorganised mathematical instruction throughout Italy. His birth took place on Dec. 7, 1830, and to 1830 also belong the names of H. A. Newton (1830–1896), both mathematician and astronomer; Carl Bruhns (1830–1881), friend of Encke and Galle, and director of the Leipzig Observatory; and the three eminent chemists, Raoult (1830–1901), recipient of the Davy Medal in 1892; Bemmelen (1830–1911),

who contributed to the founding of the Dutch school of physical chemistry; and Lothar Meyer (1830–1895), best known for the share he had in the periodic classification of the elements, and whose memorial lecture before the Chemical Society was delivered by Prof. Bedson in 1896.

The year 1830 also witnessed the death of Major James Rennel (1742–1830), the eminent geographer, who is buried in Westminster Abbey; of Richard Chenevix (1774–1830), the Irish chemist and mineralogist, whose name, like that of Rennel, is in the list of Copley medallists; and of Henry Bell (1767–1830), the steadfast but unfortunate promoter of steam navigation, whose *Comet* was the forerunner of the *Mauretania*; and it also saw the birth of David Edward Hughes (1830–1900), inventor and physicist, founder of famous scientific prizes and benefactor of the London hospitals; of Sir Edward Reed (1830–1906), the most prominent naval architect of his time; and of Gerhard von Rath (1830–1888), the Bonn mineralogist. It also was marked by the founding of the Royal Geographical Society, while in January 1830, Lyell, then thirty-two years of age, published the first part of his "Principles of Geology", that classic which Geikie said "must form an early part of the reading of every man who would wish to make himself an accomplished geologist".

News and Views.

SUPPLEMENTING our article entitled "Pleistocene Man in China" in NATURE of Dec. 28, 1929, p. 973, we are informed that Prof. Davidson Black has cabled from Peking (or, as the Chinese Government now calls the city, Peiping) on Dec. 28 as follows: "Recovered Chou Kou Tien uncrushed adult *Sinanthropus* skull entire except face letter follows". This presumably is a correction of the unofficial cablegrams that appeared in the newspapers on Dec. 15 and 16 mentioning "a complete skull with both the cranial and facial bones perfectly preserved". Prof. Davidson Black's promised statement was made at a meeting of the Geological Society of China held on Dec. 28. According to a message in the *Times* of Dec. 30 from its Peking correspondent, the credit for the actual discovery lies with a young Chinese geologist, Mr. W. C. Pei, who is in charge of the field work of the Geological Survey at Chou Kou Tien. Some four tons of fossils have been excavated, including parts of two lower jaws, several teeth, and cranial fragments of man. Among the mammalian remains is included the sabre-toothed tiger, which is contemporary with Peking Man. The evidence would appear to point to a very high antiquity indeed. Dr. Grabau, of the Chinese Geological Survey, is said to assign the skull to the beginning of the Quaternary Age, while that well-known authority on Chinese geology and archæology, Père Teilhard de Chardin, gives it an estimated antiquity of 400,000 to 500,000 years. If either of these estimates is confirmed, it would place this relic at comparatively little later than *Pithecanthropus* of Java. The skull is at present embedded in hard travertine, but the right side and vault have been freed by the removal of a relatively softer part of the matrix. It would appear that while the whole of the facial region is lacking, the brain case is almost complete and massive jaw sockets have been exposed. The brow ridges are also said to be massive. As compared with the Java skull, the length is approximately the same, but relatively there appears to be greater brain capacity.

WE propose to publish week by week throughout this year a calendar of historic natural events; and the first set of notes in this series appears on pp. 32, 33. It is intended to include in the weekly record as wide a range as possible of remarkable natural occurrences and phenomena observed in past times. Great storms, floods, frosts, and similar meteorological phenomena will naturally make up a large part of the collected events, and notable earthquakes, volcanic eruptions, and like terrestrial disturbances will also frequently come into the calendar. Whatever has commanded scientific attention on the earth or in the heavens—including of course the appearances of new stars, bright comets, and meteor showers—will, it is hoped, be brought back to memory under their appropriate dates during the year. Events in the natural history or biological field are more difficult to assign to particular dates, and we shall be grateful to any readers of NATURE who will assist us with references or notes upon remarkable occurrences of this kind. Without such aid it will be difficult to make the historic records so comprehensive as we should like them to be.

THE material for the calendar will be derived from a great variety of sources, too numerous to mention individually. Special reference should be made, however, to the *Quarterly Journal of the Royal Meteorological Society*, the *Meteorological Magazine*, Dr. C. Easton's work, "Les hivers dans l'Europe occidentale" (Leyden, 1928), W. Andrew's "Famous Frosts and Frost Fairs in Great Britain" (London, 1887), and a manuscript collection of extracts from the Saxon Chronicle and Holinshed's Chronicles, compiled by the late Miss Eleanor A. Ormerod and now in the possession of the Royal Meteorological Society. In compiling the records, the dates employed have been those of the actual calendar in use at the time. It will be recalled that, in 1752, eleven days were added to the date in the British Isles, Sept. 2 being directly followed by Sept. 14, in order to bring the calendar into conformity with that introduced by Pope Gregory XIII.

IN the second week of this month the centenary of the discovery of the Murray River by Captain Charles Sturt will be commemorated by representatives of South Australia, New South Wales, and Victoria, who will meet at Wentworth on Jan. 7. The next day the delegates will witness the opening of No. 6 Lock, near the Victorian border, and during the following week they will proceed down the river, unveiling memorials at historic spots, arriving at Hindmarsh Island on

Jan. 19. Here the Deputy Governor of South Australia will unveil a granite column 40 feet high, with a bronze tablet, to commemorate Capt. Sturt's landing place after his journey in a whaleboat down the river a hundred years ago. Sturt, who was born in 1795 and was educated at Harrow, served in the Peninsula and in France, and in 1827 became military secretary to Sir Ralph Darling, the Governor of New South Wales. He made several hazardous journeys into the interior, and in 1829 descended the River Murrumbidgee to its confluence with the Murray, and by the latter travelled to the coast. His discoveries led to the founding of South Australia, of which Captain (afterwards Rear-Admiral Sir John) Hindmarsh became the first Governor in 1836. Sturt afterwards became the assistant-commissioner of lands and colonial secretary of the new colony, and one of the counties bordered by the Murray River bears his name. He published accounts of his journeys and received the founder's gold medal of the Royal Geographical Society. Sturt returned to England in 1853 and died at Cheltenham on June 16, 1869.

THE Report on the Administration of the Meteorological Department of the Government of India in 1928–29 has recently been issued. It covers the period during which the head office was reorganised and moved from Simla to commodious new buildings at Poona. The opening ceremony, which took place on July 20, 1928, is described in this report, and the speeches made on that occasion give a good conspectus of the present position and future prospects of the department. The men who occupy the superintendentships of the various branches at headquarters are all Indians. It is to them and their younger colleagues that we must chiefly look for new contributions to our meteorological knowledge of India during the next decade or so, and it is perhaps a good augury that the dislocation caused by the move has not prevented research work from being carried out during the period under review. Some of these researches have already been reviewed in our columns.

SIMLA was badly placed for three very important pieces of work. Mr. J. H. Field, the late Director-General of the Department, had to conduct his pioneer work in the exploration of the upper atmosphere, by means of sounding balloons carrying self-recording instruments, far from the central office, for balloons liberated at Simla are generally lost outright in remote parts of the Himalayas or in Tibet, carried eastwards in the circumpolar westerly circulation that is in evidence at high levels in northern India throughout a large part of the year. An equally important line of investigation—the study of the tropical cyclones of the Arabian Sea—is also more readily conducted with Poona as a base. Lastly, there is the forecasting of the monsoon, upon which the economic life of India is so dependent. The rain-bearing south-westerlies from the far side of the equator reach Poona early, and in full strength, while Simla not only experiences them long after the greater part of India, but also as a 'wave' that has nearly spent its poleward impulse.

THE Safety in Mines Research Board has come to the conclusion that its technical papers are somewhat too difficult for the ordinary miner to understand, and it has, therefore, commenced to issue a series of pamphlets headed "What Every Mining Man Should Know". The first two of these have now been published, and are priced at a very low sum (6*d*. and 3*d*. respectively) in order to make them generally available. The first deals with research problems that have already been more or less completely solved and those that are now undergoing investigation, the object apparently being to bring before the ordinary coal miner the large volume of data which are as yet unknown and will have to be found out before coal mining can be made as safe as is humanly possible. The second pamphlet is on gas and flame, and attempts to make clear to the unscientifically trained mind the rationale of gas ignition and gas explosion. The authors have attempted to attain this object by photographs of a number of experiments; no doubt if the experiments could actually be seen, they would make the matter quite clear to the uninitiated, but it cannot be said that the photographs alone are equally conclusive. Upon the whole, the effort, and especially the objects underlying it, are praiseworthy; unfortunately, it may be gravely doubted whether the great body of coal miners will be sufficiently interested even to read these pamphlets.

DURING recent years there has grown up a general recognition of the value of international conferences. This is especially evident in connexion with illumination, a subject which is in a state of constant development. International co-operation has been greatly fostered by the reconstitution of the original International Photometric Commission, on a wider basis, as the International Illumination Commission, to which are linked national committees in all the chief countries of the world. Since the War, meetings held in Paris (1921), Geneva (1924), Bellagio (1927), and New York (1928) have revealed continuous progress. The conference held in the United States last year, which was attended by five hundred delegates from eleven different countries, was perhaps the most important ever held in connexion with illumination. The next International Illumination Congress will be held in Great Britain on Sept. 3–13, 1931, and will be combined with excursions to places of interest in England and Scotland. Papers dealing with varied aspects of lighting will be presented, and topics of local interest will be dealt with at each centre. The congress will be followed by the technical meetings of the International Commission on Illumination, which will be held in Cambridge on Sept. 13–19. In Great Britain the machinery for the study of illumination is perhaps more perfectly organised than elsewhere, and the aid of all the leading scientific and technical bodies interested, and of organisations concerned with gas and electric lighting, is being secured. The honorary general secretary of the Congress is Col. C. H. Silvester Evans (c/o The Illuminating Engineering Society, 32 Victoria Street, London, S.W.1), to whom all communications should be addressed.

MR. T. G. N. HALDANE read a remarkable paper to the Institution of Electrical Engineers on Dec. 19. He described a new method of producing low grade

heat from electricity by means of a device which he calls a heat pump. In 1824, Carnot imagined a perfect reversible heat engine and proved that its efficiency is the ratio of the difference of temperature between the high and low temperatures of the working substance to the high temperature when the temperatures are expressed in the absolute scale. If we imagine the Carnot engine reversed, that is, if it be supplied with mechanical energy, then a small amount of mechanical energy will allow a very much larger amount of heat to be pumped from the low source to the high source. The general principle of this process was first pointed out by Kelvin in 1852. Little practical application has been made of it hitherto, possibly because it appears at first sight to contradict ordinary engineering principles. Mr. Haldane points out that the process of producing cold is simply that of pumping heat from a relatively cold to a relatively hot source. Hence the refrigerator is the most familiar type of heat pump. It is shown both from theoretical considerations and from practical tests on refrigerating plant that where heat at a comparatively low temperature is required, an 'efficiency' of the order of from 300 to 500 per cent can be obtained. The heating efficiency is the ratio of the heat produced by the heat pump to the heat equivalent of the electrical energy expended. The principle can be applied to the heating of large buildings and very usefully to the heating of public baths. A description is given of experiments which demonstrate the soundness of the principles used. Engineering estimates are given. It appears that the heating of swimming baths is the most suitable field for the immediate application of the system.

USERS of the telephone will find a paper, on interruptions on telephone conversations, by Mr. K. W. Waterson, published in the *Bell Telephone Quarterly* (vol. 7, p. 166), both interesting and useful. Everyone has felt annoyance when a telephone conversation is suddenly interrupted by what is technically called a 'cutoff'. It is small consolation to know that this only occurs about six times in a thousand. Half of these are due to failure in human effort by the operators or to a fault in the extensive network connecting the two subscribers. The other half are in private switchboards which are outside the company's control. 'Cutoffs' on conversations from dial telephones occur less frequently than on connexions completed manually, as there is less opportunity for human error. All long-distance calls are subject to a greater risk of a cutoff. In a long distance cable connexion from New York to Chicago there are 1500 relay or movable contacts and 9000 other fixed contacts of various kinds. In addition, there are 40,000 soldered connexions in the toll line itself. Considering the complication of handling the calls on a switchboard, the operator does well to keep his mistakes down to 1 in 1500, which is less than one in a day's work.

THE errors due to the telephone subscriber generally arise when he trusts too much to his memory when calling a number, when he speaks indistinctly, or when, in the case of a dial telephone, he dials before hearing the dial tone. During the last ten years the percentage of wrong numbers asked for by the subscribers has remained practically constant. On the other hand, the wrong numbers attributable to the telephone company have diminished to half their former value. At present it is difficult to see how the causes of 'bell rang' complaints can ever be eliminated. However good the maintenance of the apparatus, it will occasionally get out of order, and however excellent the training and supervision, operators will sometimes err. It is not always convenient for a subscriber to carry on a conversation the moment he is called, and the caller is often not able to wait until he gets a reply. All efforts should be made to effect improvements in this direction.

THE lure of spectroscopic investigation as applied to industry fascinates many a chemist until he reads a treatise, studies the subject in detail, and concludes that the goal is beyond his reach owing to high cost of equipment and the need for long training in the technique. However far from or near to the truth this may be in the ordinary way, the reader will find his fears greatly reduced or even dispelled in a new publication entitled "Spectroscopic Outfits for Metallurgical Analysis" (4to., pp. 40), published by Messrs. Adam Hilger, Ltd. Equipments of various types are so clearly described with regard to both their construction and the purposes to which they are adaptable, that the reader can scarcely fail to make a wise selection and to be assured that the cost will not greatly exceed the sum estimated, since accessories are listed together with the main equipment. Part 2 opens up three new methods of quantitative spectrographic analysis; Barratt's twin spark photometric method, in which the unknown intensity of the given lines is adjusted to equality with that of known lines; Scheibe and Neuhäusser's method employing a 'rotating logarithmic wedge sector', which expresses in the length of the photographed line a function of its intensity; and Occhialini's method, also depending on measurements of the lengths of lines.

SINCE the Arctic Islands of Canada were incorporated in the North-West Territories of the Dominion, a great deal of exploration and survey work have been done annually, both in respect of routine patrols and in definitive pieces of investigation. A small chart, published by the National Resources Intelligence Branch of the Department of the Interior, shows the routes of officers carrying out patrols, inspection, and investigation during the present year, by land and by sea. Nearly the whole of the north-west passage was visited, and extensive explorations were made in the little known Foxe peninsula, the eastern side of Foxe basin, and the northern coasts of Hudson Strait. Most of the coasts of Baffin Island were visited, and in the far north patrols touched Melville Island, Bathurst Island, and Alex Heiberg Island, besides Ellesmere Island, where there is a police post. The Department keeps in active touch with all the areas inhabited by Eskimo, and has made Canadian jurisdiction much more than nominal in these arctic territories.

ON Dec. 23, according to the *Times*, a memorial to Sir Stamford Raffles was unveiled in Batavia. Born at sea, off Jamaica, in July 1781, Raffles at the age of

fourteen entered the East India house and in 1805 was sent to the Far East as assistant-secretary of Penang. Rising rapidly to more responsible positions, from 1811 until 1816 he was Lieutenant-Governor of Java, where he abolished slavery, instituted schools, and in other ways ameliorated the lot of the natives. His work, it was said, " will make his memory adored on the island of Java for ages to come ". Afterwards Governor of Bencoolen in Sumatra, in 1819 he hoisted the British flag in Singapore. He returned to England in 1824, where he founded the Zoological Society, of which he was the first president. His death occurred on July 5, 1826, and his statue was afterwards placed in the north aisle of the choir of Westminster Abbey.

IN his address at the twelfth anniversary meeting of the Bose Institute, Sir J. C. Bose said that the advance of plant physiology had been obstructed by narrow specialisation. His new type of ' growth balance ' not only visualises imperceptible growth but makes an immediate measurement of the rate. The establishment of the laws of growth, on which the advance of scientific agriculture depends, has been rendered possible by this new method. Experiments carried out side by side on plant and animal tissue have established identical life mechanism in the two kingdoms. The leg of the frog and the leaf of Mimosa produce similar motile response under nervous impulse caused by cathodic excitation of an electric current. The characteristic effects of drugs are shown in automatic pulsations of both plant and animal. Indian plants are being found having medicinal properties which were not previously suspected, and the efficacy of which in reviving the failing heart appears to be exceptionally high. Further steps necessitate the isolation of the active principles from plant extracts, as well as prolonged investigation for standardisation of dose on human subjects.

IN the November *Scientific Monthly*, Prof. M. F. Guyer describes the marine biological stations of Japan. So much good work has come out of these institutions that it is interesting to have some general account of them, and the attractive photographs inspire one with a desire to work in these laboratories. Two are described, the Marine Biological Station at Asamushi on the north-eastern coast of the main Island of Japan, and the Misaki Marine Biological Station, which lies on the southern extremity of a peninsula which separates the Bay of Tokyo from Sagami Sea. Both offer hospitality to foreign workers and both have much to offer in interesting plants and animals and ideal collecting grounds. The Asamushi Station has a staff of fourteen, with Prof. Hatai as director. There is a well-equipped laboratory and aquarium and an under-sea laboratory which is half submerged. The Misaki Station was founded by the Japanese Government in 1887 at the suggestion of Prof. Mitsukuri. It is now under the direction of Prof. Yatsu of the Tokyo Imperial University. The wonderful fauna and flora of this part of the world is well known for its richness, and regular courses are given for teachers in fisheries, planktology, and oceanography. Here also the laboratory is well equipped, and there is a library and aquarium, besides research rooms for investigators. Both of these stations are of the greatest possible value.

THE question of growing crops subsidiary to the staple products of a country is discussed in a recent issue of the *Bulletin of the Imperial Institute*, vol. 27, p. 307, with particular reference to the tropical colonies. The danger of depending solely on one crop has recently been emphasised by the occurrence of a slump in the tobacco industry in Rhodesia, Nyasaland, and elsewhere, but many factors, notably transport, need to be considered before a suitable subsidiary export crop is selected. The industry suggested is the manufacture of essential oils, of which peppermint, geranium, and lavender appear the most promising. The oil is prepared from the plants by steam distillation, the process being carried out by the grower on the spot. A full account of the different varieties, the methods of cultivation, harvesting, and preparation of the oil, is given for each plant, together with the average yields to be expected and the present market conditions. Co-operation with the Royal Botanic Gardens at Kew is being arranged, plants for trial cultivation being sent to certain areas and the resulting oil being returned to the Imperial Institute for analysis and valuation. For those desiring further information a list of useful references is appended ; the Imperial Institute is prepared to advise planters with regard to the type of still required and to put them into touch with makers of the necessary apparatus and merchants through whom the oils may be marketed. Intending planters are, however, also recommended to consult the agricultural officers of the country concerned so that they may obtain advice based on a thorough knowledge of local conditions.

THE growing appreciation of the value of trade associations for protecting the interests of their members is exemplified by the formation of the British Disinfectant Manufacturers' Association, the inaugural meeting of which was held on Dec. 16 last. About fifty firms, representative of all the branches of the disinfectant trade, have signified their intention of joining the new Association. One of the main objects of the Association is to protect and further the mutual trade interests of its members, to foster the manufacture of British disinfectants and promote closer co-operation between British disinfectant manufacturers. The Association will also serve as a medium for placing before government departments or other public bodies, at home and abroad, the views of British disinfectant manufacturers on matters affecting their industry. Mr. N. F. Kingzett, of the Sanitas Co., Ltd., was elected chairman, Mr. W. H. Hivey, of Taylor's Automatic Disinfector, Ltd., vice-chairman, and Mr. R. A. Blair, of Burt, Boulton, and Haywood, Ltd., honorary treasurer of the new Association, which will be affiliated to the Association of British Chemical Manufacturers, 166 Piccadilly, W.1. The Association has already taken steps to investigate certain questions of tests which have arisen in connexion with the standardisation of disinfectant specifications by a government committee.

WE much regret to announce the death, on Dec. 25, of Major P. A. MacMahon, F.R.S., president in 1917–19 of the Royal Astronomical Society, who was formerly Deputy Warden of Standards, Board of Trade, at the age of seventy-five years; also of Major P. H. Hepburn, president in 1920–22 of the British Astronomical Association and treasurer in 1927–28 of the Royal Astronomical Society, on Dec. 25, aged fifty-six years.

THE fourteenth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation, New York. Methods of keeping records are dealt with in this series, and as models specimens of the following are given: (1) the complete case sheets of a case of fracture, Massachusetts General Hospital, (2) the blank forms used in a sanitary survey, Peking Union Medical College, and (3) a summary of the records and record system of the Children's Hospital, Cincinnati, Ohio.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A principal of the County Technical College and School of Art, and organiser of evening school work in the Borough of Newark—The Clerk to the Governors, Education Offices, Old Magnus Buildings, Newark (Jan. 14). A principal of the County Technical Institute, Worksop—The Director of Education, Shire Hall, Nottingham (Jan. 25). A lecturer in physical and stratigraphical geology in the Egyptian University, Faculty of Science, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (Jan. 31).

Our Astronomical Column.

An Active Region on the Sun.—Although the maximum of the present cycle was reached in 1928, the sun has shown considerable activity during the past three months in the appearance of several large spots (see NATURE, Oct. 19, p. 631, Nov. 9, p. 737, Dec. 7, p. 888, Dec. 28, p. 998). During the latter part of December, another group of spots crossed the disc, covering with its attendant faculæ a great extent of the sun's surface. The group (or possibly two separate but allied groups), which consisted of a long stream extending over 18° of longitude or 130,000 miles, occupied the place of the big naked-eye spot, No. 16 of the previous rotation, which also was the return of a complex stream beginning its development on Oct. 30. Notes relating to the early history of this active region are given in the *Observatory* for December last, p. 365.

The present group was observed at Greenwich with the spectrohelioscope presented to the Royal Observatory by Dr. Hale, and it was seen to be associated with extensive bright hydrogen flocculi. Preceding the group, on Dec. 24–26 (the only days when observation was possible), there was a very long, slender, dark filament which represented a prominence of considerable size and activity. Measures taken with the velocity recorder or 'line-shifter' of the spectrohelioscope showed on Dec. 25 a difference of 95 km./sec. in radial velocity between the two ends of the filament, the southern end rising from the sun with a velocity of 25 km./sec. and the northern end falling back with a velocity of 70 km./sec. A detailed account of a similar observation of a dark filament but connected directly with a sunspot is given by Dr. Hale in NATURE of May 14, 1927, p. 711.

The following table completes the list of large sunspots seen during the year 1929.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
19	Dec. 21–Jan. 2	Dec. 27·5	16° N.	2000

Comets.—A new comet, 1929*d*, was discovered on Dec. 20 by Mr. Wilk of Cracow Observatory, who will be remembered as one of the discoverers of comet 1925XI (Peltier-Wilk). The following positions, of which the first is only approximate, have been transmitted by telegram from the I.A.U. Bureau, Copenhagen:

	U.T.	R.A. 1929·0.	N. Decl. 1929·0.	Observer.	Place.
Dec.	20d 17h 45m	18h 8m 35s	36° 19′	Wilk	Cracow
	21 17 32·1	18 20 15·67	35 23 30	Wolf	Königstuhl

The magnitude was noted as 7 on Dec. 20, 9 on Dec. 21. The deduced rate of daily motion is +11m 48s, −56′. This gives the rough position for the evening of Dec. 28, R.A. 19h 43m, N. Decl. 28° 52′, which is some 5° east of β Cygni. This is the first comet readily visible with small instruments in European latitudes for nearly two years, and the first orbit likely to prove parabolic since the bright comet 1927IX (Skjellerup).

As the comet is approaching the sun, though receding from the earth, it is likely to become somewhat brighter: the following positions were secured by Dr. W. H. Steavenson at Norwood:

			R.A. 1929·0.	N. Decl. 1929·0.
Dec. 25.	18 37·3	U.T.	19h 5m 36·64s	30° 42′ 14″
„ 26.	18 21·0	„	19 15 47·91	29 24 37

Prof. Banachiewicz, Director of Cracow Observatory, has deduced the following orbit from observations on Dec. 21, 23, 25:

T	1930 Jan. 22·257	
ω	157° 8′	1929·0
Ω	178 41	1929·0
i	124 31	1929·0
log *q*	9·82840	

EPHEMERIS FOR 18h U.T.

	R.A.	N. Decl.	log *r*.	log Δ.
Jan. 1.	20h 9m 50s	21° 1′	9·9006	9·9789
„ 5.	20 38 1	15 24	9·8783	0·0054
„ 9.	21 1 4	10 8	9·8586	0·0359
„ 13.	21 19 45	5 18	9·8430	0·0679
„ 17.	21 34 51	1 3	9·8328	0·0990

An observation by Dr. A. C. D. Crommelin on Dec. 29, not yet fully reduced, shows that the position was within 1′ or 2′ of the ephemeris place, so that the elements are probably near the truth: the comet must be looked for in the evening as soon as the sky is dark enough.

Prof. van Biesbroeck followed Forbes's Comet, 1929*c*, at Yerkes Observatory until Nov. 22: on Nov. 5 it was of mag. 15, with a diffused nucleus and a tail on the following side. On Nov. 22 the magnitude was 16·5. He is still following Stearns's Comet, 1927IV, with the 24-inch reflector. Its magnitude is 16. Carpenter's reported comet of Nov. 2 may be written off as unconfirmed.

Research Items.

The Earliest Civilisation of Egypt.—In *Antiquity* for December, Mr. Guy Brunton gives a brief account of the progress of excavation at Badari since it was initiated in 1922. He sketches in outline the civilisation of the Badarians so far as it can be reconstructed from the evidence, dating it approximately at 5000 B.C., going on to describe the differing and, it is suggested, earlier culture of the Tasians, discovered in the expeditions of the last two years. Certain points differentiate them sharply from the Badarians. The typical form of pottery is a jar having a small flat base, wide mouth, and a rather sharp angle at the bulge. The ware is greyish with black patches, and shows a vague coarse rippling which is vertical. There is sometimes a definite irregular black band around the rim. Associated with these people are beaker pots with broad flaring mouths and incised designs filled with white. Two more or less whole and many fragments come from the village sites, none so far from graves. In five places they have been found with polished celts, either of hard limestone or greyish green igneous rock. The Tasians are definitely connected with the celts by an undisturbed grave at Deir Tasa, in which was typical Tasian pottery. A poor example of the beaker was found in a Badarian grave at Qau in 1923, and may indicate an overlap of the two cultures. The Tasian culture is more primitive than the Badarian, and everything points to its being earlier. A few skulls have been found in good condition. They are rounder than the predynastic or the Badarian, and have broad faces and square jaws quite unlike the Badarian. The graves are wider and deeper than the Badarian, with a niche in the side to take the pot.

Change in an African Society.—In the *Sudan Notes and Records*, vol. 12, Part 1, Mr. G. O. Whitehead publishes a study of the social organisation of the Bari, with special reference to the changes which have taken place comparatively recently in the status of the various social groups. The Bari were formerly composed of freemen, *Lui*, and servile groups, collectively called *Dupi*. The *Dupi* proper were serfs who cooked, and were of a physique markedly distinct from their masters. They did not own cattle, but are supposed to have lost them to the freemen. Yet they had to pay cattle on marriage, these being obtained from their masters. For this the masters had a claim on their services. Probably they were racially distinct from the freemen who had conquered them when they invaded the land. Other classes were the hunters, neither owning cattle nor cultivating land. They paid tribute to their chief. Two other classes were the Artisans of the Forge and the Artisans of the River, each living in separate villages. They were not so servile as the *Dupi*. They had few or no cattle, yet married independently of their chief's assistance owing to the value of the goods they produced. The introduction of money, the increase in agriculture, and disturbance due to unrest in the Sudan have brought about a redistribution in the ownership of cattle, which no longer belong exclusively to the *Lui*, and a dislocation of the pastoral life. This has blurred the hard-and-fast lines between the classes. The *Dupi* no longer depend on the *Lui* for their marriage arrangements, while under European control the position of the chief is changed and depends upon the relation with the Government rather than his own intrinsic position. The advice of the fathers of the soil is no longer listened to as it once was.

Yellow Fever Vaccine.—Stokes, Bauer, and Hudson in 1927 made the important discovery that Asiatic monkeys, particularly *Macacus rhesus*, can be readily infected with yellow fever, and that the disease may be maintained in these animals either by direct inoculation of infected blood or tissues, or by mosquito transmission. By this means, Hindle has been able to maintain and propagate the virus in London for more than a year, and through a large series of animals (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 22, p. 405; 1929). Hindle finds that a suspension of the ground and cytolised liver and spleen taken from an animal *in extremis* will produce infection in a dilution of 1 : 10,000, but if to the suspension two parts of formaldehyde per thousand are added and the mixture is kept in the ice-chest for twenty-four hours, virulence is lost and the material may be used as a preventive vaccine. A monkey inoculated about ten days previously with this vaccine resists a dose of 1000-10,000 minimal lethal doses of active virus, and the immunity produced lasts for more than six months, the longest period so far tested.

Snakes of Ceylon.—A useful paper, by L. Nicholls, deals with the simpler recognition marks of the land snakes of Ceylon (*Ceylon Jour. Sci.*, Sect. D, vol. 2, Pt. 3, 1929, p. 91). Since every year deaths in Ceylon are attributed to non-poisonous snakes, the diagnoses have been arranged so that medical men may have at hand a ready means of determining any species and its possible harmfulness to man. In all, 61 species are described, 14 of which are earth snakes, 1 a constrictor, 42 colubrids, and 4 vipers. So far as possible, technically difficult descriptions have been avoided and identification rests for the most part on the external characters of coloration, markings, and general appearance, and simple scale characters.

Teleostean Fishes of Tortugas.—Mr. E. W. Gudger ("On the Morphology, Coloration, and Behaviour of Seventy Teleostean Fishes of Tortugas, Florida". Papers of the Tortugas Laboratory of the Carnegie Institution of Washington, vol. 26, No. 5) gives an account of his observations on various fishes. The work is specially valuable as it has to do mainly with living material, giving details of the colouring, variation, and habits both in natural surroundings and in the aquarium. Special stress is laid on the importance of the variability in colouring. The fishes also vary much in number of fin rays, scales, and relative proportions of the body. The small clupeoid *Jenkinsia stolifera* is present in schools of many thousands; often swarming round a large grey snapper, leaving a space round it and moving when it moves, only to rearrange themselves in the same way when it comes to rest. The account of the feeding habits of the grey snapper itself is interesting. *Apogonichthys puncticulatus* was found swimming inside the mouth of the shell of a large conch (*Strombus bituberculatus*), and probably lives symbiotically with this mollusk, in the same way in which *Apogonichthys strombi* lives in *Strombus gigas* as described by Plate from the Bahamas. Anatomical details of many of the fishes are given, including many notes on the internal organs besides the external features.

Gonophores of *Myriothela*.—E. A. Briggs (*Records Austr. Mus.*, vol. 18, 1929) describes the gonophores of *Myriothela australis*. All the gonophores on one individual are of the same sex; they are spherical when mature, supported on narrow cylindrical peduncles

arising from the sides of the blastostyles. The male cells are derived from cells on the floor of the subumbrellar cavity, and the first stage in spermatogenesis begins in the mass of cells covering the spadix. The secondary spermatocytes derived therefrom fill the subumbrellar cavity. At the distal pole of the gonophore, the ectoderm becomes invaginated to form the velar aperture, which breaks through into the subumbrellar cavity, and permits the escape of the sperms. In the female gonophore the cells of the germinal mass are arranged in several layers, the outer of which forms the external epithelium of the future spadix, and the others are the reproductive cells and form the oogonia. These multiply and finally fill the space between the manubrium and the subumbrellar epithelium. The oogonia give rise to primary oocytes, and here and there two of these come into contact and their cytoplasm fuses. The fusion products increase by accretion of other similar ones or of primary oocytes. The end result is that in the gonophore are five or six plasmodial masses separated by non-cellular partitions. The large definitive egg is produced by the withdrawal of these partitions and the fusion of the plasmodia, and becomes charged with yolk. At the distal pole of the gonophore is the velar aperture through which probably the sperm enters.

Cardita beaumonti Beds of Sind.—The *Cardita* [or *Venericardia*] *beaumonti* beds as they occur in Baluchistan were treated of by M. Henri Douvillé in a previous paper (see NATURE, Oct. 6, 1928, p. 552), and he now deals with them as developed in Sind (*Pal. Ind.*, New Series, vol. 10, mem. 3, fasc. 2). The fauna of these beds in Sind is definitely marine, as evinced by the abundance of Nautili and Fusidæ, whereas in Baluchistan more brackish water forms, and particularly Melaniidæ, prevail. Stratigraphical evidence shows that in Baluchistan the beds represent the lower Danian, whilst in Sind they are at the top and underlie the basaltic trap of the Lakhi hills. Many of the Sind species differ solely in specific characters from Eocene forms. Just fifty species of mollusca are described, half of which are held to be new and illustrated on eleven photolitho plates, which, considering the nature of the objects depicted, are remarkably good.

Petrographic Nomenclature.—In the *Travaux du Musée Minéralogique près l'Académie des Sciences de l'U.R.S.S.*, vol. 3, 1929, Dr. Beliankin gives an interesting discussion (in English) of the meaning of the term 'rock'. He arrives at the definition: "Rock is a mineral body, homogeneous in matter and structure", where 'mineral body' includes aggregates of one or more minerals, mineral mixtures or glasses. From this it is deduced that the classification and nomenclature of rocks should be primarily mineralogical. Beliankin points out that geographical names are not suitable, and that "a text-book of petrography turns out to be a certain kind of universal manual of geography". As a concrete suggestion for a practicable alternative, he proposes to name rocks from the first syllables of the names of their dominant minerals. For felspathoidal rocks he thus arrives at the following names, based on the abbreviations italicised in *œgi*rine; *py*roxene; *di*opside; *ti*tan-*py*roxene; *am*phibole; *bar*kevikite; *bio*tite; *ne*pheline; *sod*alite; *nos*ean; *an*alcite; *mel*ilite:

Geographical Names.	*Rational Names.*
Urtite	Leuco-ægineite
Ijolite	Ægineite
Melteigite	Melano-ægineite
Monmouthite	Amnite
Congressite	Bineite
Tawite	Ægisodite
Naujaite	Anam-ægisodite
Bekinkinite	Barneite
Fasinite	Tipyneite
Riedenite	Pynosite
Turjaite	Binemelite
Uncompahgrite	Dimelite.

The suggestion is an excellent one; it deserves serious discussion at the next International Congress of Geology.

Wave-Mechanics of α-Ray Tracks.—In a note in the December number of the *Proceedings of the Royal Society*, Mr. N. F. Mott discusses the apparent contradiction between the wave-mechanical theory of radioactive disintegration, according to which an α-particle leaks out from its parent nucleus as a spherical wave, and its particle-like attribute of leaving an almost linear trail in a Wilson cloud chamber. The discrepancy is, of course, only apparent. The wave of the α-particle must not be considered by itself, but as contributing to a wave-function in a space of many dimensions formed by the co-ordinates both of the α-particle and of every atom in the expansion chamber. Mr. Mott develops the appropriate theory for the case when there are two atoms of hydrogen present, and finds that both must lie within a cone of small angle having its apex at the radioactive nucleus, if they are both to be ionised. In other words, the α-particle should, apart from collisions with atomic nuclei, leave an almost straight trail. Mr. Mott's paper is an elaboration of one of the points raised by Prof. C. G. Darwin in his paper on collision problems in wave mechanics in the June issue of the *Proceedings*.

Measurement of Refractive Indices.—A rapid method for investigating the dispersion of liquids is described by Prof. T. M. Lowry and Mr. C. B. Allsopp in the December number of the *Proceedings of the Royal Society*. A small quantity of the substance is enclosed in a quartz etalon, and the interference fringes formed in the film in parallel light are focused on to the slit of a spectrometer, when the variation in fringe-width in passing along the spectrum—photographed in the usual way—leads readily to a knowledge of the dispersion in the liquid. The accuracy obtainable is not so high as in some methods, being largely limited by the number of fringes which can be thrown on to the slit, but the device of working with thin films in quartz makes it possible to follow the dispersion curve of even poorly transmitting substances well into the ultra-violet, and the information so obtained is very complete. A curve for nicotene, which was obtained without very elaborate precautions in the control of temperature, is reproduced in the paper, and extends to 2900 A.: hollow prism methods could only be used down to about 4300 A., below which it was impracticable to proceed, because of absorption in the liquid.

Photoelasticity.—In the first part of volume 12 of the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, Mr. Z. Tuzi describes a new method of studying the elastic stresses in structures by means of the kinematograph. A model in phenolite is placed between crossed nicol prisms through which monochromatic green light is sent. The light and dark bands produced by the stressed specimen are photographed either in the usual way with a steady load or on a kinematograph film during the application of the load. Photographs of the bands produced when the steel side of a railway carriage with its doors and windows is loaded at nine points on its top edge, are reproduced for a steady load and

for its gradual application, and are remarkably clear. The stresses are calculated from the photographs and are compared with the values calculated by the approximate methods used in designing the carriage. The agreement is not satisfactory, and the author gives more accurate methods of calculation which agree better with the experimental results.

Shearing and Punching Metals.—More than 110 pages of the *Bulletin* of the Société d'Encouragement pour l'Industrie Nationale for July-August-September are devoted to M. Charles Fremont's account of his researches on the shearing and punching of metals, which have been carried out with the support of the Society. He has investigated the influence of the form of the shears or punch on the work which has to be done in the shearing or punching process, and by means of photomicrographs determined the distortion the material undergoes. The 268 figures add greatly to the interest of the memoir.

Precipitated Selenium Dioxide.—In the November issue of the *Journal of the Americal Chemical Society*, Hoffmann and Lenher show that the precipitate formed by the action of ozonised oxygen on a solution of selenium in selenium oxychloride is selenium dioxide. The density of the precipitated dioxide is appreciably lower than that of the sublimed substance, although the molecular weights of the two were found to be identical. The precipitated dioxide absorbs dry hydrogen chloride to form a fuming, straw-coloured liquid similar in composition and density to selenium hydroxychloride. No evidence of the existence of selenium trioxide or chloroselenic acid was found.

Union of Hydrogen and Chlorine.—When a mixture of equal volumes of hydrogen and chlorine is exposed to white light of constant intensity, combination occurs more slowly in narrow capillary tubes than in wider. D. L. Chapman and Grigg, who discovered this effect, explained it by assuming that the combination is due to an unstable catalyst which is destroyed in contact with glass or a film of water. In the November number of the *Journal of the Chemical Society*, they describe further experiments which show that the mean life of the catalyst is of the order of magnitude of the time taken by the catalyst molecules to reach the surface, although there are some points in which the theory proposed is not closely followed. The mean life always increases with decreasing pressure, which seems to show that one or both of the reacting gases have an inhibitive effect, a conclusion which is supported by an observation of M. C. C. Chapman that hydrogen can act as a weak inhibitor. The results are consistent with those of Weigert and Kellermann, published in 1923, these authors being the first to attempt to estimate the life of the catalyst which is formed when the gas is exposed to light. The experiments give no indication as to whether this catalyst is a chain of alternately formed chlorine and hydrogen atoms, as postulated by Nernst and Bodenstein, or unstable nuclei of unknown structure.

Glycogen.—Glycogen is a peculiar material very similar to starch which is found in the livers of mammalia. It is coloured wine-red by iodine. In the November number of the *Journal of the Chemical Society*, Haworth, Hirst, and Webb describe some preliminary experiments with glycogen which indicate that the hypothesis supported by Karrer, that starch and glycogen are similarly constituted, both structurally and configurationally, is correct. The difference in the colour reaction with iodine may be distinctive, but it is possible to prepare a starch fraction which gives the same colour as glycogen. In accordance with modern views, glycogen is assumed to be constituted on the basis of continuous maltose units, that is, of a conjugated chain of α-glucose units. The difference in properties of the two substances is supposed to be due to a difference in size of their respective micelles. The experiments involved acetylation of glycogen with acetic anhydride, in presence of either chlorine or sulphur chloride as catalysts or of pyridine, when the triacetate was obtained in almost quantitative yield as a white powder. Although this was denser than starch triacetate, the two products showed nearly the same optical rotation in chloroform solution. Deacetylation gave a regenerated glycogen having all the characteristic properties of the original polysaccharide. Similar results were obtained by methylation following simultaneous deacetylation of the two triacetates.

Experimental Cold-rolling Mill.—The invention of rolls for metal working dates back at least so far as the twelfth century, probably being used then for producing gold strip. Leonardo da Vinci was the first to suggest their use for heavier work, but the rolling of iron did not come in until the eighteenth century. The Swedish man of science and engineer Triewald had a rolling mill with 10-inch rolls, but it was in England that the mill was fully developed and rolling both hot and cold is widespread. To further the study of the cold-rolling of steel and other metals, a cold-rolling mill has been placed in a new laboratory attached to the metallurgical and engineering departments of the University of Sheffield, see NATURE, July 13, p. 66). The machine, constructed by Messrs. W. H. A. Robertson and Co., Ltd., of Bedford, is described in *Engineering* for Dec. 6. The rolls, of Hadura alloy steel, made and presented by Messrs. Hadfields, Ltd., are 10 in. diameter by 10 in. face and are suitable for the cold-rolling of strip up to 6 or 7 inches wide. Special attention has been given to the cooling of the rolls and the lubrication of the bearings, and the rolls are driven by an electric motor of 50-120 h.p., giving a speed of anything from 59·3 ft. to 300 ft. per minute. A good deal of the work done will naturally be in the direction of metallurgical research, but it is hoped that opportunity will be taken to obtain reliable data on the effect of rolling speed on power consumption, accuracy, etc., matters of the greatest value to the industry.

Fuel Tests.—Canada's resources in fuel are abundant, but the distribution is unfortunate. Ontario and Quebec rely largely on anthracite from the United States. This dependence has been inconvenient in recent years owing to recurrent shortages, and many substitutes have been tried. In order to determine the relative value of these, the Dominion Department of Mines has instituted a series of "Comparative tests of various fuels when burned in a domestic hot water boiler", reported by E. S. Malloch and C. E. Baltzer (*Report* No. 705. Ottawa: F. A. Acland, 1929, 20 cents). These tests were carried out with great elaboration and on thirty fuels of the most varied type, ranging from anthracite to peat, consumed in a typical domestic appliance and for house-heating. The most efficient fuel tested was Welsh anthracite, 8·4 tons of which was equal to 10 tons of American anthracite, taken as standard. Scotch semi-anthracite was nearly as good. The tests showed that more than 70 per cent of the heat of anthracites and cokes could be transferred to the water. With semi-bituminous coals 65 per cent, and with low-grade fuel less than 55 per cent, of the heating value of the fuel could be utilised. The results should be very encouraging to those interested in the export of British coals.

Nickel Steel in the *Golden Arrow*.

THE publications of the Bureau of Information on Nickel of the Mond Nickel Co., Ltd., have from time to time provided most valuable information on many different aspects of the use of nickel in all types of metallurgical and engineering activity. Paper A, No. 4, recently issued, deals with the use of nickel steel in the *Golden Arrow*, in which Sir Henry Seagrave attained an average speed in two runs in opposite directions of 231·36 miles per hour.

The whole of the main and sub-frames of the *Golden Arrow* were made of a nickel steel containing 3·5 per cent of nickel and 0·3 per cent of carbon, and it is of interest to note that the side members, which were 19 ft. 6 in. long, were pressed in one length. The very extensive use of this steel, which incidentally was largely used in the brake equipment, indicates its dependability and the wide range of properties obtainable from it with different heat treatments. In the normalised condition it will give a tensile strength of 35 tons per square inch, together with 25 per cent elongation. A 1½ in. diameter bar oil-hardened from 840° C. and tempered at 550° C. gave a yield point of 42 tons per square inch, a maximum stress of 55 tons per square inch, an elongation of 25 per cent, a reduction of area of 61 per cent, and an impact figure of 56 ft.-lb.

For the main parts of the axles, where a particularly strong material was needed, a nickel-chrome-molybdenum steel of the following composition was chosen: Carbon 0·3 per cent, manganese 0·4 per cent, nickel 3·5 per cent, chromium 0·65 per cent, molybdenum 0·2 per cent. This material, which was also used for the gears, gives in the heat-treated condition a yield point of 56 tons per square inch, a maximum stress of 63 tons per square inch, 20 per cent elongation, 60 per cent reduction of area, and an Izod value of 67 ft.-lb. This steel gives exceptional uniform properties throughout its cross-section when properly heat-treated, which, no doubt, influenced the designer in his selection.

A 5 per cent nickel case-hardening steel containing about 0·1 per cent of carbon was extensively used for parts subject to considerable wear, such, for example, as the swivel-pins. Refined at 830° C. and quenched from 760° C., the approximate tensile figures given are: Maximum stress 55 tons per square inch, elongation 15 per cent, reduction of area 40 per cent, with an impact value of 20 ft.-lb. For several parts of the steering mechanism where the stresses involved may be exceptionally high, a nickel-chrome-molybdenum steel of the following composition was chosen: Carbon 0·25 per cent, manganese 0·5 per cent, nickel 3 per cent, chromium 1·2 per cent, molybdenum 0·2 per cent. In the quenched and tempered condition, the mechanical properties obtained from this steel are: Yield point 62·5 tons per square inch, maximum stress 69 tons per square inch, elongation 19·5 per cent, reduction of area 61·5 per cent, impact value 54 ft.-lb.

For the clutch casing, cover plates, and certain small levers, a nickel-chrome steel was specified containing 0·3 per cent of carbon, 3·5 per cent of nickel, and 0·6 per cent of chromium. When hardened in oil from 830° C. and tempered at 600° C. the material gave: Yield point 49 tons per square inch, maximum stress 58 tons per square inch, elongation 22 per cent, reduction of area 55 per cent. For the clutch centre, withdrawal sleeve, and several other details, a high tensile case-hardening steel containing 3·5 per cent of nickel and 1 per cent of chromium was employed. After carburising, the steel was given two quenching treatments, one from 830° C. and one from 770° C., and afterwards tempered at 200° to obtain a maximum toughness. The properties of this material in the form of a 1⅛ in. diameter bar were: Yield point 55 tons per square inch, maximum stress 69 tons per square inch, elongation 15 per cent, reduction of area 45 per cent, and impact value 28 ft.-lb.

It will be appreciated that, apart from the use of nickel steels, the construction of this machine would have been impossible.

Investigations in Greenkeeping Problems.

THE St. Ives Research Station, Bingley, Yorkshire, which has been established by the British Golf Unions for the purpose of studying greenkeeping problems from the scientific aspect, has issued the first number of the *Journal* of the Board of Greenkeeping Research. The development and organisation of the scheme are explained in a foreword, and an interesting account is given by the Director, Mr. R. B. Dawson, of the surroundings and historical associations of the St. Ives estate. A general discussion follows of the kind of problems confronting the greenkeeper and the line of attack to be undertaken in their solution. The station has an ambitious programme, and useful work has already been accomplished.

It is realised that the present condition of a turf is largely due to its previous treatment, and that much valuable knowledge may be obtained by collecting and classifying existing information. All those interested are invited to contribute their experiences for this purpose. An advisory system is already active and a special feature of the *Journal* will be the publication of inquiries dealing with problems of general interest, together with their respective replies. Excellent examples of such correspondence are given in the first number.

The choice of site for the research station has been fortunate. There is a wide range of soils within the relatively small confines of the estate, and further, a difference in elevation from 300 ft. to 900 ft. is available. More than three acres of adjoining land have been acquired and some 400 plots are to be set up to determine the best conditions, both manurial and cultural, for the production of first-class putting greens, for comparative tests with selected seed mixtures, and for vegetative propagation trials of other grasses, notably *Agrostis canina*, which produces stolons. The use of stolon-forming grasses for lawns in India is the subject of a further article of interest.

Greenkeeping problems have changed considerably in recent years, owing largely to such alterations in practice as the use of compost in place of the heavy roller, and by the introduction of mowers of improved design and numerous chemical fertilisers. Hitherto, agricultural methods have usually been employed, and too often the supposition that what is suitable for pasture is equally good for the golf green has proved a fallacy. A special type of turf is required for greens, free from coarse grasses, weeds, and worm casts. For this purpose the effect of various fertiliser treatments will be determined and a thorough, unbiased investigation of the so-called acid theory, which maintains that the type of turf required is obtained under acid soil conditions, will also be undertaken. Consideration will be given to climatic, physiographic, edaphic, and biotic factors.

For the success of the work it is essential that the various golf clubs themselves should give their hearty co-operation and such financial support as they are able. Later, it is hoped to increase the scope of the work and to extend the investigations to the problems of turf culture peculiar to other sports.

Canadian National Research Laboratories.

TENDERS have been invited by the Government of Canada for the construction of a National Research Laboratories building that will cost, when finished, approximately three million dollars (Fig. 1). Appointment of chiefs to two of the laboratory divisions has been announced.

Dr. H. M. Tory, formerly president of the University of Alberta and now the president of the National Research Council, has expressed the view publicly that the new home for research in Canada will be one of the finest to be found in any country. It is being built on the banks of the Ottawa River in the capital city. Designed in the form of a giant figure ' 8 ', it will stand 60 feet (four stories) high, 418 feet long, and 176 feet deep. Two hundred and fifty thousand feet of floor space will be provided. Library accommodation will be for 300,000 volumes. An assembly hall and associated rooms will be capable of accommodating the staff and the various scientific societies of the Dominion.

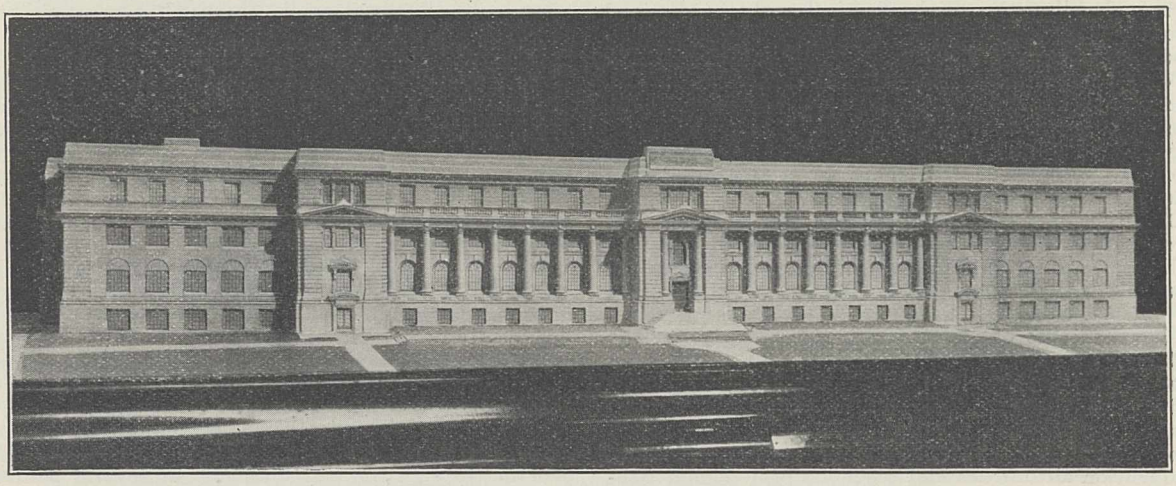


FIG. 1.—Architect's model of the National Research Laboratories building to be constructed by the Government of Canada in the capital city of Ottawa.

Plans call for the development of the following divisions: the divisions of physics and engineering physics, to the head of which Dr. Robert William Boyle, dean of the faculty of applied science at the University of Alberta, has already been appointed; the division of industrial chemistry, to the head of which Dr. George Stafford Whitby, professor of organic chemistry at McGill University, has been appointed; the division of economic biology and agriculture, to which Dr. Robert Newton, professor of field crops and plant bio-chemistry at the University of Alberta, is the acting head; the division of industrial engineering, the division of textiles, the division of standards, and such other divisions as improvement in industrial processes, the development of natural resources, and the utilisation of waste require.

Dr. Boyle was graduated from McGill University in 1906, and from then until 1909, when he received the Ph.D. degree and the 1851 scholarship, he did research on the properties of matter and radioactivity. From 1909 until 1911 he continued his work under the direction of Sir Ernest Rutherford at the University of Manchester. Returning to Canada, he lectured at McGill, was appointed assistant professor in 1912, and the same year was made professor in the University of Alberta. During the War years, on the recommendation of Sir Ernest Rutherford, Dr. Boyle was engaged in research for the Admiralty Board of Invention and the anti-submarine division; and in that work he developed important applications of ultra-sonics. In 1924 he tested apparatus for the detecting of icebergs and the sounding of depths in the Belle Isle Straits.

Dr. Whitby studied chemistry under Sir William Tilden at the Imperial College of Science and Technology, London, graduating in 1906 with the Frank Hatton prize. He was one of the first scientific workers to study the rubber industry, and one of his books thereon, " Plantation Rubber and the Testing of Rubber ", 1920, has markedly influenced the trend of rubber research. In recognition of his contribution in that field, the Institution of the Rubber Industry (Great Britain) recently awarded him the Colwyn gold medal. In 1928 the distinction of Officier d'Académie was conferred upon him by the Government of France. The same year he was president of the Canadian Chemical Association.

As assistant director of the division of physics and engineering physics, Prof. John Hamilton Parkin, associate professor of mechanical engineering at the University of Toronto, has been appointed to direct the development of national aeronautical research laboratories.

Plans for the new National Laboratories building call for completion early in 1931. Meanwhile, temporary laboratory space has been provided.

University and Educational Intelligence.

EDINBURGH.—Dr. Alexander Nelson, formerly superintendent of research in the Department of Agriculture in Tasmania, has been appointed lecturer in the Department of Botany, and Dr. W. H. McCrea, formerly senior scholar of Trinity College and Isaac Newton fellow in the University of Cambridge, has been appointed lecturer in the Department of Mathematics.

MANCHESTER.—Prof. H. J. Fleure, professor of geography and anthropology in the University College of Wales, Aberystwyth, has been appointed professor of geography.

THE Carnegie Foundation for the Advancement of Teaching published in its last annual report an account of an educational inquiry differing from those which

it has hitherto undertaken or promoted, in that it involves tracing the progress of individual students throughout their careers in secondary schools and in college. Previous studies have presented in cross section pictures of a situation at a selected time without regard to what went before or followed in the experience of the individual student. The investigations, which will necessarily be prolonged through a period of ten years, will embrace the work done in most of the secondary schools and fifty colleges in Pennsylvania, and will, it is hoped, throw light on the validity of currently used methods of classification of pupils according to abilities and interests, on the degree of consistency to be looked for in normal educational growth, and on the actual efficiency of secondary and higher institutions in the organisation and administration of courses of study, the evaluation of educational products, and the rewarding of student effort. In tracing the progress of individual students through college, material will, it is thought, be obtained for dealing with difficulties resulting from the kaleidoscopic nature of the elective curriculum and the bewildering variety of personal contact and advice, much of it of a partisan character, to which the college entrant is exposed. Much might be done, it is suggested, in "initiating vigorous, wholly avowed and official measures to *understand* the student, and thus to discharge primary obligations of the college". Other matters of general interest in the report are reviews of the rise and present position of endowed foundations in the United States, of professional salaries, and of pension systems.

THE League of Nations sets a high value on the dissemination among the children and youth of a knowledge of its aims and achievements. The question how this may best be accomplished has been investigated during the past eighteen months by a joint committee representative of English and Welsh education authorities and teachers' professional associations, and the conclusions arrived at as a result of its labours are now published in a pamphlet entitled "Education and the League of Nations". The committee's investigations embraced work done in elementary and secondary schools and in training colleges and university training departments. It is in the elementary schools that progress has been most marked. In secondary schools there is a disposition to look askance at instruction in the principles and activities of the League as 'propaganda', and to mark time pending adaptation of examination syllabuses by the various school examination authorities to the League's educational policy. The teacher training institutions do not seem to have made hitherto an adequate response to Lord Eustace Percy's appeal to the conference of local education authorities in June 1927, when he pointed out that it is above all the students at these institutions for whom opportunities must be provided for acquiring a sound knowledge and a balanced view of the origin and work of the League. In its recommendations the joint committee has shown how this ideal may be translated into practice. It deals also with such matters as school celebrations, visits to Geneva, interchange of correspondence, school journeys, and the interchange of schoolboys and girls. If the minds of the rising generation are to develop the attitude postulated by the Kellogg Pact, it is essential that measures such as those recommended should be adopted, and not only in Great Britain but also among other, including less peace-loving, peoples. Copies of the pamphlet can be obtained (price 3*d*. each) from the office of the League of Nations Union, 15 Grosvenor Crescent, London, S.W.1.

Historic Natural Events.

Jan. 1, 1926. Rhine Floods.—The river began to rise rapidly on Dec. 27, and by Jan. 1 stood 32 feet above normal low water at Cologne, the highest level of the Rhine on record. Three-quarters of the town was under water, which stood 13 feet above the river banks. Great damage was done by the Rhine, Scheldt, and Maas in Holland; dykes burst, and wide areas of low ground were flooded. The floods were caused by heavy rain on the hills coinciding with high winter temperature and the melting of the snows.

Jan. 6–7, 1889. Rime.—After two days of frost and dense fog in Norfolk, the wind changed to south-west, and an unusually thick deposit of ice-needles, up to two inches in length, was formed on the windward sides of exposed objects. Many isolated deciduous trees, especially birch, oak, elm, and poplar, were badly damaged, while nearly all overhead telephone and telegraph wires were broken down.

Jan. 6–7, 1839. Great Storm.—On the night of Jan. 6–7, western and northern Ireland, northern England, and southern Scotland were visited by an exceedingly violent gale from the south-west, probably the worst since that of 1703. Many thousands of trees were uprooted in Ireland, houses were unroofed, chimney stacks and walls blown down. Many vessels were wrecked and there was great loss of life. Menai Suspension Bridge was damaged.

Jan. 6–7, 1928. Thames Flood.—The predicted height of the high tide at London Bridge on the early morning of Jan. 7, that is, the height to which the water would rise if the meteorological conditions were normal, was 21 feet above Admiralty datum. This is not especially high, for the predicted height sometimes reaches 25 feet. The water actually rose nearly six feet above the predicted height, making the highest known level of the Thames in London, and flowed over or through the embankments at several points in the City, Southwark, Westminster, and westward to Hammersmith. The low-lying riverside districts are below the level of spring tides, and were deeply flooded, while fourteen people, most of whom were sleeping in basements, were drowned.

The abnormal rise was due to a 'storm surge' in the southern North Sea. On Jan. 6 a deep barometric depression travelled rapidly across Scotland in an east-south-east direction, and in its rear a gale blew from north-west and north over the North Sea during the evening, driving a storm wave southwards. At 3 P.M. on Jan. 6 the level was 1·6 feet above the normal tide at Dunbar. Travelling along the east coast the wave grew in height and reached Southend at 11 P.M., raising the level 5 feet. Opposite the Thames estuary it divided into three parts; only a small part passed through the narrow Straits of Dover, raising the level about 3 feet, another part travelled north-eastwards along the coast of Holland, and the remainder entered the Thames estuary, reaching London at 1 A.M. on Jan. 7. An auxiliary factor in the London flood may have been the high level of the Thames itself, due to heavy rain and melting snow. On Jan. 7 the flow at Teddington Weir was 9500 million gallons a day, more than double the flow when the river is 'bank high'. This river water would, however, be rapidly distributed in the widening estuary, and probably did not contribute more than a few inches to the height of the tide at London Bridge.

Jan. 7, 1558. 'Calais' Storm.—It is recorded by Holinshed that at the taking of Calais "began a marvellous sore and rigorous tempest, continuing the space of four or five days together". A severe thunderstorm beat down houses and churches.

Jan. 7, 1831. Luminosity.—Owing to the presence of a kind of luminous mist, print could be read at midnight in Italy and Germany. The abnormally light nights continued for a considerable period.

Jan. 8, 1924. Cyclonic Wave.—A small but deep barometric depression passed from Ireland across France. It was accompanied by a cyclonic wave which struck the coast of Brittany, causing the sea to rise 3 feet above the level of the highest spring tides, and inundating the coast.

Jan. 9, 1857. Californian Earthquake.—An earthquake, preceded by strong shocks, was felt in southern California, from Sacramento to Fort Yuma, a distance of nearly 600 miles. It was most severe at Fort Tejon, in the neighbourhood of which a fissure 40 miles long was formed. A remarkable feature of the earthquake was its effect on the rivers of the district. The water of the Mokelumne River was thrown on its banks so as to leave the bed bare in one place, while the stream of the Kern River was reversed.

Jan. 9, 1896. High Pressure over Scotland.—During the second week of January, an anticyclone moved westward from the continent of Europe over the British Isles, where it combined with another anticyclone lying off our north-west coasts, and increased suddenly in intensity. At 8 A.M. on Jan. 9 the barometer exceeded 31 inches (1050 millibars) over the whole of Scotland, the first appearance of that isobar on our weather charts. The highest reading, corrected for gravity, was 31·139 inches (1054·5 mb.) at 9 A.M. at Ochtertyre, Perthshire. After Jan. 9 the whole system moved away south-westwards, and on Jan. 10 the highest reading was just below 31 inches. A remarkable return of high pressure occurred at the end of the month, when the corrected barometer rose to 30·975 inches (1048·9 mb.) at Valentia, Ireland. A peculiarity of both anticyclones was the mild weather associated with them. In the British Isles high pressure in winter is generally associated with frost and fog, but on both occasions in January 1896 temperature was almost everywhere above the freezing-point.

Jan. 10, 1608. Severe Winter.—The winter of 1607–8 was probably the most severe on record in western Europe, and was long remembered as "the great winter". In England the cold continued from Dec. 5 to Feb. 14, but on the continent of Europe it continued until the middle of March. On Jan. 10, in a church in Paris, the wine froze in the chalice. All the great rivers of western Europe were frozen, fires were lit on the Thames, and the Zuider Zee was crossed from Harlingen to Amsterdam. Many human beings, cattle, and young trees were killed. The break-up of the ice was followed by great floods.

Jan. 10–15, 1820. Great Cold.—A short period of very intense cold occurred from England to Italy. Arago remarks that on Jan. 10 a great number of mulberry trees split along their whole length, mostly trees from ten to thirty years old. The openings remained until the end of the frost, after which they healed up and the trees survived. An observer at Tunbridge Wells recorded that on Jan. 15 the thermometer fell to −10° F., "the lowest by fourteen degrees that I ever remember it". The details of this thermometer and its exposure are not known, so that this reading cannot be compared with modern 'records'.

Jan. 11, 1900. Haloes and Mock Suns.—Brilliant optical phenomena were visible over the greater part of south-east England during the morning. The common halo of 22° and the rarer halo of 46° were both visible and brilliantly coloured. Above both haloes were arcs of contact, and a mock sun appeared to the right of the true sun on the 22° halo. Some observers also saw a second mock sun to the left of the true sun.

Societies and Academies.

LONDON.

Geological Society, Dec. 18.—**Frederick Walker**: The geology of the Shiant Isles. The Shiant Isles form a small uninhabited archipelago in the North Minch, some five miles east of the Park district of Lewis. The group is made up almost entirely of crinanite sills separated by relatively thin argillaceous strata which have undergone considerable contact-alteration, but the fossil content of which (ammonites, belemnites, and one species of *Inoceramus*) assigns them to a low position in the Upper Lias. The two largest islands are each over a mile in length, and are joined by a shingle beach. A third large island lies about a mile to the east, and is also to a great extent made up of a single thick sill of crinanite. East of this island, however, the crinanite passes gradually into syenite, towards the centre of the sill, the thickness of the alkaline rock being at least 60 feet. The age of the igneous activity is almost certainly Tertiary, and is probably the same as that of the Trotternish sills in Skye. Although glacial striæ are not seen on the islands, their general aspect indicates a flow of ice from south to north during the Glacial Period.

DUBLIN.

Royal Irish Academy, Dec. 9.—**Gertrude Connolly**: The vegetation of southern Connemara. The paper dealt with the vegetation of a large area lying west of Galway between the sea and the mountains—a vast tract of almost unbroken bog. This area had not previously been examined botanically save along its margins. Rainfall and humidity are very high, and in consequence the bogland is perennially extremely wet and difficult to explore. The vegetation proved to be limited in number of species, and alternated mainly between those of drier and wetter bog.

LEEDS.

Philosophical and Literary Society, Dec. 10.—**G. W. Brindley**: (1) On the dielectric constants of helium and argon. The dielectric constants of these gases are calculated from the charge distributions obtained by Hartree, using an expression due to Pauling and others for the dielectric constant of an electron in a central field of charge Z^1e, Z^1 being chosen so that r^4 is the same for the hydrogen-like distribution as for the Hartree charge distribution. The calculated value of $(K-1)$ for helium agrees well with the experimental value, but the calculated value for argon is not good.—(2) Note on the accuracy of constants in an optical dispersion formula. The accuracy is considerably less than the accuracy of the experimental values of the refractive index. In the case of methane, if $(\mu-1)$ is assumed accurate to 1 part in 50,000, the constants in the formula $(\mu-1)=C/(p^2-n^2)$ can only be accurate to about 1 per cent, owing to the form of the dispersion curve and the limited range of experimental data.—(3) Note on distribution of charge with carbon atom (2). A continuation of a previous paper, pointing out that some new experimental measurements of the X-ray scattering factor F are in good agreement with the theoretical value given in Part 1.—**R. Whiddington**: Note on the electron gun. Experiments are described in which the electron beam from a gun is used in a cathode ray oscillograph and is found to possess a velocity much less than that calculated from the applied potential. A curious shortening of the beam under certain conditions was also observed.—**J. E. Roberts and R. Whiddington**: Note on inelastic electron

collisions in oxygen at low pressures. Experiments are described in which electrons of about 100 volts velocity traverse oxygen gas at low pressure. Quantum losses are observed and certain interpretations suggested.—**A. E. Battye** and **H. M. Dawson**: The nature of the reaction between phorone and iodine and the influence of the acidity of the aqueous medium on the reaction velocity. The rate at which iodine disappears from the reaction mixture is determined by the velocity of the keto → enol transformation of the phorone. The variation of the speed of the reaction in buffer solutions ranging from *p*H 3 to *p*H 9 shows that the major catalytic effects are due to the joint action of the hydrogen and hydroxyl ions. The graph of the velocity against *p*H gives a catenary curve.—**J. Grainger**: (1) The appearance of bean mozaic in England. A short descriptive note on an infection in dwarf kidney beans at Weetwood, Leeds. The symptoms of the malady are identical with those of bean mozaic described in America by Reddish and Stewart, Fajardo and others.—(2) An attempt to cultivate the virus of tobacco mozaic *in vitro*. Two experiments on the cultivation of the virus of tobacco mozaic *in vitro* are described. One followed the method of Olitsky, and in the other a chloroplast suspension was employed. Neither showed an increase in virus concentration during cultivation.—**W. H. Pearsall** and **Alice Wright**: The proportions of soluble and insoluble nitrogenous materials in fresh and dried plant tissues. An examination has been made of the effect of drying leaves by the method of Link and Tottingham, upon the distribution of protein and non-protein nitrogen. The amount of non-protein nitrogen extracted by 60 per cent alcohol is only slightly increased (1·5-2·0 per cent of total) by this method of drying. The variations in the ratio of protein nitrogen to soluble nitrogen in dried leaves follow those in fresh leaves, but are proportionately lower. In leaves having a higher water content there is no increase in the relative amount of hydrolysis on drying.—**T. M. Naylor** and **A. G. Abel**: An analysis of the link gear of an old beam engine. A short illustrated description of the link gear of an old beam engine constructed by Boulton and Watt in 1792 and dismantled in 1888.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 18).—**N. N. Nasonov**: Contribution to the freshwater fauna of *Turbellaria rhabdocœlida* of Japan. Fourteen species have been found on the island Chondo, several of them new to science. One of the latter, *Macrostomum saifunicum*, is very near to the American *M. sensitivum*.—**K. K. Flerov**: Some new data on *Capreolus* of eastern Asia. Supplementary distributional data are given (see author's paper in *C.R.*, p. 479, 1928), and descriptions of young animals of all species are presented.—**M. Galadzhiev** and **E. Malm**: The influence of some physico-chemical factors on marine water Protozoa. Studies on the influence of oxygen, hydrogen, and carbon dioxide in the water on marine Protozoa indicate that the effects may be very different even when the *p*H value is the same. The main physiological factor proved to be the carbonic acid, towards which there is a specific reaction; for example, the Protozoa of the family *Tintinnoidea* are killed within 40 seconds in sea water saturated with carbon dioxide, while *Metopus signoides* can survive up to 9 days.—**A. B. Verigo**: An apparatus for the determination of the electrostatic capacity of electroscopes. An apparatus is described which can be fitted on to the lid of an electroscope and permits of determining its capacity within 1-2 per cent.—**A. B. Verigo**: A rotary apparatus for increasing electric tension. The apparatus described increases the tension up to five times.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation.—**G. Abetti** and **B. Nováková**: Structure of the line $H\alpha$ and period of rotation of the solar chromosphere. A note on the dissymmetry of the line $H\alpha$ at the sun's border, as determined by spectrograms obtained at Arcetri, was published in 1926. A large number of measurements made in 1927 and 1928 give the result $H\alpha_3 - H\alpha_2 = -0{\cdot}059 \pm 0{\cdot}002$A., the centre of the dark component $H\alpha_3$ being hence displaced with respect to $H\alpha_2$, together with the emission components, by 0·059 A. A series of spectrograms comparing opposite edges of the sun at various latitudes shows that the velocity of the hydrogen layer giving rise to the line $H\alpha_3$ is greater than that corresponding with $H\alpha_2$, that of the inverting stratum lying between the two. The equatorial acceleration is sensibly the same for the three layers. The dissymmetry appears to be greater in the east than in the west.—**D. Mercogliano**: The quadratic complexes containing the congruence of the axes of a cubic hump and the conditions for two binary cubics having two common roots.—**E. Persico** and **F. Scandone**: The Hall effect with extended electrodes (1).—**M. Merola**: *R* Scuti. A series of 85 photometric observations on this variable, made at Capodimonte between Aug. 10, 1927, and Dec. 6, 1928, indicate two maxima and four minima, and confirm the irregularity of the period and of the light curve, in accordance with the observations of Jacchia, Spears, Peltier, Carr, and Ford, and with the discussions of Sawyer and of Campbell.—**F. de Carli**: Viscosity isotherms of binary mixtures (4): The system, benzaldehyde-sulphur monochloride. Thermal analysis of this system being impossible, since all the mixtures give, on cooling, viscous masses with scarcely appreciable velocities of crystallisation, use has been made of the viscosity. The maximum divergence of the observed from the calculated viscosities occurs with mixtures containing 60 per cent of the aldehyde, the formation of the compound $2\,C_6H_5{\cdot}CHO$, S_2Cl_2 being thus indicated.—**A. Ferrari** and **A. Inganni**: The importance of the crystalline form in the formation of solid solutions (6): Thermal and X-ray analysis of the anhydrous systems $CaCl_2 - CoCl_2$, $CaCl_2 - FeCl_2$, $CaCl_2 - MnCl_2$, and $CaCl_2 - CdCl_2$. Cobaltous and ferrous chlorides give eutectics with calcium chloride at 614° and 592°, the molecular proportions of the calcium salt being 54·3 and 44·5 per cent respectively. Manganese and cadmium chlorides give mixed crystals with calcium chloride in all proportions, and these crystals, even with small proportions of one of the components, decompose into their constituents at about 475° and 414° respectively. The behaviour of these systems points to a difference between the structure of calcium chloride and those of the rhombohedric chlorides of cobalt, iron, magnesium, manganese, and cadmium, since none of the systems shows the complete miscibility devoid of maximum and minimum solidification temperatures characteristic of isomorphous mixtures. Assuming Goldschmidt's values, the radii of the ions are: Co^{++} 0·82 A., Mg^{++} 0·78 A., Fe^{++} 0·83 A., Mn^{++} 0·91 A., Cd^{++} 1·03 A., Ca^{++} 1·06 A.—**G. Piccardi**: Spectrographic detection of bismuth in the ashes of animal organisms. If certain modifications are made in the circuit, the detection of very small amounts of bismuth is possible by means of lines in the ultra-violet region of the spark spectrum, especially the line λ3067, which is observable with solutions containing only 0·001 per

cent of the metal.—**G. Scagliarini and P. Pratesi**: The colour reaction between sodium nitroprusside and creatinine. Two possible formulæ are suggested for the ruby-coloured substance formed, according to Weyl's test, by the action of sodium nitroprusside on creatinine in alkaline solution.—**G. Scagliarini and G. Tartarini**: Additive compounds of halides of bivalent metals with organic bases (7). The following hexamethylenetetramine compounds are described: $2MgCl_2$, $16H_2O$, $5C_6H_{12}N_4$; $2MgI_2$, $16H_2O$, $5C_6H_{12}N_4$; $2MgBr_2$, $16H_2O$, $5C_6H_{12}N_4$; $2CaCl_2$, $8H_2O$, $5C_6H_{12}N_4$.—**Giambattista Dal Piaz**: Geological notes on the region of the Aurine Alps and of the Giant Vedrettes (Upper Adige).—**A. Palombi**: The biological cycle of *Diphterostomum brusinæ* Stossich (Digenetic trematode: fam. Zoogonidæ Odhner).—**M. Tirelli**: Opening of Malpighian tubes in the meso-intestine.—**G. Mezzadroli and E. Vareton**: Action of Wood's light on the germination of seeds and on the growth of plants. Experiments on barley, beans, peas, and maize show that Wood's light exerts a favourable influence on the germination of seeds and on the growth of plants when applied for 15 minutes to some hours per day. The action is especially favourable during the early stages of development, the plants being increased in number, vigour, and height.—**G. Mezzadroli and E. Vareton**: Comparison between the actions exerted by ultra-short electromagnetic waves (λ2-3 mm.) and by the Lakhovsky oscillating circuit on the germination of seeds and the growth of plants. The favourable influence of electromagnetic waves on seeds and plants is similar to, but more marked and more constant than, that of the Lakhovsky circuit, and is a function of the intensity of the waves themselves.—**P. Pasquini and G. Meldolesi**: Investigations on radio-sensitiveness in the development of the eggs of amphibia (1). Differential radio-susceptibility of the various embryonic stages (Anurans).—**M. Curzi**: A new and serious disease of maize. During last June certain maize was attacked, with loss of about 80 per cent of the plants, by a malady which resulted in necrosis at the base of the stalk. The plants affected fell to the ground and there continued to grow without any sign of withering, communications between the aerial and subterranean organs remaining uninterrupted. The disease is due to a mould, probably communicated from the previous year's crop of beet.—**Constantino Gorini**: Acido-proteolytic enzymes of tanning.

SYDNEY.

Royal Society of New South Wales, Nov. 6.—A. R. Penfold and J. L. Simonsen: Note on the leaf oil from *Dacrydium Franklinii* Hooker. The chemical composition of the terpene fraction as previously revealed was confirmed, but the principal terpene for which the name dacrydene was proposed has now been shown to consist of Δ-^{4}carene and beta pinene. The former is a new bicyclic terpene first isolated by Dr. Simonsen from Indian pine oil. The solid diterpene, phyllocladene, was also isolated from this oil.—**A. R. Penfold and F. R. Morison**: The essential oils *Melaleuca decora* (Salisbury) Druce and *M. Nodosa* var. *Tennifolia* (de Candolle) from the Port Jackson District (1). The principal constituents of oil from the former are *d*-α-pinene (50-60 per cent) and sesquiterpenes (25-30 per cent), with small quantities of α-terpineol, dipentene, and sesquiterpene alcohol. The oil from the later yields cineol (40-55 per cent), α-pinene, dipentene, α-terpineol, sesquiterpene, etc. Both these species of paper bark tea tree occur in extensive areas close to Sydney, but the rapid advancement of settlement foreshadows their extermination at an early date.

Official Publications Received.

BRITISH.

Canada. Department of Mines: Mines Branch. Core Drilling Bituminous Sands of Northern Alberta. By S. C. Ells. (No. 710-1.) Pp. 26. (Ottawa: F. A. Acland.)

Southern Rhodesia. Report of the Education Commission. Pp. ii+187. (Salisbury.)

Report on the Somaliland Agricultural and Geological Department for the Years 1927 and 1928. Pp. 48. (London: The Crown Agents for the Colonies.) 5*s*.

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the Year 1928. Pp. viii+141+13 plates. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Tide Tables for the Eastern Coasts of Canada for the Year 1930: including the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits, and Information on Currents; in addition Tide Tables for New York and Boston, U.S.A. Issued by the Tidal and Current Survey Division of the Hydrographic Service, in the Department of Marine and Fisheries of the Dominion of Canada. (Thirty-fourth year of Issue.) Pp. 90. (Ottawa: F. A. Acland.)

Canada. Department of Mines: Mines Branch. Summary Report, 1928, Part A. (No. 2202.) Pp. 210A+4 plates. Summary Report, 1928, Part B. (No. 2206.) Pp. 131B+5 plates. Memoir 158: Britannia Beach Map-area, British Columbia. By H. T. James. (No. 2193.) Pp. ii+139+4 plates. 25 cents. (Ottawa: F. A. Acland.)

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Arboricultural Society. Vol. 43, Part 2, October. Pp. xiv+81-168+37-46. (Edinburgh.) 7*s*. 6*d*.

Ministry of Agriculture and Fisheries. Marketing Leaflet No. 15: The Commercial Pig; Interim Report by the Pig Industry Council. Pp. 12. (London: Ministry of Agriculture and Fisheries.)

Proceedings of the Society for Psychical Research. Part 113, Vol. 39, December. Pp. 193-246. (London: Francis Edwards, Ltd.) 1*s*. 6*d*.

FOREIGN.

Scientific Papers of the Institute of Physical and Chemical Research. No. 217: On the Difference of Behaviours of Different Parts of Three-Part Spark in Igniting Combustible Gas Mixture. By Torahiko Terada, Kiyohiko Yumoto and Ryûzô Yamamoto. Pp. 132-148+plate 15. (Tôkyô: Iwanami Shoten.)

Contributions from the Dudley Herbarium of Stanford University. Vol. 1, No. 3: A New Genus of the Saxifrage Family, by Leroy Abrams and Rimo Bacigalupi; Two New Downingias from Oregon, by Elmer I. Applegate; Four New Plants from San Diego County, California, by Ira L. Wiggins. Pp. 89-102+plates 5-9. (Stanford University, Calif.: Stanford University Press.) 50 cents.

Stanford University Publications. University Series: Biological Sciences. Vol. 5, No. 3: The Principles of Systematic Entomology. By Prof. Gordon Floyd Ferris. Pp. 169. 2 dollars. Vol. 6, No. 1: A Contribution toward a Monograph of the Adelginae (Phylloxeridae) of North America. By Dr. P. N. Annand. Pp. 146. 2 dollars. (Stanford University, Calif.: Stanford University Press.)

Department of the Interior: U.S. Geological Survey. Bulletin 800: Geology and Mineral Deposits of Southeastern Alaska. By A. F. Buddington and Theodore Chapin. Pp. x+398+22 plates. 85 cents. Bulletin 804: Geology and Coal and Oil Resources of the Hanna and Carbon Basins, Carbon County, Wyoming. By C. E. Dobbin, C. F. Bowen and H. W. Hoots. Pp. vi+88+27 plates. 60 cents. Bulletin 812-A: The Forsyth Coal Field, Rosebud, Treasure and Big Horn Counties, Montana. By C. E. Dobbin. (Contributions to Economic Geology, 1929, Part 2.) Pp. v+55+10 plates. 20 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 597-C: Problems of the Soft-Water Supply of the Dakota Sandstone, with Special Reference to the Conditions at Canton, South Dakota. By Oscar E. Meinzer. (Contributions to the Hydrology of the United States, 1928.) Pp. ii+147-170+plate 20. Water-Supply Paper 597-E: Surface Water Supply of the Sacramento River Basin, California, 1895-1927. By H. D. McGlashan. (Contributions to the Hydrology of the United States, 1928.) Pp. vi+189-250. 10 cents. Water-Supply Paper 611: Surface Water Supply of the United States, 1925. Part 11: Pacific Slope Basins in California. Pp. viii+383. 50 cents. Water-Supply Paper 612: Surface Water Supply of the United States, 1925. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+160. 25 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

FRIDAY, JANUARY 3.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Eng. Vice-Admiral R. W Skelton: Progress in Marine Engineering (Thomas Lowe Gray Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—J. G. Wellings and C. G. Mayo: Instrument Transformers.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—F. T. Wood: Speedy Draughtsmanship.

SATURDAY, JANUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (4): Boats and Furniture.

MONDAY, JANUARY 6.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Major C. K. Cochran-Patrick: Places seen from the Air (Christmas Lectures) (1).

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—W. L. Morgan: Organisation of Public Service Motor Vehicle Repairs and Maintenance Systems.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—W. H. Ambler: Single Dry Spun Yarns.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Dr. R. Unwin: Regional Planning, with Special Reference to Greater London.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—C. J. J. Fox: The Micelle Chemistry of Cellulose.—J. A. Pickard: Metafiltration.

TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8.—Dr. E. H. Rayner: Power Transmission at High Voltages.

TUESDAY, JANUARY 7.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (5): The Workshops.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (jointly with Nursery School Association) (at University College), at 5.30.—Principles and Practice in Nursery School Education.—Mrs. S. Isaacs: What the Nursery School can do for the Young Child.—Miss Lillian de Lissa: Nursery School Aims and Problems.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—L. Richmond: The Modern Tendency in Art.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—J. R. Harnott: The Rigid Six-wheeled Vehicle.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—T. W. Cooper: Roller Bearings.

TELEVISION SOCIETY (at Engineers' Club, Coventry Street), at 8.—W. S. Newton: Photographic Problems of Picture Telegraphy.

WEDNESDAY, JANUARY 8.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. Stanley Smith: On some Valentian Corals from Shropshire and Montgomeryshire; with a Note on a New Stromatoporoid.—Dr. Stanley Smith: The Carboniferous Inliers at Codrington and Wick (Gloucestershire).

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—C. A. Masterman: Combustion, Wind and Flue Equipment.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—E. Downs: Electrolytic Gold Refining.

THURSDAY, JANUARY 9.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (6): Hieroglyphs.

LINNEAN SOCIETY OF LONDON, at 5.—W. H. Thorpe: Further Notes on Biological Races in *Hyponomeuta padella* (Linn.).—J. T. Cunningham: The Origin of Adaptations.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—T. W. Ross and H. G. Bell: Recent Developments in the Protection of Three-Phase Transmission Lines and Feeders.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—R. McKinnon Wood: The New American Wind Tunnel.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.—F. W. Sharp: Dyebro.—F. R. Newens: A New Formula and Method for 3-colour Carbo.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—G. H. Chalmers: Lubrication.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—G. Mortimer: The Aluminium Industry.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—F. G. Conyers: Wood Distillation.

OIL AND COLOUR CHEMISTS' ASSOCIATION, at 7.30.

INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester).—Dr. L. H. Lampitt: The Historical Development of Work on Yeast.

INSTITUTE OF CHEMISTRY.—Dr. A. M. Brontë: The Medical Witness.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch).—J. W. Hobson: Locomotives for Industrial Purposes and their Maintenance.

INSTITUTION OF THE RUBBER INDUSTRY (Birmingham and District Section) (at Grand Hotel, Birmingham).—H. Standring: Outstanding Features in the Progress of the Rubber Industry.

FRIDAY, JANUARY 10.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—H. G. Watkins: By Canoe and Dog Sledge in Labrador (Christmas Lectures) (2).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir Basil P. Blackett: The Economic Progress of India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. A. Kreiken: The Frequency of Double Stars of Different Spectral Types and Absolute Magnitudes.—J. Jackson: The Shortt Clocks of the Royal Observatory, Greenwich, with Special Reference to the Effect of Variation in Arc.—H. Jones: Deviations from Boyle's Law in Stellar Interiors.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—L. C. Burrill: Design and Construction of the Rail-car-carrying Steamship *Seatrain*.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. E. K. Rideal: Some Aspects of Surface Chemistry and their Industrial Implications.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Free Trade Hall, Manchester), at 7.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Prof. T. P. Hilditch: Recent Research on Fats bearing upon the Drying of Oils in Paint and Varnish.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—J. Pringle: The Geology of Ramsey Island (Pem.).—*Papers to be taken as read*:—The Palæobotany of the Kent Coalfield, Dr. R. Crookall and J. Pringle; The Preparation of Thin Sections of Friable and Weathered Materials by Impregnation with Synthetic Resins, R. J. Schaffer and P. Hirst.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. J. N. Riddle: The Track Circuit in Railway Signalling.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Burlington House), at 8.—J. R. Booer: Autogenous Welding in Chemical Works.

PHILOLOGICAL SOCIETY (at University College), at 8.—G. G. Loane: Notes on N.E.D.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff).—E. H. Williams: Graphitic Lubricants.

PUBLIC LECTURE.

TUESDAY, JANUARY 7.

PHILOSOPHICAL HALL, LEEDS, at 6.—E. G. Boulenger: Behind the Scenes of the Zoo Aquarium (Christmas Lecture).

CONFERENCES.

JANUARY 3.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at University College), at 2.30.—K. D. Young: School Sanatoria.

BRITISH ASSOCIATION FOR PHYSICAL TRAINING (at University College), at 5.30.—Dr. D. J. Harris: The Electrical Phenomena of Muscle.

JANUARY 3 AND 4.

SCIENCE MASTERS' ASSOCIATION (at Imperial College of Science).

Friday, Jan. 3, at 9.30 A.M.—W. Corbridge: Lecture Demonstration on Some Home-Made Physical Apparatus.

At 10.45 A.M.—Dr. J. C. Munro: Industrial Biology (Lecture).

At 12.—Prof. Truscott and others: Discussion on Openings for College Trained Men in the Mineral Industry.

At 5.15.—Discussion with the Physical Society on Examinations in Practical Physics.

At 8.15.—Discussion on School Certificate Biology.

Saturday, Jan. 4.—Visits to the National Physical Laboratory and the Government Laboratory.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Friday, Jan. 3, at 10 A.M.—Discussions:—The Physical Basis of Geography in Independent Schools. Opened by B. B. Dickinson.—Geography and the Training of Teachers. Opened by T. Herdman.

At 11.30 A.M.—Col. H. L. Crosthwait: Air Survey (Lantern Lecture).

At 2.30.—The Geography I was Taught, by Members of the Association.

Saturday, Jan. 4, at 10.30 A.M.—Sir E. J. Russell: Agricultural Developments in South Africa (Lantern Lecture).

At 11.45 A.M.—Dr. Vaughan Cornish: National Parks.

JANUARY 6 AND 7.

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College).

Monday, Jan. 6, at 4.—B. L. Gimson and others: Discussion on Arithmetic of Citizenship.

At 5.30.—Prof. S. Chapman: The Use of Spherical Harmonic Functions in Mathematical Physics.

Tuesday, Jan. 7, at 10 A.M.—G. W. Spriggs and others: Discussion on Problems of Individual Education, with Special Reference to Work in Mathematics.

At 11.45 A.M.—Prof. W. M. Roberts: Gunnery and some of its Mathematical Problems (Lecture).

At 2.30.—Dr. W. F. Sheppard: Mathematics for Study of Frequency Statistics.

At 3.45.—Miss Hilda P. Hudson and others: Discussion on The Mathematician in Ordinary Intercourse.

JANUARY 7.

NATIONAL COUNCIL FOR MENTAL HYGIENE (at University College), at 3.—Discussion: Preventable Mental and Physical Strains of School Life.

EXHIBITION.

JANUARY 7, 8, AND 9.

ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY (at Imperial College of Science), from 3 to 6, and from 7 to 10.

Jan. 7, at 8.—Lord Rayleigh: Iridescent Colours in Nature from the Standpoint of Physical Optics (Lecture).

Jan. 8.—S. G. Brown: Gyro Compasses for Gun-Fire Control (Lecture).

Jan. 9.—Sir Ambrose Fleming: Television, Present and Future (Lecture).

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

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

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.