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Psychologists and Examiners.[1]

THE idea is prevalent in Great Britain that no government department will accept a new thing until it has become hoary with age. The Consultative Committee of the Board of Education has disproved the generality of the truth of this idea by the acceptance of a view which dates from the present century, and it has at the same time proved its common sense by refusing to endorse a proposition which is held true by the experts who are in a position to decide, but is not sufficiently established for non-experts to be convinced of the truth of it.

The thing the Consultative Committee accepts is the value of intelligence tests for use at the beginning of each stage of school education for the purpose of sorting out the children fit to profit by further education from those who are not fit. Such tests were used last century for ascertaining mental deficiency, but their use for the normal child first became a possibility twenty years ago when Prof. Spearman showed how numerical measures could be obtained by means of the coefficient of correlation. The approval of the Consultative Committee will lead to the rapid extension of the use of these valuable tests, which hitherto have been applied only sporadically in Great Britain.

The proposition which the Committee refuses to endorse is that there is a "general ability" which takes part in the various activities of the mind, and usually takes an important part. The use of numerical measures for psychological quantities soon brought Spearman to realise the existence of this general ability, and his writings on the subject are conclusive to readers who understand the calculation of a correlation. For the Committee to accept this proposition would have meant simply that it accepted the dictum of the experts and that it was not its own conclusion. Such acceptance is impossible for a committee the opinion of which is to carry weight, and the refusal to endorse the proposition is evidence that any conclusions it does accept are its own and thus gives these conclusions increased weight. We do not, of course, mean that the members of the Committee are not experts; we mean that although they are all experts in education, they have not the particular expertness wanted for this question. The attitude towards intelligence tests shown by men with no special knowledge even of education was exemplified by the House of Commons when that body, so wise in ordinary matters, imagined that it had finally disposed of intelligence tests by the invention of the term "jazz papers" amid Rabelaisian laughter; and by the Southborough Committee, which

[1] Report of the Consultative Committee of the Board of Education on Psychological Tests of Educable Capacity and their Possible Use in the Public System of Education. Pp. xii+248. (London: H.M. Stationery Office, 1924.) 2s. net.

also condemns them and adopts the scornful House of Commons term.

If we wish to estimate the value of any method of testing, we must first be clear about the object for which the test is to be used. The object the Consultative Committee has mainly in view is the testing of educable capacity, that is to say, the discrimination between children fit to undergo a further stage of education and those unfit to do so; and the discussion of this problem is sound. The Committee is, however, strangely blind to other purposes for which examinations may be held. Thus, for example, it looks on the First and Second School Examinations as the end of all things rather than as a test of fitness for a career or for admission to a university.

The tests that came under the consideration of the Committee may be classified as follows:

1. Tests of inborn qualities such as (*a*) general ability; (*b*) special ability, including aptitudes for particular vocations; (*c*) personality, including temperament and will.
2. Attainment tests which gauge the degree to which the examinee has benefited by his education.
3. Physical qualities which, if their investigation is found worth pursuing, will be found to subdivide into inborn qualities and acquired qualities.

These tests fall to be considered for their value for (1) entrance to an educational stage, (2) entrance to life work.

Of the tests we have enumerated, the Committee deals rapidly with all but the tests of general ability. It considers that tests of special ability and of personality may possibly have value, but that much development is necessary before it can recommend them for general use.

The approval by the Consultative Committee of the use of psychological tests of general ability is given on the understanding that:—(1) The object is to test educable capacity. (2) Elements of personality, such as temperament and will, must also be taken into account. (3) The possibility is to be kept in mind that a particular temperament or kind of will may upset the results and vitiate them as a measure of educable capacity. (4) The psychological tests now in use bring out results too high in the case of the verbalist (who is especially skilled in language), and too low in the case of the non-verbalist, in whose case justice requires the application of other tests such as performance tests. (5) The questions must be framed with proper regard to the child's environment, so that, for example, urban questions must not be set to the rural child.

It is well for us to consider what guidance we can find in the report for other purposes, as, for example, for School Leaving Examinations and First School Examinations, and for examinations used by a business firm to choose its employees. For the business firm the answer is clear. In addition to a reasonable outfit of general knowledge and a suitable personality, the candidate must possess an appropriate grade of general intelligence. The older fashioned examination may, and often does, test intelligence incidentally, but it does not discriminate between intelligence and other qualities and determine the degree of intelligence a candidate possesses. The psychological test does so, and is on that account valuable to the business firm.

The School Leaving Examination appears in the main to be an attainment test held for the purpose of ascertaining what the school has done for the pupil. If this is its object, the psychological test seems to have no place in it. Indeed, so far as the examination has the object of measuring the diligence which the boy or girl has shown, it might even be held that general intelligence should be discounted on the ground that by its help the cleverer pupil of little diligence makes as good a show as the less clever but very diligent pupil. On the other hand, so far as a school examination serves as a university entrance examination, it should require such intelligence as is necessary to undertake studies of a university grade.

It is clear, then, that the value of the psychological test for a School Leaving Examination can be decided only after the true object of the examination has been determined. The question of the true object should accordingly be among the first references to the new committee, the appointment of which is recommended by the report before us.

The value of the psychologist in intelligence tests is proved. In attainment tests, that is, in the tests of knowledge such as are conducted by the older examining bodies, there is need for co-operation between the psychologist and the old-fashioned examiner. The schemes of these examinations must be worked over to see whether the psychologist can improve them. To give an example, the old examiner, when he found that the examination results from two subjects ranged the candidates in very much the same order of merit, argued from this fact the excellence of the two question papers; the psychologist offers an alternative explanation, namely, that the two tests measure much the same qualities; and this explanation must lead us to consider whether it would not therefore be sufficient to employ one of the question papers and drop the other.

On the other hand, the psychologist must remember that the region of attainment tests is not virgin soil. The old-fashioned examining bodies have been at work for long periods, and, although equipped only with common sense in place of psychological knowledge, have attained conclusions which may require some adjustment but are likely to remain valid.

One idea that requires discussion between the old examiner and the psychologist is that of the "short answer," usually consisting of a single word. The idea of the "short answer" seems to have been transferred, without much consideration, from the intelligence test to the attainment test, and it is for the psychologist to furnish evidence as to the circumstances in which a question paper framed on these lines is better than the question paper usual in Great Britain, in which a candidate has three hours to answer half-a-dozen questions, and better than the customary French examination paper in which three hours are devoted to a single question.

The use of the competitive interview is quite recent and the experience of it slight. It has not yet had time to be standardised. It is a problem on which the old examiner and the psychologist ought to co-operate, the double point of view being even more valuable here than in long-established tests.

The Chemist as Propagandist.

The Heavy Chemical Industry. By Rex Furness. Pp. 28. *Fine Chemicals*. By T. W. Jones. Pp. 20. *Wood Products*. By T. W. Jones. Pp. 19. *The Quest for Colour: a Short Survey of the Story of Colour in Relation to Man's Needs and Achievement*. By Dr. A. T. de Mouilpied. Pp. 31. *Chemists and their Work*. By Stephen Miall. Pp. 19. *The Fermentation Industries*. By Rex Furness. Pp. 19. *Chemistry in the Manufacture of Pigments, Paints and Varnishes*. By C. A. Klein. Pp. 24. *Chemistry in Relation to Food*. By Dr. G. W. Monier-Williams. Pp. 20. (Chemical Industry Pamphlets.) (London: Ernest Benn, Ltd., 1924.) 6*d*. net each.

FEW of us consider that we occupy the exalted positions which Nature or a benevolent Providence intended us to fill, and none, except perhaps the truly meek, hesitates to use legitimate agencies for furthering his advancement. Scientific workers are no exception to this rule, and of late they have been developing a "class consciousness," and organising themselves into associations that correspond in certain features to the trades unions of the proletariat. Although they have their differences of opinion, those who depend upon science for their daily bread are unanimous in thinking that their position in the social scale is unduly low and incompatible with the value of their work for the community. The worker in pure and applied chemistry does not lag behind the rest. His picturesque forerunner, the astute alchemist, played on the whole an ignoble part in administering to the acquisitiveness of kings and courtiers; and the modern industrial chemist keeps up the tradition by selling his services to employers whose main ambition is to transmute materials and labour into gold: he seldom occupies a commanding position either in the industrial or the social world.

It may, however, now be said that chemists have passed through the first stage in their social evolution, inasmuch as they are fully cognisant of their unmerited inferior status. They have entered upon the second stage, which is combination for a common purpose; but they have yet to negotiate the difficult final stages, which comprise the selection of competent leaders and the conversion of their fellow-citizens. The chemical world has never been rich in men possessing the human qualities needed for effective leadership, and the task of selection is by no means easy; for the chemist is not only by nature an individualist, he is also a born rationalist, neither exhibiting emotion nor being influenced readily by it.

To convince the man in the street of the vital importance of chemistry, and inferentially of the vital importance of the chemist, is also difficult, as the means available for this purpose are limited. Chemistry, like most of the other sciences, is taboo to the editor of the popular newspaper and to the popular author; actors, preachers, politicians, prominent soldiers and sailors fight shy of it (though some of them may accept seats on the boards of chemical companies). It was, therefore, a good idea that prompted the Association of British Chemical Manufacturers and the Society of Chemical Industry to bring out a series of popular prints on chemical topics in connexion with the British Empire Exhibition, and all chemists will bless them if the seed they are sowing falls on fertile soil. The success of such propaganda must, obviously, depend not only on the nature of the material selected, but also on the manner in which it is treated; and this consideration impels one to comment on popular scientific literature in general.

Comparisons are sometimes drawn between the good old days when Huxley and Tyndall drew large audiences of working men and others to their popular lectures and wrote essays that were widely read, and the present time when the demand for such work is very poor. With all respect, nay, veneration, for these great expositors, it is doubtful if they would achieve to-day the same success that they won thirty to fifty years ago. The world has become more material and sensation-loving, so that a new method of attack seems imperative. A successful popular writer of to-day must understand the psychology of his readers and adapt his style to the nature of his audience. Now this is not an easy proposition, particularly for the writer of science, because, from the point of view of scientific knowledge, the man in the street is not one abstract individual but

several. For the present purpose, he may be conceived either as a man who is totally ignorant of and completely indifferent to science, or as one who learnt sufficient at school or elsewhere to realise dimly its importance. The former type is in a great majority, and it is mainly he who must be attracted and impressed. How can we approach him? What kind of reading does he prefer? The answer to the latter question is well known and writ large at the top of the columns of his daily newspaper: anything that appeals to his primitive instincts. Personalities and abnormalities, matters relating to material gain, sex, sport, fighting, and adventure: these are the main excitants. Emotion, not reason, being the keynote of his mental disposition, he must be approached through his affects. Unfortunately, the writer of popular science has only a few instincts to play upon, such as wonder, acquisition, and construction, but if he is skilful he can turn these to good account. (In this connexion it is noteworthy that the scientific topics that have been most reported of late are, Mars—mercury from gold—wonders of wireless—determination of sex.) Further, our man in the street dislikes being preached at. He has little regard for unembellished statements of fact: he must see their bearing, actual or potential, on his daily life. For historical data he does not care, and of abstract thought he is usually quite incapable. So far as possible, things must be presented to him in concrete and predigested form. Hence the language to be addressed to him must be simple, concrete, and familiar; technicalities must be avoided, sentences should be short, and headings numerous.

If these comments and desiderata be conceded, only one general conclusion can be drawn concerning the pamphlets under notice: they are unlikely to appeal at first sight to the individual whose mental attitude has just been outlined. On the other hand, they should certainly be appreciated by the minority who have already a bowing acquaintance with science. As might be expected, there is a considerable diversity of merit, and it is not easy to generalise. It may, however, be said that the authors have succeeded in demonstrating the innumerable ramifications of chemistry and the ubiquity of the chemist. The most common defect is that the authors have attempted to tell too much: they have fired their facts straight at the reader as from a machine-gun, whereas they should have propelled them at an angle, like star-shells, to burst at intervals and illuminate the scene. Further, they have not made enough of the human factor, and have not appealed sufficiently to the wonder instinct of their readers. In some cases the composition is defective; the golden rule to use the concrete noun and the active verb wherever possible has been neglected, and windy circumlocutions are numerous. Thus we read: "The cultivation of these plants is prosecuted" [These plants are cultivated]; "A great amount of careful consideration" [Much careful thought]; "Titanium dioxide has remarkable opacity, and this feature is utilised in its employment for pigment purposes" [Titanium dioxide is remarkably opaque and therefore very useful for making pigments]; "The platinum acts as a catalyst . . . without sensible alteration to its own character" [. . . without undergoing change].

The pamphlet entitled "The Quest for Colour" is by far the most attractively written; its author shows literary gifts, not the least of which is imagination, and he makes skilful use of analogy and allusion. He has selected his material with excellent judgment, has not overburdened his interesting story with a multitude of superfluous facts, and he has written an essay which every educated man, whether he have knowledge of chemistry or not, will delight in reading. Of a different and more academic type is "Chemistry in Relation to Food," the author of which has made full use of the intimate relation of his subject to everyday life. He has wisely omitted historical references, and though he has produced rather strong meat for the general reader, his matter is very interesting and well brings out the value of chemistry in safeguarding the purity of our food supplies. "Chemists and their Work" is somewhat disappointing, as one hoped—perhaps wrongly—to find in it some pithy remarks on the psychology of the chemist; and the opening statement that "Chemistry is the key to modern prosperity, to modern civilisation" is too bombastic even for Exhibition literature. The author has, however, succeeded in conveying his information in simple language, and his story, though somewhat sketchy, is distinctly readable. "Fine Chemicals" and "Wood Products" contain fluent accounts of these important materials which will be appreciated by those who already have some knowledge of chemistry; and the same may be said of the pamphlets on "The Heavy Chemical Industry" and "The Fermentation Industries," which are bursting with information and written in too verbose a style. Judicious pruning by the editorial knife would have greatly improved these two pamphlets. The writer of "Chemistry in the Manufacture of Pigments, Paints and Varnishes" is an acknowledged authority on these materials, and his articles are always worth reading; but although he has many interesting things to relate in his pamphlet, he cannot be said to show the gift of popular exposition.

It seems, therefore, as if the scientific worker is not well fitted, either by nature or nurture, to play successfully the part of propagandist to the man in the

street. He is usually too academic, too objective, too much devoted to statements of fact and too little to feeling. A popular appeal must be through the human heart and by the stimulus of the spirit of discovery. It is not necessary to adopt the specious methods of the politician or the sensational style of the popular press, but the gospel of science can be taught only by the apostle who realises that " il ne s'agit pas de parler, il s'agit de persuader ; il ne s'agit pas d'écrire sur du papier, il faut écrire dans les cœurs."

The Analysis of Sound by the Cochlea.

The Mechanism of the Cochlea : a Restatement of the Resonance Theory of Hearing. By George Wilkinson and Dr. Albert A. Gray. Pp. xx+253+4 plates. (London : Macmillan and Co., Ltd., 1924.) 12*s.* 6*d.* net.

THE means by which physical stimuli are converted into sensations are always the subject of controversy. So far as the recognition of the physical events is concerned, it is undesirable that the intermediate processes should obtrude themselves on the observer's consciousness ; nevertheless, the mechanisms of interpretation form a fascinating, though difficult, subject for a physiologist.

In order to understand the whole process, one must know the applications of physics to the subject of discussion, as well as have a sound knowledge of the minute anatomy of the interpreting organ, and of the physiology of the nervous system.

Drs. Wilkinson and Gray have presented a readable outline of the mechanism of the cochlea. They quite rightly exclude all hypotheses which place the mechanism of analysis in the brain. The presence of such a complicated organ as the cochlea would be quite unnecessary if the nerves merely conveyed a complicated series of impulses corresponding to the waves of pressure in the air, and so far as all physiological evidence goes, the nerves are incapable of conveying impulses of such high frequency as occur in sounds of high pitch. In fact, such hypotheses are merely a confession of failure to explain the mechanism.

Of all the analytical processes ascribed to the cochlea, the authors believe that the correct one is a resonator mechanism. They point out that there is a progressive differentiation in the length and tension of the fibres of the basilar membrane, and in the load due to the liquid in the cochlea from its base to its apex. Thus all the terms in the formula

$$\text{frequency} = \frac{1}{2 \times \text{length}} \times \sqrt{\frac{\text{tension}}{\text{mass per centimetre of length}}}$$

help to make the basal end of the organ of corti resonate to high notes, and the apical end to low notes.

The authors commence by a description of the physics of sound and of the principles of resonance. This is followed by a brief outline of the evolution of the cochlea and a more detailed description of the mammalian cochlea. In the latter description one might expect to find some mention of the division of the basilar membrane into subarcuate (elastic) and pectinate zones, and some discussion as to the possibility of the rods of corti altering the periodicity of the resonating mechanism. Although the rods of corti are present only in mammals, they ought to have some influence on the analytical mechanism of those animals in which they are found.

Dr. Gray explains very clearly how it is possible that a note of a certain pitch can be recognised although the vibration of the organ of corti may be spread over a number of receptors : in fact, the more strongly stimulated receptors cause an inhibition of the sensations which might be produced by neighbouring less stimulated ones. One sees examples of such inhibition in other sensory mechanisms.

The authors doubt the adequacy of " sound picture " and " travelling bulge " hypotheses to explain sound analysis, and it must be granted that if the latter are to have any meaning, they resolve themselves into a process of localised movement of the basilar membrane corresponding to a resonance process ; otherwise, the distance that a wave travels up the cochlea should be a function of its amplitude and not its frequency.

Dr. Wilkinson describes the well-known model which he has made to illustrate the analysis of sound waves by a resonance system comparable to that of the cochlea, and the method of construction is given in an appendix. Such a model merely shows the possibility of the analysis by a corresponding resonance mechanism without proving that it is the only way in which the result can be obtained. The reviewer would point out that it is possible to differentiate frequencies of pressure waves by means of viscosity *in spite of* the inertia acting in the opposite direction. Thus, two tubes of the same length but of different diameters, united to a common tube, can be used. Pressure differences applied to the common end will cause movement of a contained liquid mostly in the wider tube, but if a small bulb closes the far end of the wider tube, and a large one the far end of the narrower tube, it will be found that low frequencies of pressure changes will cause most movement along the narrow tube, whilst high frequencies will cause most movement along the wider tube. The inertia for the same extent of movement should be less in the narrower tube, therefore this differentiation occurs in the reverse direction to what one would expect from the mass of liquid contained in the tube. It is in view of the fact that

friction may have some effect on the analysis of sound waves that the model described on page 104 differs from that of Lux and others. It may be true that viscosity has nothing to do with resonance, but there is a mechanism due to liquid friction by which analysis can be produced; this process may be supplementary to the factors discussed by Drs. Wilkinson and Gray.

The authors say nothing about the variations in area that occur along the scalæ of the cochlea, and these variations become significant in relation to viscosity effects.

This book should be read by all those interested in the problem of how sounds are analysed, and it gives a concise and adequate description of the various facts and hypotheses concerned in the action of the cochlea.

H. E. ROAF.

Diving in Birds.

The Bird as a Diver: a Contribution to the Natural History of Diving Birds. By Dr. John M. Dewar. Pp. xii+173. (London: H. F. and G. Witherby, 1924.) 10*s.* 6*d.* net.

DR. DEWAR has for many years been investigating in a quantitative way the problem of diving in birds, and more particularly the relation between the length of time spent under water and the depth of water. This book is a statement of his evidence and his conclusions.

The most important of these may be briefly summarised. The diving habit has been acquired independently several times over in birds. In spite of this, in five of the six families of birds studied by Dewar, the relation between time and depth is the same. Roughly speaking, it is 20 seconds for the first fathom of water, 10 seconds for each subsequent fathom. As a matter of fact, the data are more accurately represented by an S-shaped curve, with time as the abscissa. This, of course, is the curve of an autocatalytic reaction, and our author believes that the depth-time relation is determined by some autocatalytic reaction in the body. It is, however, equally legitimate (and more likely !) to suppose that there is some initial delay connected with "getting under way" subaqueously, and that below a certain depth each additional foot becomes more and more difficult. This would give a curve which, with the evidence here presented, it would be impossible to distinguish from the regular S-shaped curve of autocatalysis.

The coot alone, of all the birds studied (which included diving ducks, grebes, cormorants, divers, and auks), does not eat its food below water; it therefore has no "bottom time." The rough rule for the coot is 10 seconds for each fathom, including the first, but this species also shows the S-shaped curve.

From a study of the ratio between length of dive and length of pause, rate of increase of pause per fathom of depth, and longest dive, it was possible to grade the diving birds for diving ability. The coot came out lowest, the auk highest, with the others ascending in the order given in the preceding paragraph.

Numerous interesting points are brought out concerning under-water speed, greatest depth of dive (which is probably much less than is generally believed), etc.; but the point which Dewar rightly emphasises as the most interesting is the fact that not merely a similar but an identical time-depth relation has been independently evolved in at least five separate families of birds under the influence of environmental similarity.

Although many will feel that a rather small single problem is here treated at somewhat excessive length, the book is certainly a welcome contribution to a scientific natural history, and shows what useful biological work can be done by the field naturalist who is possessed of the scientific spirit and not of the mere collector's instinct.

J. S. H.

Regional Survey of Cambridge.

The Archæology of the Cambridge Region: a Topographical Study of the Bronze, Early Iron, Roman and Anglo-Saxon Ages, with an Introductory Note on the Neolithic Age. By Dr. Cyril Fox. Pp. xxv+360+37 plates+6 maps. (Cambridge: At the University Press, 1923.) 31*s.* 6*d.* net.

MAPS are the mainstay of this attractive volume on the antiquities dating from the later Stone Age to the Domesday Survey in a selected area, having Cambridge for a centre. In a pocket at the end are five tinted reproductions of the 1 in. Ordnance Survey map of nearly 2000 square miles, showing the distribution of population and the natural features by which that was determined in the various periods; there are also sketch-maps in the text showing the relation of this square to eastern England. These limits are chosen not because they constitute a geographical unit, or area isolated by natural barriers, but because they include most of the localities which have furnished the Archæological Museum of the University with material here rendered accessible to students in more than the ordinary sense. The most interesting specimens of the successive periods treated are represented on 37 photographic plates, which have a home-made appearance but are generally adequate, and bring to light a good deal of new material. The text goes further, and describes many finds preserved elsewhere, but all part of the local story. Here, above all, the author's industry and method are revealed and merit general recognition, as the way is now indicated for a

similar treatment of other large collections. Seldom have the utility and purpose of a museum been more palpably illustrated. Though much is given, much is also withheld—perhaps only temporarily. The region includes parts of Norfolk and Suffolk that swarm with flint implements, as the Neolithic map clearly shows; but this period is dealt with in 15 pages, and the Early Stone Age not at all. One has to confess that a Continental work of this kind would have been better proportioned; and Cambridge has a mass of flint to interpret to the world.

The careful study of museum specimens, the verification of their *provenance*, and the identification of others not within the fold have led, as might have been expected, to important results; but the spade has many a surprise in store, and new light has recently been thrown on the history of this part of England by the excavation of the dykes or ramparts that form a series of barriers south of the Fens, and were evidently erected against an inland people, as the ditch is to the south-west. Below the Fleam Dyke, for example, were found Roman remains on the original surface; and as there would have been no reason for such a work in the Roman period, it is now definitely referred to the early Anglo-Saxon period and attributed to the East Anglians, who did not trust their neighbours to the west. Such vast earthworks can only have been constructed by large and organised communities; and the next stage is to decide who were the people that threatened to attack, and also at what moment the position became serious. History can here derive much assistance from archæology; and Dr. Fox has pointed out the military value of these lines across the main road in open country between Newmarket and Royston. Traffic flowed at right angles to this road in Roman times, and the crossing of two Roman highways was evidently the nucleus of Cambridge.

In striking contrast to the other four is the map of Anglo-Saxon settlements, on which the Domesday Vills are uniformly scattered over what a few centuries before had been dense woodland on a clayey soil, difficult to cultivate and dangerous to traverse. The same might be thought to hold good of the Fens, but large areas on the south-east of that formation were evidently inhabited in the Bronze Age, and must therefore have sunk in the last 3000 years.

The work is planned on a generous scale, and Dr. Fox's thesis has not only benefited himself but has also done excellent service to the Museum with which he is connected. It is no small achievement to have realised the golden mean between the superficial guide-book and the voluminous and often unreadable catalogue. Museum curators, please copy.

Our Bookshelf.

A Textbook of Petroleum Production Engineering. By Prof. Lester Charles Uren. Pp. vii+657. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 30*s.* net.

OIL production, like oil geology or oil refining, has undergone rapid development in method and technique during the last few years, and the profession of the petroleum engineer, formerly one of somewhat uncertain definition, is fast becoming one of specialisation both in training and accomplishment. The industry has in the past relied on, and still to a large extent relies on, the services of practical field-men who, though they may have years of experience behind them, lack the requisite technical education enabling them to assume control of large-scale operations involving a competent knowledge of the science of oil production. The demand for qualified men of this description has brought about the establishment of systematic academic training at several universities, especially in America, and the author, himself a professor in the department of petroleum engineering at the University of California, has designed this work as a text-book of reference for students reading for this particular faculty.

The book thus presents to a larger audience the substance of theoretical and to some extent practical teaching of this phase of engineering, in accordance with the curriculum laid down at that university, and as an academic conception of the subject it is well done. The plan of the work is to trace the various stages of field-operations from preliminary exploitation through the ramified processes of drilling and production to transport and storage of petroleum, each of which is treated in great detail. Unfortunately, being an academic treatise of an intensely practical subject, the text reveals the atmosphere of the class-room rather than that of the field, with the result that the large amount of descriptive matter tends to be formal, stereotyped, and tedious to read, besides conveying (doubtless unintentionally) the suggestion of orderliness in actual operations which is far from being the case. Perhaps this is more noticeable in view of the fact that Suman's recent and excellent treatise on "Petroleum Production Methods" has, by its essentially scientific though practical point of view, set a standard as yet unattained by any other work of its kind, not excluding the present volume. To be really successful, a book such as this must give a lead rather than follow precedent; the student of the future, even more than the trained man of the present, will need inspiration as well as guidance, suggestion of possibilities rather than mere digestion of technical data. H. B. MILNER.

Analytical Conics. By Dr. D. M. Y. Sommerville. (Bell's Mathematical Series: Advanced Section.) Pp. vii+310. (London: G. Bell and Sons, Ltd., 1924.) 15*s.* net.

WE welcome Prof. Sommerville's book as one of the most comprehensive English treatises on analytical conics. The author shows a wide, detailed, and accurate knowledge of the subject, ranging from elementary co-ordinate geometry to chapters on systems of points on a conic and invariants. A student wishing to acquire a thorough knowledge of the subject cannot do better

than work steadily through the book, but one desiring a light course only will need much guidance in deciding what portions to leave out.

Various points require some slight alteration. In the early pages the notation 2, 2 instead of (2, 2), for the co-ordinates of a point, is unfortunate, as a beginner will have to unlearn it later. The classification of curves given by real equations of the second degree (p. 114) is incomplete, no mention being made of $m^2x^2+n^2y^2+1=0$. It should also be noted that $ab=h^2$ is not a sufficient condition for a parabola, and, on p. 247, that the algebraic freedom-equations must be rational. A few results are stated incorrectly, *e.g.* No. 12 on p. 255. Neither is the distance of a point from a line in homogeneous co-ordinates found in the best way.

However, these matters are only minor blemishes which can easily be adjusted in a later edition. Scientifically the weakest feature is the treatment of complex geometrical elements. Although the author lays stress on the fact that he has written about geometry, and not about algebra with a geometrical interpretation, he is content to say that a quadratic equation with unreal roots defines two "imaginary points" on a real line and to assign to these points the qualities of real geometrical entities. But the treatment of complex geometrical elements is unsatisfactory in most English text-books, and the author of this one follows many precedents in the course he has adopted.

We cordially recommend Prof. Sommerville's book both as a work of reference for mature readers and as a text-book for students desiring to make a serious study of analytical conics. The numerous problems will be specially valuable to the latter. W. E. H. B.

Cancer: How it is Caused, How it can be Prevented. By J. Ellis Barker. Pp. 432. (London: John Murray, 1924.) 7*s.* 6*d.* net.

WE cannot agree with Sir W. Arbuthnot Lane that this book "will prove a great boon to mankind" or "that it is easily the most important practical work on cancer existing in English or in any other language." These statements are extravagant or, at least, very doubtful. Mr. Barker's book is the work of a journalist and is from beginning to end uncritical in a scientific sense. He states (p. 110) that he is "fully acquainted with the latest discoveries," but if so he has not given them to us but has used his book to express his opinions that cancer is due to constipation and lack of vitamins, two views which in our opinion have little foundation in fact. Almost the only authorities he quotes are surgeons—notoriously the least fertile of our medical researchers—whom he describes by some appropriate adjective such as great, very great, able, eminent, famous, or celebrated. Their statements, mostly from the general press, are regarded by Mr. Barker as an authoritative canon. We are reminded with irritative frequency that Sir W. Arbuthnot Lane has said, "Cancer never affects a healthy organ or healthy tissue." Sir W. Arbuthnot Lane may believe this, but it is our duty to point out that there exists a very extensive scientific literature for and against this opinion.

The whole aim of Mr. Barker's book is to put forward the pious belief—it is nothing more—that cancer is a disease of civilisation and is associated with constipation, which can be alleviated by eating raw food and roots like the beasts in the field. A great deal is made of the catchword "auto-intoxication." If Mr. Barker would like to know how little is the knowledge which science possesses on intestinal auto-intoxication we can commend to him the article by Dr. W. C. Alvarez in *Physiological Reviews* (1924, vol. iv. pp. 352-393).

In our opinion the book will do much more harm than good, as it can only have a deleterious action and make people concern themselves with morbid symptoms in their abdomens. It may lead to a few intestinal "kinks" being unkinked, but it is very improbable that Mr. Barker's precepts will have any influence on the incidence of cancer of the abdomen or elsewhere.

Evolution at the Crossways. By H. Reinheimer. Pp. 191. (London: The C. W. Daniel Co., 1924.) 6*s.* net.

TWENTY-FIVE years of dietetic experiment have enabled the author to frame new theories of evolution. Like a disciple of M. Coué, he states that to be true which he wishes to be true, and produces a picture of the world which will be pleasant to many.

"Selectionists . . . impute a very low kind of morality to Nature—low enough to approximate the ruthlessness of elemental forces"; but for Mr. Reinheimer "the roots of morality go back to the mutual relations existing between the lowliest of organisms, the nitrifying bacteria." "Palæontology shows that those organisms which have aimed at a self-sufficient life, have received no encouragement from Nature." "Parasites are failing species." "An organism, in order to persist on the road of progress, must seek its provender amongst the spare products of another kingdom." "Habitual predacity invariably leads to protoplasmic impoverishment." For "the frugivorous animals, including man himself . . . their high prerogative was purchased by biologically righteous behaviour." "A carnivorous career necessitates an inordinate supply of blood to the large fangs, which is the cause of the brain being fatally under-supplied." (The relative brain-power of dogs and sheep is not discussed.) Righteous birds feed on grain and fruit, and righteous insects on leaves. (The debt of agriculture to unrighteousness is not discussed.)

Many will admire this book, whom we cannot remind that sharks are older than land-animals, and carnivorous echinoderms older than sharks; that most animals live in the sea, and of them nearly all larger than a rice-grain are carnivorous; that beautiful fish are not less predaceous than ugly fish; and that the production of thousands of eggs for one to survive is not "a form of disease and penalisation," but is repetition of an ancient marine habit still followed by most female animals, and by all males. G. P. B.

Animal Life in the Yosemite: an Account of the Mammals, Birds, Reptiles, and Amphibians in a Cross-section of the Sierra Nevada. By J. Grinnell and T. I. Storer. Pp. xviii+752+62 plates. (Berkeley, Cal.: University of California Press, 1924.) 7.50 dollars.

THE present volume describes a survey of the vertebrate natural history of the United States National Park of the Yosemite region, the geology and botany of which had previously been explored. It was under-

taken by the California Museum of Vertebrate Zoology, its object being to learn the species and the local distribution of each, to map out the general life areas, to learn the food relations and breeding habits of the species, and, finally, to present all in a form accessible to the public, both lay and scientific. The section studied is divided into six zones, the characters of which are enumerated, the species found in each being shown pictorially; as the Sierra crest is 10,000 to 13,000 feet in altitude and the two sides of the divide differ greatly in aridity, there is clearly plenty of scope. Censuses of birds observed are recorded, numbers of each species seen in stated times and distances in each zone. The balance of Nature from insect to bird, bird to tree, and tree to insect is claimed to be mutually beneficial. Then follows a typical natural history account of each of the 246 species of mammals, birds, reptiles, and amphibians that were found, the book closing with an excellent bibliography and more than sixty well-chosen plates illustrative of the fauna. We should certainly have this book with us if we were visiting the Yosemite region, for, as a first complete work on the locality, it adequately fulfils its object. It will be a useful basal foundation for subsequent periodical surveys to ascertain the changes taking place in the Park due to the closer settling of neighbouring regions.

The Marine Plankton, with special reference to Investigations made at Port Erin, Isle of Man, during 1907–1914: a Handbook for Students and Amateur Workers. By Dr. James Johnstone, Andrew Scott, and Herbert C. Chadwick. Pp. xvi+194 (20 plates). (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd., 1924.) 12*s.* 6*d.* net.

THIS is an account of the researches of the authors on the distribution and succession of the plankton in a particular area of the sea. Apart from the important data recorded here, the book gives an admirable account of how a research of this kind is and should be conducted. It can therefore be used as a preliminary guide by any one who wishes to pursue a similar research in other parts of the sea.

After an opening chapter on "The Plankton in General," a large series of illustrations is given of various plankton types. These enable the student to identify the main classes to which the organisms of a particular plankton sample belong. A chapter on the distribution in space of plankton and the succession of forms throughout the year then follows: this is based on the authors' researches. The last chapter gives an account of nutrition in the plankton and of organic production by plant and animal organisms.

There is a valuable appendix on methods to be employed, and a short bibliography from which further references can be obtained. The illustrations are very good. The reference to the quantum theory on p. 156 is perhaps rather out of place in a book of this scope; the account is necessarily too short to be clear, and does not really seem to be of importance to the argument.

This kind of book is unfortunately not common enough. One cannot help wishing that there were books of a similar scope and price to help the student of, for example, fresh-water biology.

The Principles and Practice of Fly and Bait Casting. By Reginald D. Hughes. Pp. xi+80+8 plates. (London: A. and C. Black, Ltd., 1924.) 5*s.* net.

MR. HUGHES is both a caster and an angler, that is, he is an expert in the art of casting for its own sake, without regard to its application to the sport of fishing, and also an enthusiastic angler, who has brought to the pursuit of his sport all the knowledge acquired in the practice of his art. His book, therefore, will be of the greatest service to anglers. It covers both branches of angling, dry-fly fishing, and fishing with bait, and in each case the general principles involved are discussed, and precise and careful directions given for both single-handed and double-handed rods. The veriest tyro can follow the author's instructions with ease, and should, by careful attention to detail and assiduous practice, acquire that precision in casting which will add to the pleasure of his sport and to the weight of his basket. Clear illustrations and drawings help the text very materially, and anglers will be grateful for the sound advice so clearly and concisely given. Casting is not fishing, as the author is aware, but that correct casting is the first requisite in the making of a successful angler, no one, least of all anglers themselves, will deny.

A Dictionary of Electrical Terms: for Electrical Engineers and Students. By S. R. Roget. Pp. vii+296. (London: Sir Isaac Pitman and Sons, Ltd., 1924.) 7*s.* 6*d.* net.

As many new branches of applied electricity are continually developing, new terms come into use, and it is difficult even for the professional electrician to remember what they all mean. This book of Mr. Roget's therefore fulfils a useful function. For example, it is no use to look up in an ordinary dictionary to find out what a traction engineer means by an "ear" or a "frog," or an illuminating engineer means by a "lux" or a "lumen." We are glad that the author includes American terms. Every electrician must now read a certain amount of American technical literature, and he might easily be puzzled by such terms as "resistor," "inductor," "quarter-phase," etc. We can congratulate the author on having got such a comprehensive list into such a small volume. It will prove useful to many.

The Racing Eight: Notes on its Design and Propulsion. By W. B. Coventry. Pp. iv+39. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1922.) 3*s.* 6*d.* net.

MR. COVENTRY'S aim is to discuss how to obtain the maximum speed out of a racing eight. It is clear that the design of the boat is an important factor determining the success or failure of the crew, and the author claims that in several cases the result of the Universities Boat Race was due to the superior design of the boat used by the victors. His chief contention is that a racing eight should be as short as possible. He bases his view on theoretical grounds, as well as on the successes achieved by the short boats constructed by Mat Taylor of Newcastle for Oxford in 1857 and for the Chester Rowing Club in 1856. In his theoretical investigation he assumes that the resistance is mainly due to surface friction on the wetted surface, being proportional to the wetted area and to the 1·852 power of the speed. S. B.

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.]*

A New Method of Investigating Sea Waves.

THE common methods of investigation of a high sea permit the height and the length of waves to be measured, but do not give any means of determining the changes of form of the wave, which can sometimes differ considerably from the simple form of a trochoid. "Forced waves" especially undergo deformation inasmuch as their steepness has often to be left out of account. Precise stereo-photogrammetric methods are always complicated, cumbersome and slow, which reduces their applicability to large amounts of material, as in other regions of geophysics. In such cases, when comparisons of the steepness of waves have to be made with large masses (as in the comparison of ocean and smaller sea waves) in order to study the relations between it and the wind-velocity, etc., the following method can be used.

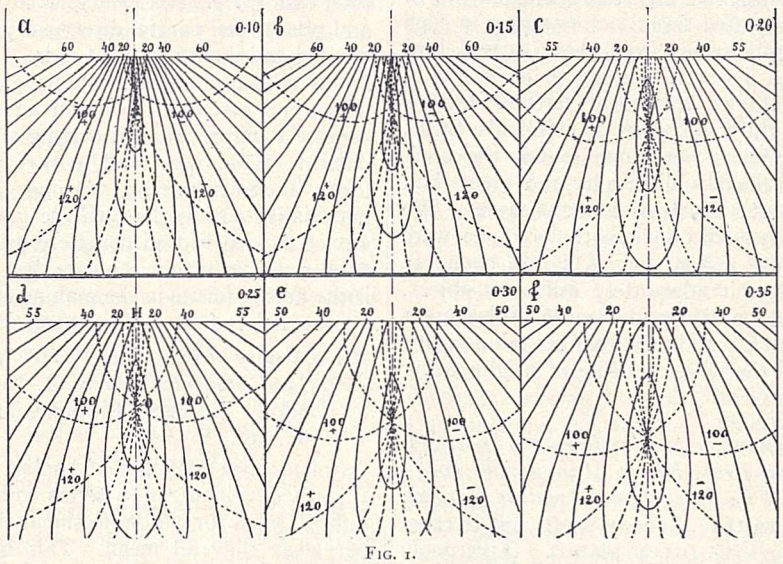

FIG. 1.

If rays from the sun fall upon a perfectly calm mirror-surface of water, an observer sees a single reflected image of the disc of the sun (or the moon may be used) at a point which makes with the horizon the same angle downwards as the heavenly body is above the horizon. In reality, there are generally instead of a single image a series of such shining spots, forming a shimmering strip upon the waves through reflection of the luminary in innumerable mirrors from differently inclined elements of the sea waves. By following the rays of light, one can find the relation between the position of a sparkle on the surface of the sea and the inclination of the corresponding element of the wave, as well as the direction of its path. To create a clear picture of a high sea it is best to use a net of isoclinals (of curves of an equal inclination of waves to the horizontal plane) and isogonals (showing an equal rotation of a wave-element about the vertical axis) as projected on the surface of the sea, in the place of the strip of glittering spots under the sun (or moon). On such a net, constructed by me by means of a very simple instrument[1] for six different heights of the sun (Fig. 1),

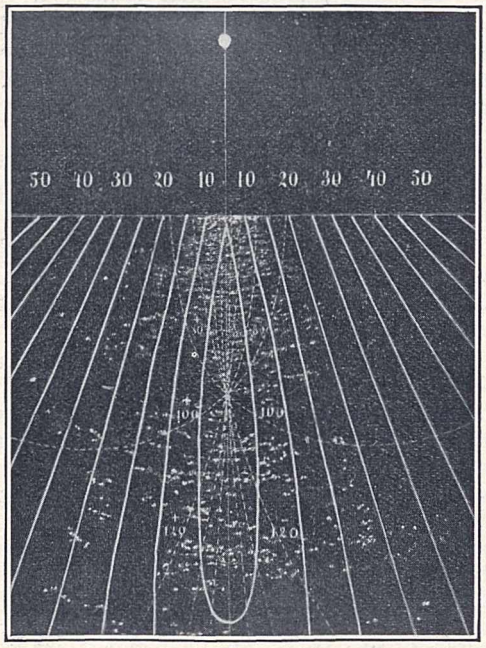

FIG. 2.

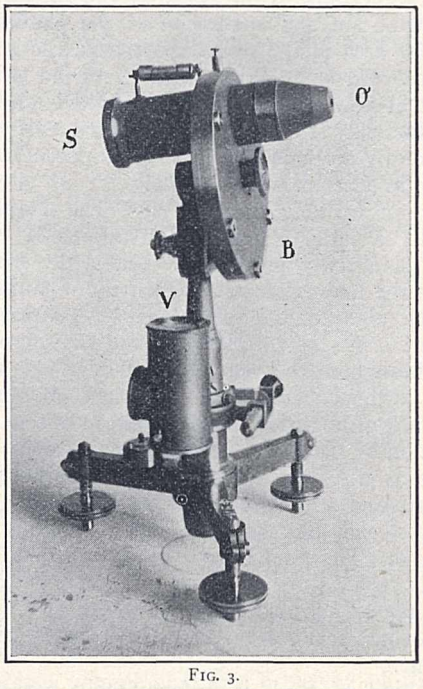

FIG. 3.

may be superposed a photographic negative of the light strip on the sea surface.

[1] Was. Shoulejkin, *Nautical Magazine*, 1924, and Hydrographical Memoirs of Russian Hydrographic Office, 1924.

The scale of nets (Fig. 1) may be such that the distance *HO* (Fig. 1, *d*) is equal to a quarter of the focal length of the apparatus used in taking the photographs. As an example, I give here a photo (Fig. 2) superposed on a net. As will be seen, the predominating steepness of the waves is here equal to 15°. The steepness of small waves arising from the surface of the chief waves is nearly 35°. A rush of wind is evidently creating capillary waves with an azimuth +120°, as can be seen from the sparkles superposed upon corresponding curves.

If observations are made, not from a ship, but from a sea shore, photographs are unnecessary; it is sufficient to project a corresponding net of curves (Fig. 1) directly on the sea surface. For such observations I have constructed an instrument, illustrated in Fig. 3. In the field of the eye-piece, *O*, of the tube *OS* is placed a revolving disc (enclosed in the round box *B*) with six nets like those of Fig. 1. The observer rotates the instrument about the vertical axis until the image of the sun's (or moon's) disc appears on the control-line of the ground-glass (*V*). On this control-line are marked six points, corresponding to six particular heights of sun, and provided with the same numbers as the nets of the revolving disc. After noticing at which of the points the sun's image is situated, the observer brings into the field of view the net with the corresponding number, and he can then easily find the steepness of the waves as well as their direction.

It would be of interest to make observations of the influence of wind-velocity, and of the depth and size of the basin, on the steepness of the waves, possibly on a large scale, by means of this simple method.

WAS. SHOULEJKIN.

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The "Ship-designs" on Prehistoric Egyptian Vases.

THE interpretation of the ship-like designs painted on the light-brown vases of prehistoric Egypt, such as those figured by Sir Flinders Petrie on plates xix.-xxii. of his "Prehistoric Egypt," has given rise to considerable discussion. These designs, which have been considered to be "stockaded forts," "barbaric designs of boats," or "sea-going galleys," present a more or less curved structure from which a long series of tall columns or "fringe-like lines" (Budge) depend from its under margin at about equal distances apart. Those who adopt the boat interpretation consider these fringe-like lines or columns to be oars. Others interpret them as sand-ripples. Upon this curved structure stand two erections designated "cabins" by some writers; by others as "two blockhouses forming a pylon entrance." They stand on each side over above a gap in the pendent series of fringe-like lines. The majority opinion supports the view that these pictures are ship-designs; but many find it difficult to convince themselves of the reality of this interpretation for several reasons.

The body of the structure, or platform, is certainly boat-like and is probably modelled upon a boat; but the pendent columns, which obviously have no resemblance to oars, all originate from the lower margin of the platform and are never shown reaching as high as the gunnel level, which they would naturally do if they were oars; nor in any of the designs are there ever any indications of rowers. The number of the pendent fringe-like lines, which varies from 30 to 70 on a side, is out of all proportion to that required as oars, even if the structures represent sea-going galleys. Moreover, 60 to 140 sailors could not be accommodated, not to speak of their oaring, in the space provided for them on any of the crafts pictured. Sir Wallis Budge, while accepting the adscription of these structures to boats, considers the "fringes cannot represent oars," but "the water through which the boat is passing." If the fringes be not oars, it seems to me that the rest of the picture can scarcely represent a boat. The identification of the fringes with water, however, fails to explain the invariable behaviour of this element in spacing itself opposite the cabins on the deck; or why in Vase Brit. Mus. 32,639 the usual hieroglyphic for water, employed in the upper part of the panel, is so different from the "water" of the fringe-like lines.

Since the pottery decorators of the period knew quite well how to delineate "with unusual delicacy and spirit" boats with boatmen in action, and in appropriate number, as plate xxi. 46K of "Prehistoric Egypt" attests, it is difficult to understand why artists so capable should draw such barbaric objects if they intended them to be boats. These pendent columns (*tom. cit.* plate xix. 40M) are frequently represented, by the usual hieroglyphic, as set in water. Although this sign is often omitted it may be taken for granted, since all these ship-designs are so similar, that they all bear the same relation to water, associated as they are so frequently with a long-legged wading bird—the flamingo. I suggest that the associated flocks of flamingoes supply the key to an interpretation of the designs in question somewhat different, I believe, from any so far proposed. It is important to note that the birds are flamingoes and not ostriches. "The Cambridge Ancient History" (i. p. 570) and Sir Wallis Budge (Brit. Mus. Guide to the IV. etc., Egyptian Room, p. 247) designate these birds ostriches.

In 1909 I suggested in NATURE, with regard to the same scenes, that the birds were flamingoes, not ostriches, a view which has been accepted by Sir Flinders Petrie and others. The scenes under discussion are much too watery for birds with feet adapted to the hot desert sand. The pictures are consequently not river scenes, which flamingoes do not frequent, but shallow lagoons, or inundated marsh lands beloved of these birds, which are here seen at home, and not passers-by on the wing, or casually resting. In such lagoons surely (since the water does not reach half up the flamingoes' tarsus) it would be impossible to navigate a craft requiring 140, or even 70 oarsmen. The figured structures therefore, I suggest, are not craft either for river or sea navigation, but represent in front view, perspective disregarded, watchers' naviform pile-platforms or hunting-lodges supported on reed piles set up in the delta lakes or the marshes—hunting-grounds from time immemorial. On plate xix. 41U (*tom. cit.*) there are seen the halves of two mounds of concentric wavy circles, which might excellently, and probably are meant to, represent, in plan, flamingoes' nests, which, as is known, are composed of mud built up in zones of decreasing diameter to a summit depression a couple of feet out of the water.

The ruminants pictured in the same scenes, and in some of them apparently inside the "lodge," probably represent animals—including a flamingo—either captured and imprisoned for domestication, or subjects for capture still feeding in the fens. The flowering plants so often figured in relation to these ship-designs seem to me (if I may dare to differ from a botanist so well versed in the African flora as Prof. Schweinfurth) scarcely to represent the aloe, a plant with which I was familiar in Sokotra, where, as in Egypt, it was hung as a charm over the doors of houses. Only one flower stalk arose from each root-stock; in these scenes there are sometimes more than one. Besides, the habitat of the aloe is in dry, rocky or sandy situations; a flamingo-frequented

marsh would not suit it. The figured vegetation recalls to me rather foreshortened date-palms with branching fruiting stems, showing in addition the cabbage—prized as a vegetable—in the crown of the palm. Sir Flinders Petrie, however, is of opinion that they are "aloes in tubs or vessels around which the leaves hang," as they are "never represented as springing from the ground." If so, the tubs must be standing in the watery mud. The stem of the plant (Petrie's "tub" I take it) shows palm-like growth-rings; and though it does not reach the water or ground, neither do always the "oars," the birds' or the ruminants' feet. The fan-like objects (*tom. cit.* plate xx. 44D) among which the flamingoes are wading, appear to me to represent young palms growing from the nut (which in palms sprouts without necessarily being covered) in or on the edge of the water, as I have seen them throwing up a single leaf on the marshy edge of the river of Hadibu in Sokotra.

The two erections midships on the deck (resembling cabins on paintings of unmistakable boats), each flying its Nome ensign, may be entrance gateways, or perhaps shelters. The gangway between them is invariably situated over the gap in the piles, the discontinuity of which would facilitate landing at the lodge from a reed-bundle float or small boat, or afford a passage-way underneath the lodge. The overhanging branch at one end may serve for shade—perhaps branches with dates for refreshment—just as it does at the look-out end of navigable Nile boats; while the tying-up rope dangles from the stem for the purpose of mooring any visiting boats.

HENRY O. FORBES.

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The Supposed Constancy of the Hybrid between the Common and the Water Avens, *Geum urbanum* × *rivale*.

IN several publications issued during the last few years,[1] M. L. Blaringhem has asserted that the hybrid *Geum urbanum* × *rivale*, sometimes described as *Geum intermedium*, retains its character unaltered during subsequent generations, and he cites this plant therefore as an example of the constancy of an interspecific hybrid. In making this assertion M. Blaringhem neglects to take account of the result of experiments carried out by us,[2, 3] which are in direct contradiction to the view he puts forward. We should like therefore to direct attention to the facts observed by us and confirmed by further experiments.

Our observations were made quite independently, and have resulted in the establishment of the fact that a distinct segregation of characters takes place in the f_2 generation of this hybrid. This segregation concerns a considerable number of characters.

1. The *inclination of the peduncle* varies both towards the pendant condition of *G. rivale* and equally towards the erect position of *G. urbanum*.

2. The *presence of anthocyanin* in the peduncle and calyx, which the f_1 generation inherits from the Water Avens, varies considerably in degree in the f_2 generation, and this colouring matter may be almost absent in some specimens.

3. The *calyx*, which is more or less expanded in the f_1 generation, shows this condition in the majority of cases in the f_2 generation, but some individuals possess the closer calyx of *G. rivale* and others the reflexed calyx of *G. urbanum*.

4. The *colour of the flower* in the f_1 generation partakes of the character of both parents, the petals being yellow on their inner and red on their outer surfaces. In the f_2 generation there is a distinct segregation of yellow colour, about 75 per cent. having this colour and 25 per cent. lacking it, according to the observations of one of us. This proportion agrees with the Mendelian ratio 3 : 1. The red colour varies considerably in degree in f_2, but scarcely any individual is found to lack this colour entirely. This may be explicable by supposing this colour to be due to several factors.

5. A segregation is also presented by the *form of the petals*. Thus, one of us has shown that in the f_2 generation 49 individuals had notched while 159 had entire petals, figures which approximate very closely the Mendelian ratio of 1 : 3.

6. The *stipules* were observed to show considerable variation in size in the f_2 generation, tending towards those of the respective parents.

It seems curious that, in spite of such obvious segregation to which we have directed attention, M. Blaringhem should still maintain the former but erroneous view that *Geum urbanum* × *rivale* is an example of the constancy of hybrids between different species. This is all the more remarkable as M. Blaringhem admits in his publication of 1922 the occurrence of some variation in this hybrid. We can only imagine that he has not recognised that such variation is due to segregation because some of the characters may be due to two or more factors; so that to obtain completely recessive forms it is necessary to cultivate a very large number of individuals.

As M. Blaringhem's erroneous view of the constancy of hybrid *Geum urbanum* × *rivale* may gain currency among those who are not familiar with the progeny of this plant, it seems desirable to direct attention to the results of the experiments carried out by us prior to the publication of his conclusions.

F. E. WEISS.
D. ROSÉN.

The Victoria University of Manchester.

Fine Structure of X-Ray Absorption Edges.

IN the issue of the *Zeitschrift für Physik* for July 2, 1924, Dr. Coster reports the existence of a white line on the long wave-length side of the absorption edge in the case of the higher valence forms of various elements. Evidence has been obtained in this laboratory that iodic acid and potassium permanganate, two of the substances for which he reports this line, are slowly reduced by X-rays. If this occurs in the absorbing screen, it seems reasonable to expect that the photographic plates will show not only the absorption edge of the original compound, but also that of the reduced portion. According to Lindh's results with phosphorus, sulphur, and chlorine, the absorption edge of the reduced form might be expected to fall on the long wave-length side of the main edge. It seems reasonable, therefore, to raise the question whether the white line Dr. Coster reports may not be the absorption edge of that part of the material in the absorbing screen reduced by the X-ray.

In the effort to discover whether reduction of iodic acid could be demonstrated chemically, we have sealed portions of a 25 per cent. solution of iodic acid in water in thin walled glass test-tubes, with suitable precautions to prevent reduction by the heat of the blast lamp. In one of these tubes of iodic acid we

[1] Blaringhem, L. Les Problèmes de l'hérédité expérimentale. Paris, Flammarion, 1919. Habilité et fertilité de l'hybride Geum urbanum L. × rivale L., *Comptes rendus Acad. Sci.* T. 170. Paris, 1920. Nouvelles recherches sur les hybrides, *Comptes rendus de l'Ass. Française pour l'Avanc. des Sciences*, 1922.

[2] Rosén, D. Kreuzungsversuche G. urbanum L. × rivale L. *Botaniska Notiser*, 1916.

[3] Weiss, F. E. Geum intermedium (Ehr) and its segregates. Report Brit. Ass., Dundee, 1912.

placed a cubic centimetre of chloroform and in another an equal amount of carbon tetrachloride, both of which give a pink coloration in the presence of free iodine. The other tubes contained only iodic acid and were broken open and tested with chloroform after X-raying for a number of hours. All the tubes gave the test for traces of iodine after exposure to the X-rays. Solid iodic acid crystals take on a brownish coloration when X-rayed, but it has not yet been found possible to demonstrate conclusively that this coloration is due to free iodine. A very dilute solution in water of potassium permanganate was found to have lost its pink colour and to have become distinctly yellow after being exposed to X-rays for an hour, thus indicating reduction of the permanganate ion.

A little evidence has also been obtained on the spectrographic side. We have taken plates of the iodic acid L_3 absorption edge with a Siegbahn spectrograph, using two different absorbing screens, one containing iodic acid free from all traces of iodine by the chloroform test and the other containing iodic acid contaminated with traces of iodine or iodide. The white line on the long wave-length side of the edge was more pronounced with the impure iodic acid.

The spectrographic data available would also seem to support our hypothesis in that it shows a rather remarkable agreement between Dr. Coster's values for the white lines with highly oxidised compounds and the values for the absorption edges with the free elements. In the case of iodic acid, he gives 2711·5 X units for the white line and 2712 for the absorption edge of free iodine. For tellurous acid, he reports the white line at 2846·9 X units and his value for the edge of metallic tellurium is at 2847·1. We have just obtained the absorption edges for metallic antimony and metallic tin, and the agreement with the white lines Dr. Coster reports for the oxidised compounds of these elements is equally striking. He reports white lines at 2991·1 and at 3147·5 for the oxidised compounds, and we have found the absorption edges for the free elements at 2991·5 and 3146·9 respectively. Thus, in the case of all four elements, the absorption edge for the free element is within a fraction of an X unit of the value Dr. Coster gives for the white line. This, coupled with the fact that X-rays can act as a reducing agent, would seem to be definite evidence in favour of the hypothesis that a part of the highly oxidised compound in the absorbing screen is reduced and that the white line reported is the absorption edge of the reduced portion. KATHERINE CHAMBERLAIN.

Physical Laboratory,
University of Michigan,
August 31.

Low-Voltage Arc Spectra of Copper and Silver.

IN NATURE of July 21, 1923 (vol. 112, p. 100), was published a letter from me giving results I had obtained on the ionisation potentials of copper and silver vapour by the low-voltage arc method. The spectroscopic examination of these metals is complicated by the fact that the spectrum of the ordinary arc contains large numbers of spark lines. By using a three-electrode arrangement *in vacuo* such as was used by Foote and Mohler, I have succeeded after some difficulty in obtaining spectrograms of the ultra-violet arc spectrum of silver vapour entirely free of spark lines. The only lines appearing are the first two pairs of the principal series. The wave-lengths of the second pair, as measured by Pina, are not correct. The small quartz spectrograph which was used in these experiments, and was in perfect focus, gave values always within 0·1 Å of the calculated wave-lengths quoted by Fowler. This is sufficient evidence that the value of the ionisation potential given in my former letter is incorrect.

The arc spectrum of copper is, of course, complicated by the presence of at least one "X" level between $1S$ and $1\pi_1$, which makes it possible for arc lines other than principal series lines to appear below the limit of the subordinate series at about 3145 Å. The arc in vapour at 8 volts gives a large number of lines terminating with a single line. This line I have measured on five plates of the ordinary arc, and have obtained values 2024·30 Å, ·35, ·30, ·34, ·36, giving an average of 2024·33, the value calculated for $1S - 2\pi_1$. This line is very strong in the low-voltage arc and it certainly cannot have any accompanying line of comparable intensity at 2025·67, the wave-length calculated for $1S - 2\pi_2$. This throws much doubt on the accepted interpretation of the X-combinations leading to these values.

The three-electrode apparatus which gave only arc lines in silver shows the copper lines given in List I., when operated at 8·2 volts and 6 m.a. These lines are almost certainly arc lines, and must, therefore, be combinations either with $1S$ or with terms of type X. They should be important in the disentanglement of the copper arc spectrum.

LIST I.

2165·08	2824·42
2179·39	2883·00
2181·74	2961·19
2225·68	3010·90
2230·11	3036·09
2441·67	3063·41
2492·15	3247·55
2618·39	3273·96
2766·38	

List II. contains lines extra to List I. which appear on a plate taken with an 8-volt arc in copper vapour. These lines must be either arc lines or easily excited spark lines. The wave-lengths are those given by Huppers. All the lines are so faint that intensities cannot very well be given, but the very faint lines are indicated with an f.

LIST II.

2024·33 (calc.)	2238·46 f
2138·54 f	2244·22 f
2199·64	2260·48
2214·58	2263·07 f
2215·68	2293·85
2227·74	2392·64
2236·28 f	2997·38 f

The difficulty of obtaining spectrograms of the visible region is much greater because of the high temperature of the filament and furnace, and so far only one rather unsatisfactory photograph has been obtained. It is hoped, however, to cover this region in the near future. A. G. SHENSTONE.

University of Toronto,
August 18.

Organisation in Chemical Societies.

IN common with all other members of the Chemical Society, I have received a notice to the effect that there is to be a virtual increase in the annual subscription, in that an extra charge will be made for the Annual Reports, which have hitherto been supplied to members free of charge, and at the same time directing attention to the need for increasing the membership of the Society. I have little doubt that the result will be that many members of the Society will not purchase the Report; but as this publication appeals particularly to students, and as it is from men

of this class that the Society should draw its new members, I fear that the new policy will defeat its own object.

I take this opportunity of directing attention to the position in which the lack of organisation in the chemical world places the younger men, and in particular those who are entering industrial life. The young industrial chemist may be expected to belong to the following organisations, and to pay the corresponding subscriptions, in addition to entrance fees, which I have not set down :

The Chemical Society . . .	3*l.*	0	0
Institution of Chemical Engineers .	5*l.*	5	0
Institute of Chemistry . . .	2*l.*	0	0
Society of Chemical Industry . .	2*l.*	10	0
Faraday Society	2*l.*	0	0

The total amounts to an annual charge of nearly fifteen pounds, and in addition there will be the subscriptions to be paid to one or more specialised organisations.

Between them these societies do not possess a library which is in any way comparable with the Patent Office Library, or a lecture hall which will accommodate even a moderately well attended meeting ; no set of *abstracts* comparable with "Chemical Abstracts" of the American Chemical Society is published in the country. These are hard things to say, but it is time that attention was directed to the facts.

A recent attempt of my own to recruit for one of our societies met with failure, as my intended victim pointed out that "he had the use of the Patent Office Library free, and generally preferred to attack his chemical literature through the publications of the American Chemical Society." Will any chemist suggest a suitable reply ? I have not been able to think of one.

When reorganisation of the societies connected with chemistry is suggested, it is always stated that it is impossible to raise the money which will be required. I have had a good deal to do with the raising of money for such objects, and there is one thing I know in connexion with the matter. It is this. If you want to raise money you must show that you are spending what you have got economically. You must also show that you know what you want, and what you are going to do with the money when you get it. If, as is rumoured, schemes for reorganisation are under consideration, it is well that they should see the light of day in a form in which they can easily be understood, and as soon as possible.

M. W. TRAVERS.

147 Queen Victoria Street,
London, E.C.4,
September 22.

Surface Tension and Fine Particles.

THE formation of colloidal particles is undoubtedly influenced greatly by the forces of surface tension, which will tend to cause the coalescence of fine crystals into small amorphous bundles probably spherical in shape. An elementary investigation into the forces at work shows that the activity due to surface tension effects, when one is dealing with very small particles, may be very much more pronounced than is the case with our usual observation of larger masses.

If we consider the case of two equal small spheres of matter brought together, for example, two small drops of water in air or two colloidal particles in a liquid, surface tension forces tend to make them coalesce into one body having the least possible area. The action is regulated by the law that the reduction in the potential energy of the surface is equal to $T \times \Delta A$, where T is the surface tension between the surface of the particles and the surrounding medium (supposed constant) and ΔA is the change in area due to coalescence. The total change in energy is then proportional to the square of the radius of the particles (r). This change of energy is the seat of the force pulling the particles together and deforming them into a new shape. As energy has the dimensions of FL, we have a quantity of dimensions (FL) varying as r^2, and consequently the force involved will vary as r. Now force induces in mass an acceleration, and consequently the acceleration (a) produced by the surface tension action is such that $a \propto F/m$. Since $F \propto r$, and $m \propto r^3$, the acceleration produced varies inversely as the square of the radius of the particles.

Although, of course, no definite acceleration can be determined in any particular case, the above shows that what we might call the "activity" of the effect of surface tension on small particles will vary inversely as the square of the radius of the particles and, for very small ultramicroscopic particles, the rapidity of this action will be far beyond anything that we are acquainted with in ordinary macroscopic observation.

E. F. BURTON.

Department of Physics,
University of Toronto.

The "Hole, Slot and Plane" Geometrical Constraint.

A DETAIL in the "hole, slot and plane" geometrical constraint (which is one of the commonest forms of the "six point support" mentioned in Sir George Greenhill's letter in NATURE of September 27) seems often to be described and constructed wrongly. In this constraint, one contact occurs between a rounded projection on one body and an approximately "plane" part of the second body ; two contacts occur between a rounded projection and the sides of a groove or "slot" ; and the remaining *three* contacts should therefore be arranged to occur at the "hole."

The "hole" contact should not consist of a conical point resting in a conical hole of larger angle ; for contact would not occur at three places, and the two cones cannot be made accurately right to their apices. If a conical projection be used, resting in the end of a simple circular cylindrical hole, contact would in general occur at two places. If the axes of the cone and cylinder were coincident (or if a sphere were used in place of the cone), line contact would theoretically occur, the actual places of contact depending in practice on the accuracy with which the surfaces were shaped. The *three* contacts at the "hole" could, however, be made by using a spherical or conical projection resting in the end of a hole of triangular transverse section (or resting on three spheres or three cylinders attached to the second body).

W. N. BOND.

University College, Reading,
September 17.

The Large Black Slug at Honolulu.

LAST month, when in the Mansa Valley, Honolulu, Hawaiian Islands, I became acquainted with the large slug which is now common in that locality. A living specimen was handed to me by Dr. Robert Faus, and later Dr. Montague Cooke gave me a good series from the collection of the Bishop Museum. Until recent years these slugs were unknown in the islands, and no

doubt remained that they had been introduced. Nevertheless, as Dr. Cooke informed me, no one knew whence they came, or what (if any) described species they represented. I find that they agree with *Veronicella leydigi*, described from specimens collected at Brisbane, Queensland. Simroth, who made the species known, gave good coloured figures, and figured the anatomy. Henry Tryon (1899) gave a popular account of the slug, showing that it was destructive in gardens. Both he and C. Hedley were of the opinion that the animal had been introduced from some unknown locality. Dr. Willey found specimens at Esafate, New Hebrides, and this may be the original home.

The species will be known by its large size, dark colour above, with a slender yellowish line; more or less black beneath (as well shown in Simroth's figure), with pale sole. I described the living specimen thus: upper tentacles black above, dull yellowish below; lower tentacles stout, pale basally, black at apex; back dull black, with a slender broken pale ochre-tinted line, best defined posteriorly; underside black, with the sole dull pale yellowish; length about 80 mm., width about 25 mm., width of sole about 13 mm. Internally, a noticeable feature is the great length of the filiform glands. Probably this slug has been carried to other places, and it will be of interest to record new localities, should they be found. The specimens described by Simroth were not of full size, but the large size of well-grown examples is shown by Tryon, who gives a good photographic plate.

T. D. A. COCKERELL.

University of Colorado, Boulder,
September 3.

The Preparation of Line Sources of Radium C.

WHEN an active line source of radium C is required, the usual method of preparation is to seal a platinum wire into the end of a glass tube. Radium emanation is pumped into the tube with mercury, the wire being made the negative electrode with the mercury just beneath the wire forming the positive electrode. After a sufficient exposure, the emanation is pumped off, and the glass tube broken to remove the source. Even with quantities of emanation so small as 10 to 20 millicuries, the efficiency is very low, only 10 to 15 per cent. of the active deposit being found on the wire. This low efficiency is probably due to the distribution of the potential gradient along the wire. The drop takes place between the end of the wire and the mercury, while in the upper part of the tube there is practically no potential gradient. Thus most of the emanation is in a "dead" space.

The efficiency may be increased fourfold by the following device, which has been in use here for some time with satisfactory results. The wire is sealed into the tube as before, and a thin foil of iron or nickel, which will not contaminate the mercury, is slipped into the tube, forming a cylindrical sheath around the wire. The emanation is pumped into the tube and the mercury level raised until it makes contact with the sheath. The wire is made negative and the mercury and sheath positive. 110 volts gave 40 to 45 per cent. of the active deposit on a wire of 0·4 mm. diameter; 200 volts gave an efficiency of more than 50 per cent. The tube should be of not less than about 7 mm. internal diameter, and the foil should fit as snugly as possible against the wall right up to the end of the tube.

G. H. HENDERSON.

University of Saskatchewan,
Saskatoon, Saskatchewan.

Recent Work at Stonehenge.

THE extremely interesting article of Col. Hawley in NATURE of September 20 leads me to ask him two questions which are raised by it:

(1) Were the Bronze Age interments found on both sides of the rampart, or only on the outer side?

(2) Are the "Aubrey Stones" contemporaneous with the main structure of Stonehenge, or were they a subsequent addition?

A description of Stonehenge has long been recognised in Diodorus Siculus (ii. 47), which he derived from Hecatæus, a writer of the 6th century B.C., "& some other" authors. We are told that it was dedicated to Apollo, the sun-god, in whose honour a great festival was held every 19 years which lasted from the summer solstice "to the rising of the Pleiads." We are further told that in the immediate neighbourhood was a city inhabited by the priests and their disciples, who worshipped the god daily with hymns and the harp. It would seem to follow that in the time of Hecatæus or his authorities the sacred precincts of the temple could not as yet have been desecrated by cremation burials.

A. H. SAYCE.

8 Chalmers Crescent, Edinburgh,
September 23.

THE Bronze Age interments referred to by Prof. Sayce occurred both on the inside and outside of the Stonehenge rampart, but by far the greater number were on the inside and at the bottom of the slope. Here there is loose soil about 14 inches deep of humus and chalk rubble, affording easy digging, in which the remains had been deposited without any attempt to make a cist to contain them.

Occurrences of interments on the outside of the rampart were six in number, but the remains were deposited with greater care. They were found at the top of the silt which had filled the ditch, and were placed in bowl-shaped cavities excavated to about two feet from the surface where the rampart slope joins the silt. Owing to deeper burial, they were better preserved and were coated with a thicker deposit of lime than those found inside: they were also greater in quantity and probably represented the remains of an entire body, whereas those on the inner slope were mostly only portions of cremations.

The Aubrey Holes were evidently of Pre-Stonehenge date, as the stratum of that period passed over them and the chips characteristic of it were not found in the soil filling the holes. They were evidently open holes during the neolithic period, for in one of them there was a quantity of chips which had been discarded by an implement maker and evidently struck from one large piece of flint. Some of them can be fitted together, and when so placed it is interesting to see where the blow was delivered to detach them. There is a description with drawings of twenty-three of these holes in a report to the Society of Antiquaries given in the *Antiquaries' Journal*, vol. 1, Part 1, of January 1921.

I have read the supposed description of Stonehenge given by Hecatæus of Miletus, but regard the existence of a city anywhere near here to be impossible. There are no Bronze Age settlements very close, and those with which I am acquainted in the neighbourhood must have been extremely primitive and rough: very dirty too, if one may judge by the refuse of black ashes, animal bones, and sheards of badly baked pottery strewn about them.

WILLIAM HAWLEY.

Asiatic Expeditions of the American Museum of Natural History.

By Dr. HENRY FAIRFIELD OSBORN.

THE Third Asiatic Expedition was projected in the year 1920 as a sequel to American Museum explorations in Japan, Korea, China, and Mongolia, collectively known as the First and Second Asiatic Expeditions. The first and second expeditions were purely zoological in purpose; the third was planned to occupy the very much wider field of geology, palæontology, botany, zoology, and anthropology. The leader of these expeditions, Roy Chapman Andrews, crossed Mongolia during the season of 1919 and observed that the broad level stretches of the Gobi Desert, bordered with gentle terraces, lent themselves to exploration by automobile as well as by the older method of camel transportation, and he conceived the plan of a geological and palæontological expedition which should begin with widespread reconnaissance by light and heavy automobiles, while the large camel caravan could do the heavy transportation. A camel caravan travels two and a half miles an hour, fifteen miles a day; a well-equipped automobile train is capable of ten times this speed. This plan promised a double advantage over the work of previous explorers who had crossed the Gobi with only a camel transport, namely, Raphael Pumpelly (1864), Ferdinand von Richthofen (1877), and V. A. Obruchev (1894–96).

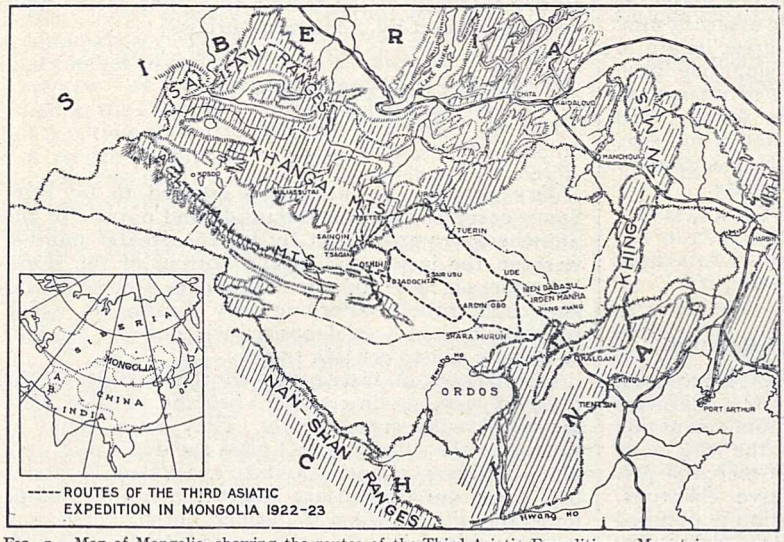

FIG. 1.—Map of Mongolia, showing the routes of the Third Asiatic Expedition. Mountainous areas are shaded with slanting lines, while the great basin of Mongolia is left white.

In the year 1920 Mr. Andrews submitted the plan to the president and trustees of the American Museum of Natural History, chiefly with the hope of putting to the test the theory advanced by the present writer in 1889 and 1890, that the high plateau region of central Asia would be found to be the chief homeland or centre of origin, evolution, and distribution of the great orders of mammals. With this main stated object and the discovery of the principal centre of human origin as the chief popular object, Mr. Andrews aroused widespread public interest and succeeded in financing the expedition for a five-year period, 1921–26. The first year, 1921, was devoted to organisation in China and Mongolia, to the assemblage of the scientific staff and the *matériel* of the expedition. The second year, 1922, was given to a three-thousand-mile reconnaissance in the Gobi Desert and, for a short time, in the Khangai Mountains north of the desert. The third year, 1923, was given to intensive exploration in five of the most promising fossil-bearing formations discovered in 1922.

The 1922 party left Kalgan, northern China, on April 20, according to programme, as follows: Roy Chapman Andrews, leader and zoologist; Walter Granger, chief palæontologist; Charles P. Berkey, chief geologist; Frederick K. Morris, assistant geologist and topographer; S. Bayard Colgate, motor expert in charge of three light and two heavy automobiles; J. B. Shackelford, photographer. A camel caravan train of seventy-five camels left two months earlier and joined the party in the centre of the Gobi Desert. The entire personnel included twenty-three men—six Americans, eight Chinese, nine Mongolians. By the perfect organisation and combination of the modern and more ancient methods of desert transport, the party made a three-thousand-mile reconnaissance in the five months' season of 1922, to the north, to the north-west, south, and south-east, practically skirting the entire desert of Gobi east of the Altai Mountains, but leaving certain regions east of the Urga trail still unexplored.

Both the mechanical and the scientific plans of the expedition involved many hazards, because automobiles had never previously been used in scientific exploration in Mongolia, and the accomplishment of the main scientific purpose of the expedition by discovery of the extinct fossil life of Mongolia and the remains of prehistoric man was at best extremely doubtful. In all the early explorations, and even in more recent geological work, no land fossils had ever been found, with the exception of a single fragmentary rhinoceros jaw with two teeth, which was brought back by Obruchev.

The palæontological and geological results of the first year's reconnaissance were not only encouraging but also very surprising—in fact, they far exceeded our fondest expectations. Only three days after starting, the first bones of Baluchitherium were discovered in the Houldjin gravels, where Obruchev had found the fragmentary rhinoceros jaw. A day later, April 24, the rich dinosaur deposits of Iren Dabasu, 260 miles north of Kalgan, were located. On April 27 were discovered the rich upper Eocene titanothere zone of Irdin Manha and the Irdin Manha formation, by far the most extensive fossiliferous upper Eocene deposit known. The party journeyed north and west, the geologists recording a complete cross-section of

all the rock structures traversed and determining the geologic history of the region. The great bathylith of central Mongolia was determined by Berkey and Morris in the traverse extending northward from Kalgan and westward to the Altai Mountains. For this granitic mass, the dimensions of which seem to compare favourably with the greatest bathyliths thus far known in other parts of the world, the name "the Great Mongolian Bathylith" is proposed. Above the bathylith is found an unconformity, covering early Palæozoic time; then a second unconformity between Palæozoic and Mesozoic time; finally "the Great Unconformity" which marks the close of Jurassic time.

From Jurassic time on, Mongolia has been continuously a continental surface, on which a series of more or less extensive *epicontinental* deposits were laid down. These epicontinental deposits extended in time from the base of the Cretaceous to the Pleistocene. The old rock floor which the bathylith invades includes deposits which range from the ancient Archæan gneisses to late Proterozoic graywackes and limestones which may well correspond with the Nan-K'ou series of von Richthofen. The epicontinental deposits above the old rock floor appear to correspond with the "Gobi Series" of Obruchev.

The technical, geological, and palæontological work of the expedition, largely accomplished in 1922, and continued and verified in 1923, was to analyse the "Gobi Series" of Obruchev into its component formations, beginning in lower Cretaceous time and extending to the close of the Tertiary. In every instance the geologist and topographer, and the four palæontologists worked together, and the rapid succession of important discoveries demonstrated over and over again the value of hand-in-hand work of highly trained field geologists and highly trained field palæontologists. The training of Prof. Berkey in the very difficult pre-Palæozoic and Palæozoic geology of the eastern United States was no less valuable than the quarter century of field experience in the deserts of western United States on the part of Mr. Granger and his able fossil-hunting assistants, Messrs. Kaisen, Olsen, and Johnson.

In the case of each of the three Cretaceous zones, only a single guiding fossil was found in the first season, namely, the skull of the primitive horned dinosaur Protoceratops and the skeletons of the two primitive iguanodonts, Protiguanodon and Psittacosaurus. The discovery of each of these guiding fossils required the sharpest vision and the most prolonged field training.

FIG. 2.—Members of the 1923 party of the Third Asiatic Expedition in camp at Irdin Manha. Middle row, left to right: Walter Granger, Prof. Henry Fairfield Osborn, Leader Roy Chapman Andrews, Frederick K. Morris, Peter Kaisen; top row (Americans), left to right: C. Vance Johnson, Albert F. Johnson, J. McKenzie Young, George Olsen. Two of the young Chinese members—Buckshot (front row, third from right) and Liu (top row, extreme right)—are now at the American Museum being trained as expert preparators. (Photograph by Walter Granger.)

Work during the season of 1923 on the Protoceratops zone proved it to be one of the richest and most remarkable dinosaur deposits of the world. It yielded seven clusters of the now famous dinosaur eggs, four of which were found *in situ*, apparently as they had been deposited, seventy-one skulls and several skeletons of Protoceratops, the ancestor of the great horned dinosaurs of Montana, and three new carnivorous dinosaurs, Velociraptor, Oviraptor, and Saurornithoides. This zone promises the complete life of mid-Cretaceous time in this hitherto unknown continent.

Altogether, eleven chief life zones were discovered in the season of 1922, and a twelfth zone in the season of 1923. In descending order these are as follows:

Pleistocene	OLAN and DISKE, containing *Elephas* and *Rhinocerus*, reported by J. G. Andersson.
Upper Pliocene	HUNG KUREH, 2000 feet, containing the stag *Cervus*, antelope *Hipparion*, camel, beaver, mastodon.
Miocene (?)	PANG KIANG, 500 feet, containing fragment of a rodent jaw, near *Ochotona*.
Lower Miocene	LOH, containing primitive mastodons related to those of the lower Miocene of France, and a rhinocerid.
Oligocene	HSANDA GOL, 3000 feet, containing the giant *Baluchitherium grangeri*, 19 genera of carnivora, rodentia, insectivora resembling those of France and the Rocky Mountains; also ancestral types of the cattle, deer, and pig family.
	HOULDJIN, containing *Baluchitherium*.
Lower Oligocene	ARDYN OBO, 500 feet, containing fauna similar to that of the Oligocene phosphorites beds of France—*Cadurcotherium*, *Schizotherium*, *Cynodictis*, *Eumeryz* (possible ancestor of the deer family).
Upper Eocene	SHARA MURUN, 300 feet, a mammal fauna resembling that of northern Wyoming and southern Dakota—*Protitanotherium* almost identical with species of northern Utah, long-limbed *Aceratherium*, and other mammals.
	IRDIN MANHA, 50 feet, vast flood plain rich in mammals closely resembling those of the upper Eocene of the Rocky Mountains, including carnivores, insectivores, numerous species of titanotheres, and great herds of a diminutive lophiodont. Here occurs the giant primitive carnivorous animal, *Andrewsarchos*, named after the leader of the expedition; also a new form of the dinocerata named *Eudinoceras*.
	ARSHANTO, at the base of the Irdin Manha, yielding numerous small lophiodonts.
Lower Eocene	GASHATO, 200 feet, apparently lower Eocene.
Upper Cretaceous	IREN DABASU, 150 feet, containing middle-sized *Iguanodon*, and the bird-mimicking dinosaurs.
	DJADOCHTA, 500 feet, life zone of *Protoceratops andrewsi*, a partly Æolian formation, 500 feet, containing rich primitive dinosaur fauna of *Protoceratops* and three types of small carnivorous dinosaurs; *Velociraptor*; *Oviraptor*, a small bird-like dinosaur found resting on top of a cluster of dinosaur eggs; and *Saurornithoides*. In this formation were found the seven clusters of eggs, comprising thirty-five well-preserved eggs altogether. In one cluster are seen what appear to be embryo skeletons, probably of *Protoceratops*. Thus all the growth stages in this primitive horned dinosaur, from the egg to the adult, constitute a series which gives us for the first time the ontogeny of a dinosaur.
Lower Cretaceous	ONDAI SAIR, 500 feet, containing *Protiguanodon mongoliense*, small leaf-eating dinosaur related to the *Hypsilophodon foxi* of the Wealden of England, also paper shales with insect fauna.
	OSHIH (Ashile), 1500 feet, containing small parrot-beaked iguanodont dinosaur known as *Psittacosaurus mongoliensis*, and the sauropod *Asiatosaurus* and theropod *Prodeinodon*.

In these *fifteen* formations, representing at least *twelve* new life zones, the main object of the Third Asiatic Expedition, namely, "to test the theory of the central Asian origin of the mammalian life of Europe and America," has been accomplished. According to Osborn's prediction of 1890, proof has been found of the existence in central Asia of all the great orders and of many families of mammals, excepting those orders which by common consent originated in South America, and the four orders which originated in Africa, namely, the proboscideans, the hyracoids, the sirenians, and the toothed whales, according to Osborn (1890) and the discoveries of Beadnell and C. W. Andrews (1893). Surpassing the verification of this prediction as to the mammals, the central Asian plateau proves also to have been the centre of evolution and adaptive radiation of the great division of land reptiles known as dinosauria. From this great home-country of land reptiles and of land mammals, from Jurassic time onward, races migrated westward to Europe and eastward to North America, and this affords the long-desired and complete explanation of the community of the fauna of the Rocky Mountain region and of western Europe, in both Mesozoic and Cænozoic time.

It is a very significant fact in the history of palæontology that the homeland of the mammals during the Age of Mammals, and of the reptiles during the Age of Reptiles, is the very last to be discovered. Beginning with the first palæontological work toward the close of the eighteenth century in Europe, continuing with the thorough exploration of Europe and southern Asia during the nineteenth century, and with the wonderful discoveries in reptilian and mammalian history in North America and South America from the middle of the nineteenth century onward, the homeland was still left untouched and unexplored. Discoveries in North America were so extensive and so revolutionary that many thought the homeland had been revealed in our great western fossil beds. Positive claims were advanced by Ameghino for Patagonia as the homeland of proboscidea and primates. As a result of these discoveries in the western hemisphere, it proves true that several families of mammals did originate in North America and several orders of mammals in South America, but the ancestral stock from which these orders radiated is to be traced to the high plateau region of Asia, where similar causes prevailed first, in the origin of the terrestrial dinosaurs; second, in the origin of the mammals; finally, we may predict, in the origin of primitive man. These climatic and physiographic causes are an elevated country of the savannah type, largely open, partly forested, in which there was throughout a severe competition and struggle for existence leading to highly varied adaptive radiation.

The season of 1923 differed from that of 1922 in the intensive exploration of five of the chief formations discovered, namely, Iren Dabasu, Irdin Manha, Shara Murun, Ardyn Obo, and Djadochta, yielding altogether a great collection of fossils in a remarkable state of preservation. These fossils were safely transported a thousand miles across the Gobi by camel caravan in charge of Mongol drivers, and through superior technical methods reached the American Museum without the least injury. They are now being worked out of the rock by a large force of men in the museum laboratories and are being described by Messrs. Osborn, Matthew, Granger, and Gregory in a series of preliminary papers in *American Museum Novitates* and in more popular form in *Natural History* and *Asia Magazine*. The perfect state of preservation of the

fossil bones and eggs, especially those from the Protoceratops zone, is without precedent; it appears as if wind-driven sand suddenly overcame large numbers of these animals and buried the nests of dinosaur eggs. Several of the Protoceratops skeletons were found entire; others were partly scattered. The little animal known as *Oviraptor philoceratops* (a name signifying "the egg-seizer with a preference for ceratopsian egg diet") was found directly above one of the nests. This terrestrial dinosaur fauna is entirely new to science because it belongs to a period known hitherto only in scattered deposits of littoral formations.

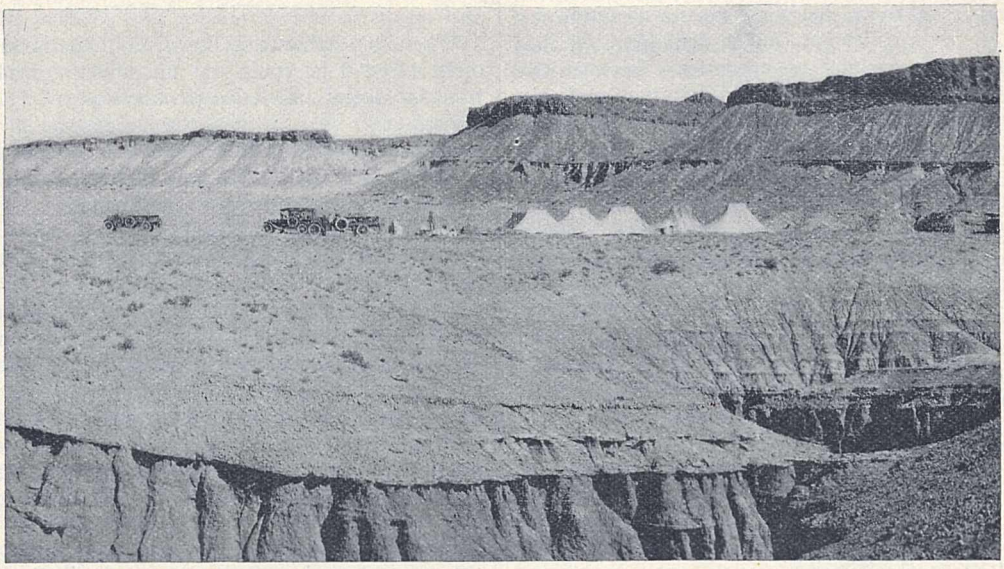

FIG. 3.—American Museum camp of the 1923 season on top of the lower Cretaceous formation Oshih (Ashile). Above is the Oshih plateau, which gives the region its name. Here were discovered the parrot-beaked iguanodont Psittacosaurus and the giant sauropod Asiatosaurus.

Interest in these discoveries, particularly in the dinosaur eggs, has been world-wide and makes evident a constantly increasing knowledge of palæontology and anthropology, which is a most hopeful sign for the future. Upwards of three thousand applications have been received for places on the expedition. The original plan of the Third Asiatic Expedition was to terminate in 1926 with excursions into unexplored portions of northern Tibet and perhaps of Chinese Turkestan, but the discoveries in Mongolia led to an important change of plan. Under the very active leadership of Mr. Andrews a new scientific and financial campaign, begun in November 1923, carried on in the chief cities of the United States, has resulted in a flow of contributions for the continuation of the expedition over a new five-year period beginning in 1924. The sum of 254,000 dollars has all been contributed, and subscriptions are coming from 235 individuals in twenty-five states. One of the leading automobile manufacturers of America has designed new cars, especially adapted for desert work.

The expedition will return to Mongolia with the original personnel, strengthened by a palæobotanist, Dr. Chaney, of the University of California, and an archæologist, Dr. Nelson, of the American Museum staff. The expedition throughout has enjoyed the hearty co-operation of the Geological Survey of China, which has contributed the services of one of its chief members, Dr. Amadeus Grabau, for the work in invertebrate palæontology and palæogeography. The expedition has been favoured by the friendly co-operation of the Mongol Government at Urga, and it is expected that this support will be continued. After seven months of campaign work in America, Mr. Andrews has returned to Peking and will outfit a caravan of two hundred camels to leave Kalgan in December so as to reach the future base of the expedition in western Mongolia in the month of May 1925. From this base, explorations will extend northward and south-westward, carrying the reconnaissance of 1922 into regions not previously explored. The upper Tertiary deposits will, in the meantime, be very carefully explored to test the new theory advanced by Osborn that we must look in the high plateau of Asia or of Europe for the Tertiary ancestors of man. The final publications of the Expedition will appear in a series of volumes entitled "Mongolia and China," of which volume i. will be the narrative of the expedition by Andrews. Volume ii., which will contain the observations and researches of Messrs. Berkey and Morris on the geology and topography, is now in preparation.

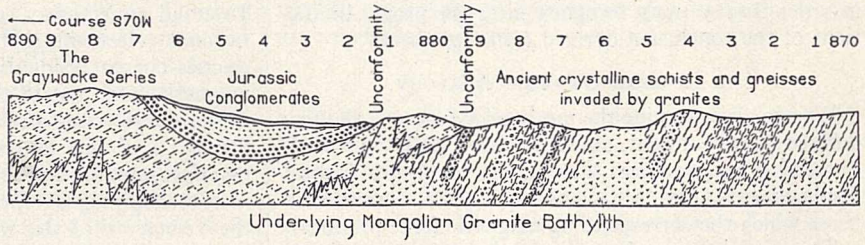

FIG. 4.—Diagrammatic cross-section of geologic relations at Tset senwan. This section lies about 200 miles wes of Urga, where erosion had exposed the granite bathylith and carried away most of its roof of graywack before the Jurassic sediments were laid down. A synclinal remnant of Jurassic conglomerate is preserved here, although several thousand feet of these strata are to be found only a few miles away.

The Forces which lift Aeroplanes.[1]

By Prof. V. K. F. BJERKNES, Geophysical Institute, Bergen.

THE DIRECT GEOMETRIC ANALOGY.

THE fields of motion produced by the pulsating and the oscillating bodies are traced out by the registering instrument, and they can then be compared with the corresponding magnetic fields shown, for example, by iron filings. In this way it can be demonstrated that there is the most striking correspondence between the geometric structure of the hydrodynamic and the magnetic field (Fig. 2). The finest part of this geometric analogy, however, which concerns the simultaneously existing impressed and induced fields in the internal spaces, can only be recognised mathematically. There is the same striking resemblance between the hydrodynamic fields of permanent motion, and the corresponding magnetic fields of steady electric currents.

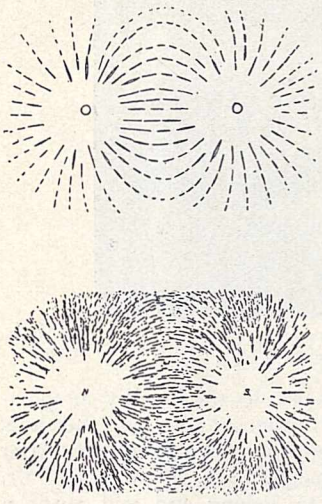

FIG. 2. — Example of the geometric analogy: bodies pulsating in opposite phases and magnetic poles of opposite signs.

One important reservation should be made, however, in connexion with this and the following experiments concerning permanent motion. The theory assumes a frictionless fluid while we make use of the fluid friction as a practical means for producing the required permanent circulation. We have brought in thereby an element not completely contained within our theory: this is important in order that we may recognise later the proper limitations of the conclusion derived from our theory.

THE INVERSE DYNAMIC ANALOGY.

We can also examine the mechanical forces in the two different kinds of field, and it is found that the hydrodynamic force produces attractions, repulsions, lateral displacements, and rotations equal but opposite to those which the corresponding magnetic force produces.

The analogy may be pursued in the most minute details. In all cases we have attraction by oscillations which are symmetrical, and repulsion by oscillations which are anti-symmetrical with respect to a plane, just as in magnetism we have attraction in the case of symmetry and repulsion in the case of anti-symmetry.

Passing on now from the analogy concerning vibratory motion to that of permanent motion, two cylinders rotating in the same direction repel each other so soon as they have had time to produce by friction the required circulating motion of the water. This corresponds to the attraction between electric currents in the same direction. Changing the direction of rotation of one cylinder, the repulsion changes into attraction as soon as the new motion has had time to develop itself. This corresponds to the repulsion between anti-parallel electric currents.

THEORETICAL AEROPLANE.

When my father had shown his experiments he was often asked if he could not imagine practical applications of them. He always answered, "That is not my affair." But if then the inquirer, half excusing his question, added, "The forces are perhaps too feeble to be of any use," he always got the answer, "From that point of view there is no objection. There is no limit to the strength of the forces."

Returning to this question now, forty to fifty years later, we at once see an application of the last illustration, namely, that with the rotating cylinders. The experiment succeeds equally well in air and water. The force will be reduced in proportion to the density, but for this we can compensate by increasing the speed of rotation. One cylinder is displaced normally to the wind produced by the other, or normally to a wind produced by any means, just as an electric current is displaced normally to a magnetic field however the field may be produced: the rotating cylinder is displaced towards that side where the circulation round it assists the external wind, while the current is displaced towards that side where its own field opposes the external field.

We can then use our rotating cylinder to ascend in the air. Given a horizontal wind, let the cylinder be placed horizontally and normally to the wind and rotated so that on its under side it moves against and on its upper side with the wind. Provided we prevent it from being carried along with the wind, it will then be pushed upwards as if attracted by an oppositely rotating cylinder higher up. Using the analogy we may calculate the force per unit length of the cylinder. To avoid unnecessary complications we use Heaviside's rational electromagnetic units. Then the hydro-electric current i equals the line-integral of the hydro-magnetic force, *i.e.* of the specific momentum, along a closed curve round the cylinder. Taking the constant density ρ of the air outside the integral sign we get $i=\rho\Gamma$, Γ representing the circulation round the cylinder. And multiplying by the hydro-magnetic induction, *i.e.* the velocity v of the wind, we get the force per unit length of the cylinder:

$$F=iv=\rho\Gamma v.$$

The formula will be exact if for Γ we take the circulation actually produced in the free air. But not knowing this circulation we may try as a first approximation to identify it with that of the circumference of the cylinder, fully recognising that we do not know to what extent friction is able to transfer this circulation to the air. Let then the cylinder have a periphery of 1 metre and a circumferential velocity of 1 metre per second. This will give unit circulation in the metre-ton-second system. If, further, the wind has the strength of one metre per second, and if we put the density of the air for simplicity equal to 1/1000, we have

[1] Continued from p. 474.

for each metre of the cylinder the lifting force of

$$\frac{1}{1000}\text{ M.T.S. force units} = \frac{1}{10}\text{ kilogram.}$$

A cylinder of ten metres length will then carry a kilogram. If we increase the circumferential velocity from 1 to 10 m. per second, the cylinder will carry 10 kg. If then we increase the wind velocity from 1 to 10 metres per second, it will carry 100 kg. Retaining the angular velocity and increasing the circumference of the cylinder from 1 to 10 metres, we get a lift of 1000 kg., and so on.

Instead of letting the cylinder mount in the wind we can move it against the resting air. We then get an aeroplane having a rotating cylinder instead of the aeroplane wings, and as our calculations have shown, it should be a very effective aeroplane from the point of view of lift if only a small fraction, such as the half or even the fifth part of the circulation of the cylinder, be transferred effectively to the air. But only experiments can give full information of this effectiveness.

The technical difficulties of such an aeroplane, however, are obvious. The main interest is, and will probably remain, theoretical: it is a mental instrument illustrating the dependency of flying upon the hydrodynamic actions-at-a-distance, just as Carnot's thermodynamic engine illustrates the dependency of the steam-engine upon the second law of thermodynamics. To see the relation of this, theoretically the simplest aeroplane, to the real aeroplane we must go to the results obtained by experimental work in the aerodynamic laboratories.

Automatic Production of the Lifting Circulation.

Here we meet with effects of friction which are not contained in the theory developed. We started with the paradoxical result that a spherical body moving at uniform velocity through a frictionless fluid experiences no resistance according to the solution of the hydrodynamical equations. What is then the origin of the resistance always experienced, which seems to be far too great to be explained merely as a direct effect of the small viscosity? The general reason has long been known: it is the formation of a wake of eddies. The origin of these vortices has been investigated especially by Prandtl and his school in the aerodynamical laboratory in Göttingen.

As demanded by theory, the vortices never originate in the free fluid. But however small the viscosity of the fluid may be, there will always be a thin layer close to the surface of the body in which the fluid masses are subject to an intensive shearing effect. This disturbs the symmetry of the motion which should otherwise exist between the front and the back of the cylinder (Fig. 3). Retarded fluid masses gradually accumulate behind the cylinder, forming there two vortices. From time to time these vortices are carried away, alternately from each side, producing the eddying wake (Kàrmàn's experiment). The resistance experienced by the cylinder is due to the work done in forming these eddies.

Now let us replace the circular cylinder by an elliptic one, set obliquely to the current. The symmetry being lost, the leeward and the windward vortices are formed under different conditions, and more especially, the conditions for their discharge are different. The windward vortex is carried away with the current, while the leeward remains anchored to the cylinder, forming a circulation round it. The lifting effect upon the inclined plane comes exclusively as a consequence of the circulation thus formed round it—a fundamental fact in aerodynamics first recognised by Lanchester, and put into a formula by Kutta and Joukowski. This formula is the same as that which we have just deduced from the hydrodynamic analogy to the electromagnetic field, and, as seen from this analogy, it is valid for all cross-sections of the wings and for circulations of any origin, not merely for the circular cross-section of the rotating cylinders in our theoretical aeroplane.

The difference between our theoretical aeroplane with its rotating cylinder and the practical aeroplane with its inclined wings reduces to this: with the rotating cylinder we produce systematically, in a way which

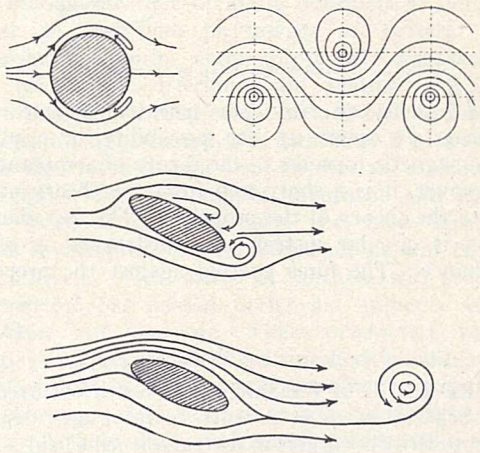

FIG. 3.—Different cylinders in a current.

we can control, the circulating motion which is the condition for lift. By the ordinary aeroplane wings the lifting circulation is produced spontaneously by the asymmetry of the wing.

Induced Resistance.

From the hydrodynamic analogy we have deduced the force lifting an aeroplane. In addition to the lifting force the aeroplane is subject also to head-resistance of which the analogy gives us the theory. Every vortex which the aeroplane leaves behind in the air represents a hydro-electric current which exerts its action-at-a-distance upon that main hydro-electric current which carries the aeroplane.

Fig. 4 shows diagrammatically the system of vortices which every aeroplane must necessarily leave behind itself: namely, the windward vortex which at the moment of starting is carried away from the aeroplane, and the vortices with axes parallel to the wind which join the ends of this vortex with those of the leeward vortex that remains anchored to the wing and carries the aeroplane. This gives a closed vortex having the form of a rectangle of which two sides are constant in length, while two increase with the velocity of the aeroplane relatively to the wind. What the aeronautical engineers call the induced resistance may be regarded

as the hydro-electric attraction of that part of the vortex system which is left behind in the free air upon that part which is anchored to the wing. The analogy with electromagnetism allows us immediately to write down formulæ for this attraction.

The theory of hydrodynamic actions-at-a-distance, which has hitherto been so absolutely useless from a practical point of view, has recently become very practical. It opens up the possibility of applying electromagnetic formulæ to the theory of aeroplanes.

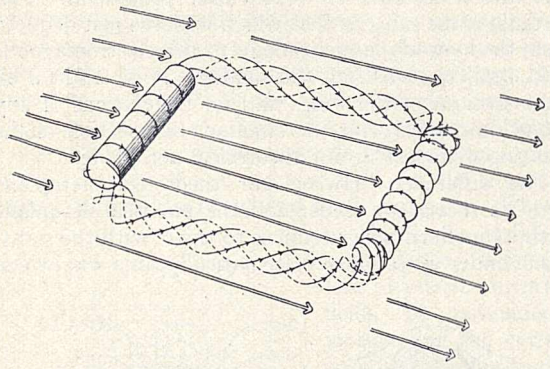

FIG. 4.—Vortex system set up by an aeroplane.

Moreover, it is a short step from the theory of the wing to the theory of the propeller. The fact that its motion is circular instead of translational is of no importance. The force exerted against the propeller blade depends upon the circulation produced round it, and can be calculated by the theory of the hydrodynamic actions-at-a-distance. From the propeller blade the way is not far to the turbine blade. The type of driving force will remain the same whether the driving medium be incompressible water or expanding steam. In the latter medium, effects of expansion will come into play of the kind exemplified by the experiment with the pulsating bodies. But the greater the complications, the more complete is the use which has to be made of the theory of the hydrodynamic actions-at-a-distance.

It is not least interesting from this point of view to consider the transfer of mechanical to electrical energy or vice versa. Let us suppose that at one end of a shaft we have a water or steam turbine, at the other end a dynamo. At the turbine blades the hydrodynamic actions-at-a-distance are in activity, and in the dynamo the equal but opposite electromagnetic actions. We derive both of them by the same formulæ, only with a change of sign when we pass from one set to the other. One set of forces is like a reflected image of the other.

Do we not here behold a deep harmony of Nature at a point where important practical problems are intertwined with ideas of deep theoretical interest? Finally, what does Nature mean by placing us face to face with this wonderful harmony between such different branches of physics as hydrodynamics and electrodynamics? This is a question which may be answered by a future Faraday.

Obituary.

VISCOUNT LONG OF WRAXALL, F.R.S.

LORD LONG of Wraxall, whose death occurred on September 26 at seventy years of age, was well known to British workers in several scientific fields. He will be particularly remembered for the unswerving support which he gave to scientific advisors while president of the Board of Agriculture in 1892–1900, as regards the necessary measures to extirpate rabies from the British Isles. At that time it had been proved beyond doubt that hydrophobia was a specific infective disease which did not originate *de novo*, but could only be introduced into a district or country by being passed on from animal to animal. Acting upon this and other knowledge when president of the Board of Agriculture, Lord Long was responsible for the issuing of muzzling orders for dogs, first for London and then for the whole country. The National Canine Defence League thereupon instituted a public campaign against the muzzle and condemned the measures wisely adopted by the Board. Lord Long, however, had instructed himself thoroughly well in the whole question of rabies, and, with laudable firmness, he resisted the outcry and the repeated assaults of the uninstructed sentimentalists. As a result, he was able to demonstrate that, by the strict carrying-out of muzzling orders, rabies could not only be checked but also reduced eventually to extinction. The eighty thousand "dog-lovers" who petitioned for Lord Long's dismissal from his office at the Board of Agriculture showed themselves to be poor friends of dogs by their action, which many of them must afterwards have regretted. In recognition of his work on behalf of science, Lord Long was elected a fellow of the Royal Society in 1902. He was also an honorary LL.D. of the University of Birmingham.

DR. R. S. WOODWARD.

DR. ROBERT SIMPSON WOODWARD, formerly president of the Carnegie Institution of Washington, died on June 29, aged seventy-four, and the following account of his scientific work is taken from the Journal of the Washington Academy of Sciences. Dr. Woodward was born at Rochester, Michigan, July 21, 1849. Following his education as a civil engineer at the University of Michigan, he served with the U.S. Lake Survey, the Transit of Venus Commission of 1882, the U.S. Geological Survey, and finally the U.S. Coast and Geodetic Survey. Leaving the Federal service in 1893, he became professor of mechanics and mathematical physics at Columbia University, New York City. In 1905 he succeeded the late Daniel Coit Gilman as president of the Carnegie Institution of Washington, then but recently founded by Andrew Carnegie. Dr. Gilman's term of office as its first president had been very short, and the real responsibility for formulating the working plans for the development of a new and comparatively untried form of research institution fell upon Dr. Woodward. Following fifteen years of successful administration in this office he retired from active duty in January 1921. He was president in 1900 of the American Association for the Advancement of Science and had also served as president of the American Mathematical Society, the Washington Academy of Sciences, and the Philosophical Society of Washington. He was a member of the National Academy and other national organisations. Dr. Woodward made notable contributions to mathematical physics and astronomy, especially as applied to geodesy and geophysics.

Current Topics and Events.

ON September 27 Ivan Petrovich Pavlov, the great Russian physiologist, celebrated his seventy-fifth birthday, and it is gratifying to learn that he is still in the full force of his mental power and physically strong, working hard at various physiological problems. His birthday is indeed an international event. Prof. Pavlov's scientific work can be divided sharply into three periods: study of the heart and blood circulation (1877–1890), investigations on the digestive system (1890 until about 1905), and research on the physiology of the brain (the last period). This distinctness in the division of his life was made consciously and is not accidental. The present writer remembers a conversation in Prof. Pavlov's laboratory during tea time, when methods of increasing the productiveness of scientific workers were being discussed. After different ideas had been suggested by his pupils, Pavlov smiled and said, "Well, from my experience, the problem seems very simple, although hard to perform. There is only one method; concentrate all the powers of your soul and body on one idea, which you investigate. Stick to it for many years, think of it daily and dream about it during your sleep. That's all." The results of Prof. Pavlov's work in the three departments of physiology he has studied are brilliant. He has discovered many important facts in the physiology of the heart and circulation of the blood, chiefly concerning the vago-sympathetic innervation of the cardio-vascular system. His investigations on the physiology of the digestive processes have changed completely our ideas on this subject. The secretory innervation of the stomach and pancreas, and the discovery of the laws governing the secretion of the digestive juices by the use of fistulas, are the most important results of his and his pupils' work. Finally, Pavlov crowns a long life, which has been devoted to science, by investigating the physiology of the brain. He is now in the course of writing a book summarising the great results of this work, which he has obtained by means of a simple but ingenious method of conditional reflexes. For Russia, Pavlov is especially precious not only as a scientific worker of great distinction but also as an example to young Russia at the present time. During 1920 and 1921 he and his family suffered badly from lack of food. He was obliged to spend valuable time in domestic work and in searching for food and fuel. In spite of this, Pavlov continued his work, at that time in unheated laboratories, hungry himself with hungry pupils, giving an example of a truly great man, who lives for one thing only—the pursuit of truth.

THE retirement of Prof. F. O. Bower from the Regius chair of botany in the University of Glasgow reminds us of the remarkable developments for both teaching and research which have marked the past forty years. During the long tenure of his chair, Prof. Bower has taken a conspicuous part in raising the standard of biological teaching and research in British universities to the high position which it holds to-day. The beautiful laboratories erected in Glasgow under his direction were indeed the material expression of the ideals born during his earlier associations with such men as Sachs, Vines, and Marshall Ward. In those days it was almost a belief that many of the manifestations of life which the microscope had revealed could be observed only in German laboratories. The removal of such views liberated botanical inquiry in Great Britain from the narrow courses of pure systematics. The widespread enthusiasm for biological investigation along lines not yet explored left their deep impression on a highly responsive mind and gave us a man of vigorous frame whose enthusiasm for the problems of plant-structure was coupled with a conspicuous power of exposition.

IT may not be widely known that Prof. Bower was among the first of living botanists to deliver a course in botanical physiology in Britain. His investigations into those problems of structure and affinity of Pteridophytic plants, and their presentation in a long series of memoirs, are widely known and appreciated. It has been a pleasure to those who have known Prof. Bower at work to see his reliance on such simple apparatus and laboratory methods as have been the bare essentials to his investigations. As a teacher he will be long remembered. An army of enthusiastic students of medicine has passed under his influence in the University of Glasgow. Their instruction in the broad principles of life as illustrated by the plant-kingdom has been to him a peculiar responsibility and pleasure. As a teacher of advanced students he displayed those high qualities of presentation and a love of argument and reasoning which have so fully marked his scientific writings. To the retirement which Prof. Bower is now seeking he will carry not only the highest appreciation of those who have been privileged to work with him and to know him, but also of the many who have been quickened by the great philosophical considerations regarding the problems of life which have been the mainspring of his work.

AFTER twenty-four years' work, Mr. Ling Roth, who is in his seventieth year, has resigned the keepership of Bankfield Museum, Halifax, owing to ill-health. Acting on the fact that Halifax is a textile manufacturing town surrounded by towns carrying on various branches of the textile industry, Mr. Ling Roth judged that an historical collection of textile tools might be useful, educational, and interesting to the town; and he has succeeded in gathering together a fascinating assembly of specimens of primitive textile tools from many parts of the world. The grouping begins with a selection of basketry followed by samples of matwork, including mat looms in which the filaments are not spun. Then follows a series of implements for spinning with spindle only, spindle and distaff and hand-spinning machines, ending up with an old local wooden hand-spinning jenny which was in use so late as 1916. The collection of hand looms

and rug looms is large and varied both in character and origin and includes two recently acquired and so far undescribed braid looms from China. There is also a considerable series of spools and shuttles, with a set showing the process of manufacture, and one wall case with specimens illustrating the development of the shuttle. From plain cloths we come to patterned cloths and embroideries, and finally there is a collection of the embroidery tools used by ladies of the eighteenth and nineteenth centuries and a rare selection of ladies' work-boxes and their muneries and often exquisite fittings or tools. The whole forms a unique collection such as exists nowhere in any other museum, and gives the visitor or student a clear survey of the tools used in the industry from its very beginnings up to the period when power spinning and weaving came into being.

MR. J. C. MOUTTON, of the Residency, Kuching, Sarawak, directs our attention to a "General Report on the Fisheries of British Malaya," published at the Government Printing Office in Singapore, in 1923. There Mr. David G. Stead writes: "In making this essential appointment [Superintendent of Fisheries Investigation in Malaya] I recommend the Government to give the fullest encouragement to the great College of Fisheries of Seattle, Washington (United States of America), or to the Stanford University of California, to offer a candidate for the position. . . . If only a marine biologist had been wanted I would have unhesitatingly recommended to the Government to make an appointment from amongst the scions of one or other of the universities of Great Britain—but however good may be (and undoubtedly is) the training given in biological work in these institutions, there are none of them, unfortunately, specialising to any great extent in applied fishery work." Now an institution that trains investigators can only become "great" and well known by reason of the work done by its past students, and the College of Fisheries at Seattle, Washington, U.S.A., has still to become famous, judged in this way. It is, in fact, only a few years old. Thus a comparison with the British university training schools cannot be made. But, for any work in fishery investigation, the essential training is that in marine biology and oceanography. That can be obtained at Liverpool or Cambridge, and at the Plymouth or Port Erin Biological Stations, in a perfectly satisfactory manner.

IT is true, as Mr. Stead suggests, that no British university has a Fisheries College attached to it, but those with experience of what fishery investigation involves know that this kind of training can best be obtained, by actual post-graduate work, at the Marine Biological Stations, at the official fishery laboratories, and at sea with the fishery investigation vessels. All these opportunities exist and are used in the training of fishery workers. The ordinary period of time required for an honours degree in marine biology and oceanography is certainly not too long for a really useful knowledge of those subjects, and the man who intends to superintend fishery investigations ought to have this knowledge, as well as practical experience of the special methods of research and of the actual conditions of the fishing industry. At present this training can be obtained at British universities, at biological and fishery laboratories, by actual contact with the industry at the fishing ports, and on board fishing vessels. It can probably be so obtained better than anywhere else in the world, and it is this kind of preparation for investigation of fishery problems that is expected by Government departments concerned with the administration of the industry.

THE Western Union Telegraph Company has little fear that the new developments in radio communication will seriously affect the traffic by submarine cable. The Company has just completed laying a cable between New York and the Azores, a distance of 2400 miles. It was manufactured and laid by the Telegraph Construction and Maintenance Company of London. It is interesting to remember that this Company laid the original Atlantic cable. The new cable marks an epoch in the development of submarine signalling. To borrow a "telephone" phrase, it is "uniformly loaded" with a band of that highly magnetic material called by the Western Electric Company, which first introduced it to engineers, "permalloy." It is an alloy of nickel and iron. This band enables signals to be sent six times quicker than with an ordinary cable. It is expected that 1500 letters a minute will be transmitted when the cable is in full working order. It is to be used with an ordinary cable made by an Italian company which will connect the Azores with Italy. When this is completed, submarine communication between Southern Europe and North America will be established for the first time.

WE learn from the Paris correspondent of *The Engineer* that the decree authorising a French government concession for the construction of a tidal power generating station at Aber Vrac'h, near Brest, to the cost of which the State will contribute in a large proportion, has been published. While the Aber Vrac'h scheme is mainly experimental, it is intended to pay its own way and will provide Brest with current by a high-tension main of 30,000 volts, and to ensure a regularity of supply the tidal power plant will work in conjunction with a power station utilising a head of water provided by a barrage across the mouth of the river Diouris. The Aber Vrac'h barrage will be 150 m. long and from 12 m. to 24 m. wide, and will be composed of three concrete caissons containing the reversible turbines and alternators. A sluice gate will permit of the basin above the barrage being filled by the rising tide. The turbines will run from nine to eleven hours each tide. Spare chambers are to be reserved in the barrage for carrying out experiments with different kinds of turbines, with the idea of attacking any problems that appear to present difficulties in the utilisation of tidal power. The power station will not ensure an uninterrupted supply of current; this will be provided for by the Diouris river barrage with a head of from 8 m. to 24 m. and actuating four turbines, each of which will develop from 75 horse-power to 1200 horse-power according to the tides.

ARCHÆOLOGISTS and others who are interested in the history and topography of Great Britain will welcome the admirable map of Roman Britain which has been issued by the Ordnance Survey (price 4s.). The scale is 16 miles to the inch. The map shows the principal settlements both military and civil, but not single villas, though a contingent promise is made that they may be included in a later issue. The roads shown are those constructed by the Romans, the trackways which belong to an earlier system, such as the Icknield Way, being omitted. The names in use in later times —Watling Street, the Fossway, and Akeman Street, and the like, for which there is no evidence before the Saxon invasion—are also not shown. This is perhaps to be regretted on the ground of their general familiarity. Where the course of a road is known with certainty from direct evidence, it is shown by a continuous double line; where it is uncertain, by a broken double line. Roads known to have existed, but for the course of which there is no evidence, are omitted. Modern names are written in italics; ancient names (when known) in Roman capitals. No attempt has been made to restore the coast line, which is known to have differed considerably on the south and east in Roman times, but the existing coast line has been shown.

THE International Commission of Eugenics held its annual meeting in Milan on September 20–22, representatives from Norway, Holland, Belgium, France, Russia, and Italy being present. The proceedings related chiefly to business matters, to international co-operation with other bodies, and to the publication in Italy of an international "Bibliothèque d'Eugénique" by the Bureau of the Società per Prevedenza ed Assistenza Sociale under the auspices of the Italian society. At the same time, the first Italian Congress of Social Hygiene and Eugenics was being held in Milan, at which Major Leonard Darwin, president of the Commission, read a paper on the "Criminal from the Point of View of Eugenics." An interesting feature of this meeting was the presence of the Rev. Prof. Agostino Gemelli, rector of the Catholic University of Milan, who read an interesting paper on eugenics and intervened in debate with interesting reports of researches in heredity. Birth-control figured largely, probably for the first time in Italy. At the inaugural meeting it was announced that a chair in social eugenics was now to be founded in the new University of Milan, and at the closing banquet a munificent endowment for the same was announced. Prof. S. Patellani, general secretary to the congress, will be the first occupant of the chair.

THE American aviators, leaving Boston on September 8, have completed their voyage of circumnavigation by their arrival at Seattle on September 28, just under six months from the official start on April 8. The crossing of the United States was of the nature of a triumphal procession rather than a serious test of the possibilities of air transport, as might be inferred from the time taken. The only serious geographical obstacle was that presented by the Rocky Mountains.

THE Department of Agriculture of the Irish Free State is requiring an assistant plant pathologist. Candidates must hold the Associateship of the College of Science, Dublin, or a University degree in science, including botany. Applications should reach the Secretary of the Department, Upper Merrion Street, Dublin, by, at latest, October 9.

THE second session of the Liverpool Psychological Society will commence on October 7, when the president, Dr. Betts Taplin, will deliver his inaugural address at the University at 8 P.M. on "The Power of Suggestion." The Society's first session was very successful, and an interesting programme of scientific research has been arranged for the coming winter. Further particulars may be obtained from the Secretary, The University, Liverpool.

APPLICATIONS are invited by the Ministry of Agriculture and Fisheries for the post of an inspector in connexion with agricultural and horticultural education and research. Candidates must have taken a course in science or agriculture at a university or college of agriculture and had special training in the science and practice of poultry and small livestock keeping, including goats and rabbits. The necessary form of application (returnable not later than October 20) may be had from the Secretary of the Ministry, 10 Whitehall Place, S.W.1.

THE South African Institute for Medical Research, Johannesburg, is undertaking a research into the harbouring of plague by wild rodents, and the specific prophylaxis and therapy of the disease in man. In connexion with the inquiry, applications are invited for the posts of a bacteriologist and an entomologist. The former should preferably be a medical man with special experience of plague; the latter not necessarily a medical man, but, if possible, with special experience in the study of ectoparasites of rodents. Further particulars can be obtained from "Bacteria," c/o the Director, Lister Institute, Chelsea Gardens, S.W.1.

MR. J. W. HAYWARD sends us an account of an unusual display of lightning which he observed in the neighbourhood of Lake Superior, Quebec, on August 31 last. The lightning took the form of an orange-coloured spark the size of a bright star which traced a narrower and whiter irregular line in a horizontal direction across the sky. Just before disappearing, the head of the flash divided into three or four parts which traced out divergent paths. The motion was sufficiently slow to be followed by the eye, and the whole path with its diverging ends remained visible for an instant. This is apparently a case of rocket lightning, an example of which was described by Mr. W. H. Everett in NATURE of October 22, 1903, p. 599.

THE Council of the Institution of Civil Engineers has made the following awards in respect of selected engineering papers published without discussion during the session 1923–1924: A Telford Gold Medal to Mr. E. H. Lamb (London); and Telford Premiums to Messrs. F. C. Temple (Jamshedpur, India), H. A. Lewis-Dale (London), and Mr. C. J. Gyde (Pretoria). And in respect of papers read at students' meetings in

London, or by students before meetings of local associations during the same period: The James Forrest Medal, the James Prescott Joule Medal, and a Miller Prize to Mr. R. W. Mountain (London); and Miller Prizes to Messrs. H. S. Smith (London) and C. D. Crosthwaite (London), H. C. Toy (Birmingham), F. W. S. Hawtayne (London), E. G. Wilson (North Shields), and W. W. Davies (London).

THE various types of microscopes manufactured by Messrs. C. Baker, of 244 High Holborn, London, W.C., are described and illustrated in a recently issued edition of this firm's catalogue. Instruments suitable for use in biological, metallurgical, and mineralogical work are included, as well as simpler models for science students. With the view of obtaining greater facility of adjustment or increased rigidity or efficiency, modifications have been introduced in several of the firm's well-known models, and standardisation of parts has been effected wherever possible. Full details are given of all necessary optical equipment, including a series of orthochromatic eyepieces recently designed by Lt.-Col. Gifford to give an increased field. A very complete list of mechanical accessories and illuminating apparatus is also given. Amongst the photomicrographic apparatus may be mentioned the Universal Geometric Slide Camera, designed by Mr. J. E. Barnard. In the design of this apparatus the geometric principle has been observed throughout, with the result that extreme rigidity can be obtained, and relative movement of any parts avoided when the apparatus is subjected to vibration.

MESSRS. Percy Lund, Humphries and Co., Ltd., hope to publish in December the Transactions, in four volumes, of the recently held World Power Conference. The work will include all the papers presented at the conference, and contain a synopsis of the discussions which followed the presentation of the papers. Most of the papers will be illustrated by maps, charts, diagrams, and reproductions of photographs.

WE learn from Messrs. Adam Hilger, Ltd., 75A Camden Road, London, N.W.1, that the firm has been entrusted with the manufacture of the interferometric apparatus with which the metre will be established in Japan, in accordance with the law passed in March 1921 by the Japanese Diet making the metric system compulsory in that country. The apparatus will also provide for the measurement of the 5-metre base, which is the foundation of the geodetic survey in Japan.

Our Astronomical Column.

FINSLER'S COMET, 1924 *c*.—This comet has been well observed, and was of at least the fifth magnitude on September 22, when it was visible in considerable twilight. Dr. W. H. Steavenson traced the tail to a length of 15′. The following elements, by J. P. Möller and B. Strömgren, from observations on September 21, 22, 23, are near the truth.

$T = 1924$, Sept. 4·559 G.M.T.
$\omega = 66^\circ\ 26{\cdot}5'$
$\Omega = 79\ \ 5{\cdot}8$ } 1924·0
$i = 121\ \ 59{\cdot}8$
$\log q = 9{\cdot}61047$

EPHEMERIS FOR GREENWICH MIDNIGHT.

	R.A.	S. Decl.	$\log r$.	$\log \Delta$.
Oct. 6.	$15^h\ 12^m\ 6^s$	7° 51′	9·9446	0·1688
,, 10.	15 22 12	10 39	9·9804	0·2033
,, 14.	15 31 0	13 2	0·0132	0·2347
,, 18.	15 38 36	15 6	0·0433	0·2633

The comet will be difficult to observe, being in the evening twilight, and low down. It is, moreover, fading rapidly.

RELATIVE NUMBERS OF STARS OF DIFFERENT SPECTRAL TYPES.—Many valuable papers on stellar statistics have been published. One of the latest is by K. G. Malmquist (K. Svenska vetenskaps. Handlinger, 3rd series, Band 1, No. 2) on the distribution of absolute magnitudes. The author adopts as his unit of distance the siriometer, which is a million astronomical units, or 4·85 parsecs. He gives as the number of stars of each type in a cubic siriometer in the neighbourhood of the sun:—B 0·005, A 0·033, F 0·300, G (giant) 0·006, (dwarf) 0·830, K (giant) 0·045, (dwarf) 2·100, M (giant) 0·004, (dwarf) more than 2·400; total 5·723.

The table brings out in a striking manner the vast excess of dwarfs over giants. The actual excess is probably much higher than the above figures indicate. Thus, Malmquist gives some 24,000 stars within 10 siriometers of the sun, of which 1 is of absolute magnitude −4, 7 of −3, the number per magnitude increasing to about 4000 in the neighbourhood of mag. 8, and then falling off to 30 for mag. 12. This falling off is probably only apparent, and due to the manner of selection of the stars he used, as a study of the sun's nearest neighbours suggests that the absolutely faint stars are far more numerous.

It is to be hoped that a decision will be made between the siriometer and the parsec as units of stellar distance. The use of two different systems causes needless confusion.

ORBITS OF COMETS.—A Copenhagen circular gives the following elements of Comet 1924 *a* (Reid) from observations made at the Cape in March, April, May.

$T = 1924$ March 13·290 G.M.T.
$\omega = 271^\circ\ 20'{\cdot}19$
$\Omega = 113\ \ 59\ {\cdot}57$ } 1924·0.
$i = 72\ \ 20\ {\cdot}36$
$\log q = 0{\cdot}24432$.

An ephemeris is given for September, the estimated magnitude being 10. But as no observation is reported, it is probably fainter than this.

Prof. A. Dubiago, of Kasan, gives in *Astr. Nachr.* 5311 the following elliptical elements of the comet 1921 I, discovered by him.

$T = 1921$ May 4·87982 G.M.T.
$\omega = 97^\circ\ 26'\ 32''{\cdot}2$
$\Omega = 65\ \ 59\ \ 8\ {\cdot}8$ } 1921·0.
$i = 22\ \ 21\ \ 20\ {\cdot}0$
$\log q = 0{\cdot}048102$.
$e = 0{\cdot}939585$.
$\log a = 1{\cdot}266949$.
Period, 79·50 years.

The comet was observed from April 24 until June 11, 1921, at eleven observatories. It was ill-defined, and the probable errors of the observations are large, but a parabolic orbit appears to be definitely excluded.

The comet is an eighth member of Neptune's family. Five of them, including Halley's, have been seen at more than one apparition.

Research Items.

Early Christian Legends in India.—Father Hosten, in a contribution to the history of pre-Portuguese Christianity which is published as No. 5 of vol. xix., N.S., of the Journal of the Asiatic Society of Bengal, discusses the origin of a number of the legends which centre around St. Thomas, his ministration and martyrdom in India, and his connexion with Mylapore (Malabar). A Latin hymn, dating possibly from the fourteenth century, refers to the conversion by the saint of three kings, and goes on to say that no heretic, pagan, or Jew could live in the city where his body lay, and that on his feast-day he appears and administers the sacrament to the faithful, withholding it from the unfaithful. The origin of these references is found in the stories said to have been told at Rome about A.D. 1122 by one Mar John, who is described as Patriarch of the Indies. A description of the saint's feast by Theodore, *circa* 590, recorded by Gregory of Tours, compares closely with conditions which prevail during feasts in Hindu shrines and temples. A number of legends are told of the miraculous attributes and actions of the right arm of St. Thomas. One of the most remarkable parallels, which must be due to borrowing on one side or the other, is found in a Mohammedan story relating to the Moslem saint Tamim from Covalong, near Mylapore, which follows the story of the burial of St. Thomas in all its main details. The correspondence may be due to an early conversion of Malabar Christians to Islam.

Egyptian Affinities in Indian Funerary Practices.—Dr. Govind S. Ghurye has collected together and published in *Anthropos*, vol. xviii.-xix., a number of examples of funerary ritual among the peoples of India which, in his opinion, even among those who practise cremation, point to affinities with the practices of Ancient Egypt. Among the Nayadis, the urn in which the calcined bones are buried is filled with curds and honey, and butter, sesamum, and barley are placed in the burial pit with it. The custom of anointing the body with oil, turmeric, or other substances, and the use of a new cloth to cover it, before burial or cremation, point to a survival of the idea of embalming. The Egyptian life-like portrait of the deceased survives, in accordance with the principle suggested by Elliot Smith, in the stone used in connexion with the rite of cremation, which is regarded among the higher castes for some time as the image of the dead, and among the lower castes generally in an effigy of the dead made of earth, ashes, and other material. Further, the Proto-Egyptian practice of protecting the corpse from the soil by mats, goat-skin, or other means, and the pre-dynastic "pit grave" with its shaft and recessed chamber, each find parallels in Indian custom. Dr. Ghurye concludes by giving a detailed list of the directions in which the body is orientated in burial and in cremation by various Indian peoples.

Rationale of Radiation Therapy.—The action of radiations (both radium and X-ray) depends upon (1) direct action upon the tissues, varying with the intensity of the radiations, (2) an indirect effect induced by the action upon the tissues and circulating fluids. The subject is discussed in the *British Journal of Radiology* (B.I.R. section), vol. xxix., No. 289, August, p. 296. There is much evidence which goes to prove that direct radiation of tumours produces in some cases an inhibiting effect upon cell development, and in others the cessation of activity and the death of the cells. If a sufficient dose of radiations be given to certain tumours a lethal effect upon the tumour cells is induced. But in the majority of cases of tumour growth treated clinically, the administration of a lethal dose to the whole of a large tumour is a practical impossibility, because of the disastrous effects upon the organism as a whole, due to the secondary or reactionary action mentioned above. Other methods of application have therefore to be employed, *e.g.* subjecting the patient to sub-lethal doses extending over a considerable period, with intermittent administrations. "It is clear to most radiologists that the cure of cancer by radiations is at present beyond our reach, and that to claim cure would be to retard indefinitely the progress of radiotherapy in the treatment of cancer. To establish the proof of a definite degree of control upon tumour growth would be a great step forward in the attack upon this intractable disease."

The Life-History of the Indian Glow-worm.—Bulletin 69 of the Department of Agriculture, Ceylon, by Dr. J. C. Hutson and Mr. G. Douglas Austin, is devoted to an account of the habits and life-history of the Indian glow-worm (*Lamprophorus tenebrosus*). This insect is luminous in all its stages from the egg to the adult. The female is of large size (60-65 mm.), and is a pale yellow larviform creature, while the male is a winged insect, 20-30 mm. long. The female lays from 30 to about 100 eggs and broods over them during the incubation period; if removed from her eggs she soon finds her way back and curls up over them. If the eggs be scattered, she usually collects them one by one into a heap again. The incubation period is about seven weeks, and the male larvæ are stated to pass through only three or four instars, while the females have five or six. The larval period for both males and females is eight or nine months, and the whole developmental period occupies less than one year during normal conditions. The species is nocturnal in its habits, both larvæ and adults remaining in concealment during the day. The larvæ appear to feed normally on the African snail (*Achatina fulica*) and probably on other local snails. The African snail is a pest of young plants in vegetable and flower gardens, in some districts of Ceylon, and the larvæ of the glow-worm are probably of some value in reducing the numbers of this mollusc. Observations made in captivity indicate that a male glow-worm larva will destroy 20-40 snails during its life, while the female larva will account for 40-60 snails. The adult male and female glow-worms, however, were not observed to prey upon the snails. The snail has spread to new areas within recent years, and it is possible that the glow-worm is still absent from such districts. Experiments might be made to introduce it into such areas.

Eggs from Infected and Immunised Hens.—H. G. May finds that in hens fed or inoculated with living cultures of three bacteria pathogenic to them (fowl cholera, fowl typhoid, and white diarrhœa), although the ovaries are infected, the organisms do not pass into the eggs. (Bull. 197, Agricultural Experiment Station of the Rhode Island State College, U.S.A.) Agglutinins and germicidal substances were formed to some, but a variable, extent in hens immunised with these organisms, and a small amount of agglutinin passed over into the egg albumin. The albumin of eggs of normal hens in a dilution of 1 in 5 proved slightly germicidal to the organisms, and with one exception there was no increase in germicidal power of the egg albumin after immunisation of the hens.

NATURE OF *BLASTOCYSTIS HOMINIS*.—This is one of the commonest parasites met with in the human intestine, and its true nature has remained uncertain since its discovery some fifty years ago. Though quite harmless, it is of importance as being responsible for mistakes in diagnosis, having been frequently confused with the cysts of the amœba of dysentery. The earlier workers regarded it as a cystic form of various protozoa or as a degenerated leucocyte. Alexieff first put forward the view that Blastocystis is a vegetable organism allied to the Blastomyces group, and now Major R. Knowles and Assist. Surg. B. M. Das Gupta support this (*Ind. Journ. Med. Research*, vol. xii., No. 1, p. 31). They regard Blastocystis as a genus of the higher fungi, closely allied to the Schizosaccharomycetes, and probably containing several different species. The general life-cycle appears to consist of (*a*) multiplication by binary and multiple fission by plasmotomy; (*b*) multiplication by exogenous budding; and (*c*) multiplication by endogenous spore formation inside an ascus into which the paraglycogen mass is converted.

BRANCHING IN BUDDED CACAO.—Cacao grown from seed produces two types of branch with different leaf arrangements, the main axis terminating in five branches, and the lateral horizontal branches, which are of the "fan" type. Cacao plants grown vegetatively from buds are always of the "fan" type. Messrs. S. C. Harland and R. G. Parga discuss this problem in the September number of *Tropical Agriculture*. Their experiments show that budded cacao is always of the fan type because the buds are taken from the horizontal fan branches. If buds are taken from the main axis, the seedling type of tree can be produced, with normal dimorphic branching.

BOTANY OF THE ABOR EXPEDITION.—In the Records of the Botanical Survey of India, vol. 10, No. 1, Mr. I. H. Burkill describes his extensive collections and observations made during the Abor punitive expedition in 1911. The flora is of a highly mixed type, since this region lies on the boundary of the Asiatic cupuliferous zone, and yet contains elements from the tropical Gangetic floras. The Himalayan and Chinese floras also mingle in this vicinity, and these various elements of the vegetation are traced by Mr. Burkill to their origins. On account of its high rainfall, the country is chiefly covered by rain-forest, but a curious feature is the absence of pines on the hills, this being attributed to the high humidity and consequent excessive competition of dicotyledons. The typical rain-forests consist of a main level of animal-dispersed and often large-leaved trees and climbers, above which arise taller, wind-dispersed and small-leaved trees. At levels above 2000 feet the forest changes; Quercus and Castanopsis become dominant and tree ferns scarce. The most striking feature, ecologically, of Abor land appears to be that the type of climax forest is by no means uniform, but it is largely determined by the soil conditions. Thus on the Pleistocene gravels, *Terminalia myriocarpa* forms pure forests, these being nearly devoid of any climbing plants. Similarly, the Dipterocarp *Vatica Shingkeng* makes pure forests on north slopes over Siwalik and Gondwana rocks, an absence of mosses and prevalence of lichens being also a noteworthy feature of these areas.

COLD WINTERS IN SOUTH-CENTRAL EUROPE.—The *Monthly Weather Review* for April has an article by Dr. J. Maurer on "Severe winters in Southern Germany and Switzerland since the year 1400, determined from severe lake freezes." The article is translated from *Meteorologische Zeitschrift* for March by Mr. W. W. Reed of the Weather Bureau, Washington. The data for northern Germany show that in the period from 1788 to 1845 there was an unusually large number of severe winters, while since that period there have been far fewer. In the 58 years from 1788 to 1845 there were 17 very severe winters, and in 72 years from 1846 to 1917 there were only 6. In southern Germany and Switzerland the occurrence of severe winters is quite different. From 1788 to 1845 there were only 3. In South-Central Europe from 1435 to 1587 there were 15 severe winters in 153 years; from 1588 to 1680, 4 severe winters in 92 years; in 1681 to 1800, 10 severe winters in 120 years; and in 1801 to 1923 there were 4 severe winters in 123 years. It is mentioned that the recent small number of severe winters permits the conclusion that an offsetting will follow, but it is difficult to predict when that will commence. The inquiry is said to indicate a kind of "climatic oscillation" the cause of which lies completely hidden. Without doubt cold winters in Central Europe affect in a marked degree the severity of the winter in Western Europe, but the absence of regular periodicity in the German data affords no aid for forecasting.

POLYPEPTIDES IN OATS.—Jodidi (Journ. Franklin Instit. 198, 1924, pp. 201-211) has estimated the amount of peptide nitrogen in ungerminated oats (four varieties) as 0·03 to 0·1 per cent. of the dry weight. Similar figures are given for the amino-acid and acid amide nitrogen.

THE CHEMISTRY OF COTTON.—The Journal of the Textile Institute (vol. 15, No. 8) contains two papers dealing with the chemistry of cotton. Messrs. P. H. Clifford and M. E. Probert (p. T401) give the results of an examination of the constituents of the wax from American cotton. A large proportion of this consists of free wax alcohols, but few wax esters being present. A new sterol, $C_{34}H_{58}O$, was detected and examined. In the same number (p. T414), Mr. H. J. P. Venn records the yields of β-glucosane obtained by low pressure distillation of cotton after various treatments. Raw cotton gives no β-glucosane on distillation—the water and acid soluble mineral substances must be previously removed. The highest yield obtained was 37 per cent., and rather lower values were obtained for American cotton than for Egyptian, the two varieties differing also in other respects.

QUARTZ GLASS MANUFACTURE.—The issue of the *Physikalische Zeitschrift* for August 1 contains a description by Dr. von Schwarz of the Herberger method, which has been in use for the last 11 years by the firm of Goertz, for producing quartz glass for therapeutic and other scientific purposes. The finely divided quartz is melted in an electric furnace in which a vacuum is maintained by continuous pumping until the melting process is complete. The vacuum is then replaced by a gas such as carbonic acid gas under a pressure of 8 to 12 atmospheres, and after a considerable time the fused quartz is allowed to cool. The result is a block of quartz containing only minute air bubbles in which the air pressure is as nearly as possible that of the atmosphere and therefore produces no elastic stresses in the material. According to observations made by Dr. G. Joos and described in the same issue, quartz glass made in this way is as transparent in the ultra-violet as rock crystal.

KERR'S ELECTRO-OPTICAL EFFECT IN GASES.—The effect was observed in gases by Hansen; but he made use of ordinary white light, so that his results are not sufficient for testing the different theories of the phenomenon. The simplest conditions prevail in a gas, since the molecules are separated from one

another, and each molecule may be considered as being acted on by the electric field, and as acting on the transmitted beam of light, independently of the other molecules. Herr G. Szivessy describes the method employed by him with sulphur dioxide, ammonia, and carbon dioxide in the *Zeitschrift für Physik* of Aug. 12. A beam of light from a powerful arc lamp was sent through a monochromator and a polarising nicol into a long vessel filled with the gas, and between the plates of a condenser inside the vessel which produced a field inclined at 45° to the plane of polarisation. On emergence the light passed through a Brace half-shade compensator into the observing telescope. Pressures up to about 1500 cm. of mercury were employed, using wave-lengths from 486 to 656 $m\mu$; it was not found possible to study the effect of temperature variation, and the temperature was kept nearly constant at about 17·5° C. The results obtained show that the electrical double refraction is proportional to the field intensity, agreeing with Kerr's law; with constant wave-length Kerr's constant is proportional to the pressure, and with constant pressure is inversely proportional to the wave-length.

IONISATION BY POSITIVE IONS.—Dr. J. Franck, in the *Zeitschrift für Physik*, Aug. 4, shows that in order to ionise another atom by collision the positive ion must have at least the kinetic energy $\frac{1}{2}mv^2 = 2(I + P)$, where I is the ionisation energy and P is the potential energy which the first ion and the new ion produced by the collision have with regard to one another. I is known for many kinds of atom, and P is approximately the potential energy which two particles with positive charges possess when their distance apart is the sum of the radii of the atom and of the ion. It may, however, be necessary to take mutual polarisation into account. The number of such collisions is small. Ionisation can take place for smaller kinetic energy if the ion, instead of ionising by direct collision, gives up its energy to another atom, which then collides with a third, thus ionising it. Collisions between ions and atoms may excite the atom, which may then be ionised by collision with another atom. It is estimated that the lowest kinetic energy of the ion which can in the end produce ionisation is about 1·5 I, but the effect will then be very small. The case of ionisation due to the collision of ions having large ionisation energy with easily ionised atoms is discussed; very small kinetic energy may then produce ionisation, as when Hg ions ionise the alkali metals. The phenomenon of the pseudo-high vacuum in pure rare gases, and the effect of traces of impurity, depends on the difference between the ionising energy of the rare gas and of the impurity. In the pure gas, a sufficient number of electrons is not produced near the cathode to allow of discharge; but the positive ions of the rare gas act on the molecules of the impurity, producing the necessary electrons.

GLOBULAR LIGHTNING AND THE CAUSE OF THUNDER.—M. E. Mathias, in the *Comptes rendus*, Paris Acad. Sci. July 21 and Aug. 18, suggests that in a lightning discharge heavy complicated molecules are formed endothermically, and that sometimes, when an exceedingly violent discharge takes place close to the ground where the air is a bad conductor, a short flash with a relatively large section will be produced, giving a cylinder filled with hot, heavy gas. This falls and contracts in length until it becomes more or less globular, and it is suggested that even in the case of gases there is some kind of surface tension at the boundary between two different fluids which can produce this result. The phenomenon was observed in detail by M. Koechlin on May 21 last, the cylinder being dazzling white at first, and the colour changing during the fall to yellow and finally to fiery red. This indicates a cooling of the mass, which finally explodes with a violent crash, the heavy gases suddenly decomposing with the formation of O_2, N_2 and a certain amount of ozone, which gives a characteristic odour. Complex molecules, such as O_{12}, N_{12}, O_6, N_6, O_4, N_4, may be formed by the discharge; and it may be that, even in an ordinary lightning flash, the main detonation of the thunder takes place some little time after the flash, when the heavy gases formed have cooled down sufficiently to explode. At the instant when the discharge takes place, a reduction of pressure is produced along the flash, owing to the formation of complex molecules, and this may cause a crack of sound; but the main detonation comes later, when these molecules suddenly decompose.

MANGANESE STEELS.—The more extensive use of steels containing from 1-1·5 per cent. of manganese has been frequently suggested on account of the superiority of their properties over those of carbon steel, especially when heat-treated. R.D. Report No. 61 from the Research Department, Woolwich, gives an account of an investigation on the properties of medium carbon steel with high manganese content, by J. A. Jones. It appears from his results that after oil-hardening at 850° C. and tempering at 650° C., all the mechanical properties of a 0·4 per cent. carbon steel are improved by the presence of about 2 per cent. of manganese. The improvement is still maintained at 3 per cent., but the additional manganese shows no advantage and may introduce difficulties in forging. Steels with high manganese content are extemely liable to show temperature brittleness when slow rates of cooling after tempering are employed, but this may be avoided by suitable heat treatment. If good impact figures are to be secured, the cooling from the tempering temperature must never be slower than in air. The author finds that the critical points Ac_1 and A_1 are lowered by the increasing amounts of manganese. In this he confirms the work of previous investigators. Ac_3 and Ar_3 are also lowered, and with sufficient manganese merge into Ac_1 and Ar_1 respectively. The presence of manganese tends to prevent the separation of ferrite and pearlite on cooling. For purposes for which it is desired to replace carbon steel forgings by steels of greater strength, the author suggests carbon from 0·35 to 0·40 per cent., manganese from 1·8 to 2·2 per cent., oil-hardened from 800° to 850°, tempering from 610° to 650° C., and cooling in air, oil, or water.

A PORTABLE MICROSCOPE.—In their "Baby London Microscope" Messrs. R. and J. Beck, Ltd. (68 Cornhill, E.C.3), have constructed the most portable microscope yet produced, for it is contained in a case measuring only $5\frac{1}{4} \times 2\frac{1}{2} \times 2$ in. The tripod stand folds up, but when extended the microscope is quite stable. It has a sliding coarse adjustment and an extending draw-tube giving a tube length of 160 mm. The fine adjustment is sufficiently delicate for use with an oil immersion objective and the objective screw is the standard R.M.S. one. The tube similarly takes the standard size eyepieces. The microscope may thus be used with all standard objectives and eyepieces, though it is primarily intended for nature study in the field. For this purpose, a special $\frac{2}{3}$ in. objective is supplied, so that the microscope will pack into its case when it is in position. The mirror is concave and provided with all adjustments, but for high-power work a condenser and flat mirror may be added. Examination of the instrument has justified the claims as to portability and performance put forward by the makers.

The Ascent of Sap and Transport of Food Materials in Trees.

IN opening the discussion on this subject in Section K (Botany) of the British Association, on August 7, at Toronto, Prof. H. H. Dixon affirmed that the cohesion theory of the ascent of sap has recently received important support from the observation of continuous water-columns in the tracheæ of wilted plants by Holle and Bode, from the new determinations of the tensile strength of water by Renner and Ursprung, and from the observations of the collapse of the transmitting wood, and even of its constituent tracheæ under the tension developed during transpiration, and of their recovery on the rupture of the tensile water-columns. The water in the tracheæ, which passes into a state of tension, has been shown to contain carbohydrates and other foodstuffs. When the movement is upward in the tracheæ, due to transpiration and the supply from the roots, these foodstuffs are carried upwards in the stream. If for any reason a downward movement is originated these foodstuffs will evidently be carried downwards. Such a downward movement may be established by cutting a leaf of a transpiring plant under water. The downward movement may be visibly traced by adding eosin to the supply to the leaf. Thus in a short time the tracheæ of the tuber of a transpiring potato plant has been shown to become infected with eosin from one of its upper leaves. In this case transpiration from some leaf-areas has drawn the eosin solution from the cut leaf downwards into the tuber. In a similar manner, we may suppose that the foodstuffs manufactured by the leaves are transported. The reversal of the transpiration stream, artificially produced in the above experiment, probably often occurs naturally. This is suggested by the backward transport of hormones in the wood, recently demonstrated by Ricca in Mimosa, and probably occurring in other cases of transmitted stimuli.

The physical properties of the bast, and its available cross-section, render it impossible to suppose that the transference of foodstuffs takes place in the bast. An increase in the permeability of regions of the mesophyll around certain bundle-endings may render the contents of these cell-masses available as sources from which the tensile sap in the plant draws. It was assumed that the fluid thus introduced into the tracheæ is dragged backwards in the conducting tracts by the transpiration of other parts. Experiments were further quoted showing the change of permeability with temperature, and also the variations in the temperatures of leaves under natural conditions. It was contended that such temperature-changes may be, in part at least, responsible for permeability-changes which originate backward movements in the water conduits, and hence facilitate the distribution of foodstuffs throughout the plant.

In conclusion, Prof. Dixon held that although it could not be affirmed that evidence amounting to a demonstration of the validity of the cohesion theory was available, nevertheless the theory as at present formulated seemed in harmony with the known facts.

In following with an account of recent experiments bearing on the transport of foods in woody plants, Dr. O. F. Curtis stated that when ringing experiments were performed during the growing season, materials necessary to growth would not move upwards through the xylem past the ring. Analyses and cryoscopic determinations indicated that the movement of sugars and other solutes was interfered with by the ring. When, just previous to spring-growth, rings were made at different distances from the tip of a branch, the growth above the rings was roughly proportional to the amount of food stored above the rings. Quantitative tests were held to indicate that the upward transfer of carbohydrates had been interfered with by the rings. It was further held that when the xylem of a given region of the stem was isolated by rings through the phlœm from other tissues which would normally receive carbohydrates from the wood or supply the latter with carbohydrates, no movement of such carbohydrates out of or into this region of the xylem occurred. It was further stated that the normal upward movement of nitrogen and ash-constituents was interfered with, though not completely stopped, when the phlœm was cut. This occurred whether the ring was made in the early spring before new xylem and leaves were formed, or in midsummer after growth was practically complete. The evidence obtained from ringing experiments was held to indicate that the influence of the ring on the upward movement of nitrogen was independent of its effects on the organic content of this part above the ring or on transpiration.

In more or less direct opposition to the view expressed by Prof. Dixon, it was finally affirmed that experiments with spiral ringing of stems provide further supporting evidence for the opinion that foods and nutrients travel both upwards and downwards in higher plants chiefly in the phlœm.

Dr. D. F. MacDougal followed with a detailed statement of experiments conducted by the aid of a dendrograph. The purpose of his communication was to lay before the section his observations on variations in volume of trees, and in the movements of liquids within them. He stated that dendrographic measurements of several species of trees show that the trunks undergo variations in volume which may be correlated directly with the transpiratory activity of green surfaces, which in turn varies with the width of the stomatal slits. The period in which stomatal slits are widest is one of contraction of the trunk; closure of stomata is accompanied or followed by expansion of the trunks. Contraction of the trunks or stems of mesophytes and sclerophylls takes place in the daytime; contraction of flattened or cylindrical stems of cacti takes place at night and expansion in the daytime, in reverse of the occurrences in the more general type.

The time or hour at which these two phases of variation prevail changes with the season. At the time of maximum growth, contraction in coniferous trees may begin within a half-hour after sunrise. Such reversible variations are modifiable by changes in relative humidity, by defoliation, girdling, topping, or any agency which alters transpiration or rate of conduction, and are explainable on the basis of Prof. Dixon's conception of the mechanism of the ascent of sap. The upward path of moving solutions of a basic dye, such as fuchsin, is found to be in the wood formed within the previous two years. When two layers are formed in a season conduction is chiefly in the one formed earlier. Whether the other layers are more available or suitable for the downward conduction of organic material is yet to be tested.

The amount of reversible variation in the diameter of a young pine may be 1 part in 170; in the upper part of a tree approaching maturity 1 part in 900; in the basal region 1 part in 1700; in a large root 1 part in 364. As this variation takes place chiefly in the outer wood, it is found that in such recently formed layers the coefficient of expansion and contraction may be five to ten times greater than that of the trunk taken as a whole, as given above.

In the discussion which followed Prof. Priestley stated that he had been a supporter of the cohesion theory of the ascent of sap, but that he was now so impressed with Copeland's criticism of the theory that he considered the latter incapable of meeting fully the criticism which it had raised. He desired to point out that Prof. Dixon had not replied to Copeland's challenge, demanding as it did an explanation as to how energy is employed in raising water in the stem. He further declared that no plant-structure had yet been shown to be capable of resisting the tensions which the cohesion theory supposed to be developed in the tree.

Prof. Overton expressed himself in general agreement with the cohesion theory, while Prof. V. H. Blackman considered that much work had yet to be done before a valid theory of the transport of organic substances could be constructed. There were difficulties in admitting that the wood furnished a downward path for organic substances, while at the same time it was engaged in transmitting the upward transpiration stream. In his opinion it seemed highly improbable that the bast is without a function. Whatever the function of the bast, he felt that it was associated with the downward transmission of food-stuffs.

In replying to the views which had been expressed, Prof. Dixon stated that in his opinion Dr. Curtis had not allowed sufficiently for the plugging arising in ringed stems. It was pointed out that the results of Dr. Curtis's experiments on branches with extirpated wood and on those the bast of which had been removed may, from the arrangements described, be explained on the known difference of resistance of wood to the transmission of water in a radial and in a longitudinal direction. In the opinion of Prof. Dixon the experiments described by Dr. Curtis did not necessarily indicate the transmission of food materials by the bast. Replying to Prof. Priestley it was pointed out that the energy for raising water in plants is applied by the transpiring cells in contact with the upper terminations of the conducting tracts. This energy is supplied by the inflow of heat at the evaporating cells or by the stored energy in the cells themselves. The tensions developed in the water are withstood by the strength of the thickened tracheal walls and by the osmotic pressures developed in the adjoining cells.

In conclusion, Prof. Dixon expressed himself in agreement with Prof. Blackman regarding the need for fuller inquiry on the subject under discussion before any theory of the ascent of sap and the transport of organic materials in plants could be generally accepted. He held that it is quite in accordance with the known structure and properties of the tracheal tissues, that upward and downward currents may be simultaneously passing in adjacent tracts. The small resistance offered by the wood to the longitudinal movement of water, compared with that which it opposes to transverse movement, secures the isolation of these two streams. Lest the unemployment of the bast should be used as a reproach against the cohesion theory of the transport of foodstuffs in the wood, he suggested that the companion-cells are glandular in function, and secrete enzymes which digest the colloids in the tracheæ. The sieve-tubes, he held, may be regarded as temporary reservoirs of these enzymes, while to the cells of the wood-parenchyma and medullary rays may be allocated the functions of introducing these enzymes into the tracheæ and of abstracting food materials from them.

J. McL. T.

Aeronautical Research.

THE issue of the report for the year 1923–1924 of the Government Aeronautical Research Committee is of more than ordinary interest, since it records that the desire expressed by the Committee, that greater recognition should be given to the claims of pure research, has been recognised, in one important respect, by the reorganisation of the old directorate of research at the Air Ministry into two new departments, namely, a Directorate of Technical Development and a Directorate of Scientific Research.

It is gratifying that the Committee is able to record steady progress in the different subjects embraced by the science of aeronautics. Research having a direct application to aeronautics is financed by the Air Ministry; the remainder, having a more general application, is financed by the Department of Scientific and Industrial Research.

Investigations on elasticity and fatigue of various metals have been arranged in the Universities of Oxford, Birmingham, and Liverpool; investigations on single-cylinder internal combustion engines have been started in the Universities of Cambridge, Durham, and Manchester, and in the City and Guilds (Engineering) College. In addition, there are the wholly subsidised researches carried out at the Royal Aircraft Establishment, the National Physical Laboratory, and the Air Ministry Laboratory in the Imperial College of Science and Technology, London.

The general field of work is so extensive that a local concentration on specific problems is necessary. In the year under review, one of the most important of the problems which has received attention is the control and stability of airplanes; the Committee justifies concentration on the attempt to secure low-speed control by the continued occurrence of accidents in which "spinning" is a primary or secondary feature. In this direction, slow but steady progress is recorded. It had been suspected for some time that one of the main reasons for loss of control in a stalled airplane lay in the fact that ordinary ailerons, besides applying a moment to roll the machine, also cause it to turn, which turn eventually introduces moments which defeat the primary action of the ailerons and render them ineffective.

A larger rudder is thought to be a part solution: a rudder of ordinary size may be capable of providing all the turning moment required in normal flight, but may prove inadequate in stalled flight, in that it must become less effective through being shielded by the body when the incidence is large, and because larger moments are required from it in order to balance those set up by the wings and by the ailerons.

The difficult problems of the cause of detonation in engines, and of the steps necessary to eliminate this feature in high-compression units, has been under consideration, and attention has been given to the bearing of American work in this field of investigation. Experimental work on engines has been undertaken in the Government establishments and in the Ricardo Research Laboratory.

The Committee records the Air Council's agreement with the view that a higher standard of technical knowledge in all ranks of the R.A.F., and particularly among squadron officers, is necessary, and states that steps have been taken to organise instructional courses at Cambridge and the Imperial College with this end in view.

The report is of modest dimensions; its form is that of a 50-page paper-covered pamphlet, and its issue price, 2*s.* 6*d.*, through H.M. Stationery Office, seems somewhat high.

Radio Communication and Research in Great Britain.

BY what means is it possible to confine the reception of radio signals to certain well-defined localities? The limiting of the radiation from a transmitting station to moderately definite directions is a *fait accompli* so far as radio signals of short wave-length are concerned, but a full solution of the larger problem is still awaited. If the regulations governing the use of radio apparatus in Great Britain for experimental and research purposes, as set out in the recently issued revised Post Office licenses, were to be taken seriously, it might be imagined that the solution of the problem is quite well known. The futility of attempting to regulate to certain frontier boundaries the transmission and reception of radio signals, as is apparently required by the rule which states that "Messages shall be transmitted only to stations in Great Britain or Northern Ireland," was discussed at some length in the autumn presidential address to the Radio Society of Great Britain which was delivered by Dr. W. H. Eccles at the Institution of Electrical Engineers on September 24. Such attempted restrictions on research work cannot be to the credit of the country or help friendly international relations in any possible way.

The experimental tests which, during the past three years, have been carried out between radio amateur experimenters in almost every civilised country of the globe have undoubtedly fostered a feeling of good fellowship between those workers—a feeling which cannot but be to the good of all the countries concerned. But what, indeed, are foreign amateurs to think of us if in the future we consistently refuse to reply to their signals and ignore all calls addressed to us through a too rigid adherence to the terms of our licenses?

The official ban on communications with stations outside the limits of "Great Britain and Northern Ireland" is not even lifted in the cases of the British Colonies, but fortunately (since it may encourage British Government officials to a wider outlook in due time) such views are not held by other countries, as is shown by the following message recently sent to the Radio Society from the Canadian Radio Relay League, a large and influential organisation of radio enthusiasts:—

"Please convey our greetings to the Radio Society of Great Britain with congratulations on their achievements. We also congratulate the Transmitter and Relay Section [of the Society] on their wonderful success in the transatlantic tests, and take this opportunity of expressing our desire for a stronger affiliation between Great Britain and the Colonies for the general benefit of amateur radio."

In most countries where experimental radio licenses are granted, the facilities given with the license are much greater than they are in Great Britain, but in view of the pioneer development work that has been carried out by the radio amateur in recent years, it seems scarcely justifiable to attempt to increase the restrictions upon him.

It should be remembered in this connexion that it was the radio amateurs who discovered the valuable properties of short C.W. waves for signalling over long distances. Up to three years ago the commercial companies and most radio engineers thought that the shorter wave-lengths were of no use for long distances, but radio amateurs, particularly in England, France, Canada, and the United States, gradually extended the ranges across which communication could be carried on with these waves until, as a result of the transatlantic tests conducted by the Radio Society of Great Britain and the American Radio Relay League, the incredulous ones looked into the matter. Since those tests the engineers of the great radio companies of the world have been rapidly investigating these short wave transmissions and carrying on with higher powers and on a larger scale the initial experiments. It seems, therefore, undesirable that there should be another bar to research in Great Britain in a field in which the amateurs in particular have already done good work.

P. R. C.

The Biology of the Suez Canal.

THE Cambridge expedition for the investigation of the intermingling of the Mediterranean and Red Sea organisms in the Suez Canal left England last week in the Orient liner *Orcades*. The fauna of the Canal, which was opened in 1869, was first studied by Keller in 1882, a later reinvestigation of the fishes being made by Tillier in 1903. The organisms of the Red Sea and the Mediterranean are very different from one another, even though these two seas were connected by a narrow strait, approximately along the line of the Canal, in glacial times. The barrier to intermingling at that period would seem to have been fresh water, a considerable Nile mouth opening into the centre of the strait. In the time of the Pharaohs a navigable canal was dug, connecting a branch of the delta with the Gulf of Suez, which then extended about 30 miles farther north. By the time of Cleopatra this canal became impassable, owing to Nile silt, but it was afterwards reopened, being finally closed for strategic reasons by the Caliph Almansur towards the end of the eighth century. French investigations, carried out at Suez when Napoleon was in occupation of Egypt, showed certain Mediterranean jelly-fish, sea anemones, and other forms which did and do not extend to the south out of the gulf of the same name. These, if they passed by the Canal, must have been able to withstand the fresh water in its centre. The conditions then were the opposite to those of the present day, for the Bitter Lakes have now a salinity of about 77 grams per litre, or about twice the salinity of either of the terminal seas. These Lakes will be intensively studied, while the fauna of the brine pools in the deserts bordering on the Canal will also be examined.

The Suez Canal Company is giving facilities in respect to boats and by the use of its Canal Stations, and it is hoped to carry the investigation to at least two areas on either side of the Lakes. Each will be intensively collected by trawl nets, dredges, and tow-nets of different sorts, while samples of the bottom and its contained fauna will be obtained by means of the Petersen grab. Similar methods will be adopted at each place, so that comparisons will be possible, not only as to the different species found in each, but also to their relative numbers. The animals will probably be those which live in more or less moving sand, and special gear has been devised to secure these. Then there are such swimming forms as fishes and a few crustaceans. Hard bottom for the attachment of sedentary organisms would only seem to be present in a limited area in the Lakes, but there are piles and other artificial erections, and sunken vessels, in places; however, the larvæ of all are practically free living. The problems before the expedition are to ascertain what forms have passed through the Canal zone from the Mediterranean to

the Red Sea and vice versa, when they passed through, whether in the prehistoric period, in the times of the earlier or of the present canal, how they passed through, whether by swimming, by drifting, by attachment to ships, or by other means. All these facts lead up to the question why some forms of life can get through the Canal and others cannot, and it is hoped that the expedition will throw light on marine migrations in general, the area being one which can be periodically investigated at small cost.

The expedition is in charge of Mr. H. M. Fox, Balfour Research Student of the University, who is responsible for the necessary physical, chemical, and physiological work. He is accompanied by Mr. Robert Gurney, who undertakes the plankton, and by two research students of the University. It has been arranged by a Cambridge committee, of which Sir Arthur Shipley is chairman, and is largely financed by the government grant administered by the Royal Society; collecting gear has been provided by the University and the Natural History Museum. It is a return to the former tradition that the Balfour student should undertake for part of his period of research an expedition to investigate some problem in the field. J. STANLEY GARDINER.

University and Educational Intelligence.

DURHAM.—Applications are invited for a lectureship in geology at Armstrong College. The latest date for the receipt of applications (10 copies of each) is October 25. They should be addressed to the Registrar, Armstrong College, Newcastle-upon-Tyne.

LEEDS.—A programme has now been issued of the Celebration Week to be held on December 15-20 to commemorate the jubilee of the Yorkshire College of Science and the coming of age of the University. The ceremonies will include a number of receptions of local bodies, public lectures on the educational and architectural history of the University by Prof. A. J. Grant and Dr. A. Hamilton Thompson respectively, and on the aims of university education, by Sir Michael Sadler. A portrait is to be presented to Sir Michael Sadler in recognition of his manifold services to the University. Most of the ceremonies will be open to the public, and on the last day the whole University will be thrown open for inspection.

LONDON.—The University College Committee will shortly appoint a Quain student in biology. The value of the studentship is 150*l.* per annum, and it is tenable for three years. Applicants must have been already students of University College in the subject of botany. Full particulars can be obtained from the Secretary, University College.

Free public lectures will be given (in English) at 5.30 o'clock at King's College, on October 16 and 17, by Prof. H. Wieland, of the University of Freiburg, on, respectively, "Organic Radicals" and "The Theory of Oxidation Processes." No tickets will be required.

APPLICATIONS are invited by the Glamorgan Agricultural Committee for the position of Instructor in Agriculture under the Director of Agriculture. Candidates must be practical agriculturists, able to lecture and demonstrate in agriculture and allied subjects and to conduct field and live-stock experiments. Application forms (which must be returned not later than the morning of October 13) may be had from the Director of Agriculture, 5 Pembroke Terrace, Cardiff.

AT the meeting of the Scottish Universities Entrance Board held on September 27, Sir Richard Lodge, who was in the chair, alluded to the loss which the Board had sustained in the death of one of its members—Prof. Darroch. The following resolution was unanimously adopted, and it was agreed that a copy of it should be sent, with an expression of the Board's sympathy, to the late professor's daughter: "Prof. Darroch was an original member of the Scottish Universities Entrance Board as a representative of the University of Edinburgh. His unique knowledge of the educational system of Scotland, his shrewdness of judgment, and the careful thought and labour which he gave to the business of the Board, made him one of its ablest and most useful members. His colleagues desire to place upon record their appreciation of his services and their intense regret at the untimely end of a life which had been devoted to the cause of Scottish education."

AT the meeting of Convocation to be held on October 14, a chairman is to be elected to succeed the late Dr. R. M. Walmsley. There are two nominations for this important office, namely, Prof. S. L. Loney, whose mathematical books and activities in connexion with the work of the University are well known, and Sir Robert Blair, who was the Education Officer of the London County Council for twenty years. Sir Robert Blair has long been associated with the progress of science teaching in the schools. So far back as the British Association Meeting in 1910, he was pressing the claims of the technical and scientific expert for higher posts in industry and commerce: he has been a pioneer in technical education and has persistently advocated the need for training at universities and higher technical institutions. His knowledge and administrative experience should be of decided value to the University if he is elected chairman of Convocation.

THE "gifted pupil" in the high schools of Iowa forms the subject of a study, published in Bulletin, 1923, No. 46, of the Bureau of Education, Washington, by Charles Deich, professor of education, Simpson College, and Elmer E. Jones, director, School of Education, Northwestern University. That it is the duty of educational administrators to provide for the early identification of sub-normal children and the adaptation of their schooling to their special needs has long been recognised, but it is now coming to be realised that it is quite as important that supernormal children should not be retarded in their development through being made to conform to mediocrity. The Association of American Universities discussed in 1922 "The sifting out of the exceptional student and his relationship to the university curriculum"; the writers of the more recent Iowa report contend that too often irreparable mischief is done at an earlier stage: "If he is hampered by association with mediocrity, and if his course is not broadened and deepened to meet intellectual abilities and desires, he is doomed to a type of retardation that is wellnigh impossible to counteract in later educational work. No matter what his college life may be, or how excellent his graduate work, he has sustained a loss in his secondary training that can never be replaced." Accordingly, it is recommended that there should be in each year a survey of the schools undertaken in co-operation with university departments of education and psychology. By using the data thus obtained, teachers in the high schools would be able to identify the exceptionally gifted students with certainty by the beginning of their third high school year, and arrangements could be made for providing for them suitably enlarged and intensified courses.

Early Science at the Royal Society.

October 4, 1667. Mr. Charles Howard suggested, that it might be considered, whether maiz might not yield a kind of sugar, the stalks of it containing a very sweet juice; and he desiring, that he might be furnished with an account of the way of ordering the sugar-canes for the making of sugar, Mr. Oldenburg offered an account relating to Barbadoes.

October 5, 1661. Sir Robert Moray produced unnealed glass hollow balls with a small hole in them; which being held in the hand till they were heated (the hole thereof being stopped with the palm of the hand) would fly to pieces.—Dr. Goddard to try the velocity of sinking bladders in water, and the lord viscount Brouncker in air.—Dr. Ent to give in writing some considerations, why it is hotter in summer than in winter.

October 7, 1670. There was read a Latin letter from Signor Montanari, containing some new observations by him of the non-appearance of some stars of the second magnitude in the sky, though formerly observed by Bayer and others; and intimating that he had sent a manuscript, containing various experiments on the breaking of the glass drops, a task imposed on him by the grand duke of Tuscany.

October 8, 1662. Mr. Boyle was desired to shew, at the next meeting, the second part of his experiment about coagulation, viz., the reducing the coagulated liquors to their former fluidity.

October 9, 1661. A living chameleon was presented to the society from Mr. Clayton by Dr. Henshaw.—Dr. Croune, Dr. Pope and Mr. Rooke were appointed a committee to view the propositions for inquiries in foreign parts.—The lord viscount Brouncker read a letter of Dr. Christopher Wren to Sir Paul Neile, concerning his hypothesis of Saturn.

1673. The president gave the council notice, that there had been lately with him a committee of the professors of Gresham College, and another of the Mercers company, inviting the Royal Society to return to that college, and to keep their assemblies there, as formerly they did before the fire. To whom he had returned his thanks for this kind offer, and for their respect to the Royal Society. The council thought good to have their hearty thanks returned to the said committee for their kindness and respect, yet without saying anything to them of acceptance or not acceptance; only, in case they should give occasion for saying more, that then it might be mentioned, that the business was under consideration. The persons appointed to give these thanks were the lord viscount Stafford, Sir Paul Neile, Sir John Lowther, Mr. Pepys, Mr. Colwall, Dr. Croune and Mr. Oldenburg, or any three of them.—Whilst this was doing, Sir Theodore de Vaux came in, being sent by the earl of Norfolk, earl marshal, to acquaint the council, that his lordship wondered, that they were not met in Arundel-house, as formerly, but yet hoped, that they would hereafter still continue their meetings there, as formerly; and that if they should remove to any other place, he could not but take it very unkindly.—Hereupon the president declared, that for this time he had caused the council to be summoned in this place (his own house?) for his particular convenience, his present occasions not having permitted him to go far off. And his lordship, at the desire of the council returned their hearty thanks to the earl marshal for his singular affection and respect to the Society.

October 11, 1669. Ordered that Dr. Merret be desired to send the collection made by Thomas Willisel in his first voyage, to the society at their next meeting at Arundel-house.

Societies and Academies.

LONDON.

The Institute of Metals (Autumn Meeting), September 10.—D. M. **Fairlie** and G. B. **Brook**: The determination of sodium in aluminium.—D. H. **Ingall**: The relationship between tensile strength, temperature, and cold-work in some pure metals and single solid solutions. The critical inflection temperature is the all-important property of any metal or alloy for high temperature service, as it would appear to be the temperature above which viscous flow may take place and below which there is only stability of the material in the cold-worked state. Other things being equal, the higher the critical inflection temperature, the more suitable is the material.—H. **Moore**: On the effect of progressive cold-rolling on the Brinell hardness of copper. It has been stated that in the cold-rolling of copper, iron, tin and other metals and alloys the Brinell hardness rises rapidly during the initial stages of deformation and then diminishes. Experiments carried out at the Research Department, Woolwich, give no support to the suggestion that severe cold-rolling of copper beyond a certain stage induces softening.—F. W. **Rowe**: (1) Some experiments on the effect of casting temperature and heat-treatment on the physical properties of a high-tin bronze. The bronze of the highest tin content (copper, 86·0 : tin, 15·95 : phosphorus, 0·05) used in engineering practice is employed for special bearings where low tin phosphor bronzes and leaded phosphor bronzes have been found unsatisfactory. This alloy attains its greatest hardness (and probably best wearing properties) with the lowest casting temperature; this is, however, very often not practicable on account of the danger of "draws" in uneven sectioned castings.—(2) Some experiments on the influence of casting temperature and mass on the physical properties of Admiralty gun-metal. Admiralty gun-metal (copper, 88 : tin, 10 : zinc, 2) gives the best results in all sizes of bars with the lowest casting temperature, *i.e.* 1100° C., and the best tests of all with the ½ in. square bar cast at that temperature.—Tomojiro **Tanabe**: Studies in the aluminium-zinc system.—T. H. **Turner** and W. E. **Ballard**: Metal spraying and sprayed metal. The process of metallisation invented shortly before the War and known generally as Schoop's metal spray process was held back in its development by the unsettled condition of industry, but is now being operated commercially. The gas-operated metal spraying pistol now used in Great Britain and a rumbling barrel type of metallising apparatus which is used for repetition work on small articles were illustrated. All articles to be sprayed are sandblasted and, in certain cases, preheating of the article to be coated is recommended, as this also tends to improve the adhesion. By spraying lightly on to glass slips it has been possible to examine the individual particles of the sprayed metals. Photomicrographs of these show that the metal must be molten at the instant it strikes the surface to be coated. Solid articles have been built up by spraying and proved machineable and resonant. Practically any metal available in wire form and fusible in the oxy-hydrogen flame may be sprayed on to practically any surface, *e.g.* on to paper, fabric, wood, or metal. The surface produced is always matte, but may be polished if desired. The matte surface is an ideal foundation for paints. Completed structures can be coated uniformly with any desired metal for protection against atmospheric corrosion, chemical attack, or furnace conditions. The process has found a particular field in ship work, and is recommended for the zincing of rail ends and fishplates for connecting purposes on electric railways.

PARIS.

Academy of Sciences, September 1.—M. Guillaume Bigourdan in the chair.—MM. **d'Arsonval, Bordas,** and **Touplain**: Study of the waters of the glaciers of the Mont Blanc massif. The chemical and microscopical analyses of the sediments show that the Tour, Argentière, and Bois glaciers form one group: the Bossons Glacier shows peculiarities differentiating it from the others, on account of its intense mechanical effects on the underlying strata.—Henri **Jumelle**: Neodypsis, palm trees of Madagascar.—Maurice **Paschoud**: Calculation of the velocities for the steady state, by polynomials, in tubes with regular polygonal sections.—E. **Jouguet**: The speed of deflagrations. A development of results given in earlier communications, the hypothesis of a monomolecular chemical reaction being abandoned.—**Jarry-Desloges**: Contribution to the study of the planets Mars and Jupiter. Details of the changes observed in the appearance of the southern polar cap of Mars.—Ch. **Gallissot**: A simple arrangement for observing the optical disturbances in the atmosphere: application to the estimation of the definition of the images given by instruments. These disturbances are of interest in two directions, as limiting the accuracy of observations and as a means of supplying information concerning the movements of the atmosphere. A simple form of Fresnel's biprism is fixed to the objective of a small telescope and this is focussed on the objective L of an astronomical telescope. Two half images are obtained, which may be either separated by a dark band, or partially superimposed, depending on the relative positions of the crest of the biprism and the focus of L. If the incident rays are free from disturbance, the exact position of the focus is sharply shown by the disappearance of the dark band. Optical discontinuities in the atmosphere are shown by striæ.—L. **Dunoyer** and P. **Thoulon**: Some electro-optical applications of arc relays. The principle of these relays has been described in an earlier communication (*Comptes rendus*, 1924, 148). Applications to optical signalling, directed optical radio-telephony, registration and reproduction of speech, television, and optical reception of radioelectric signals are described.—L. **Hackspill** and R. **Grandadam**: The saturated vapour pressures of mixtures of sodium and potassium chlorides.—H. **Gault** and R. **Truffault**: The chlorination of chloroform. The effects of light, temperature, and of various catalysts on the course of chlorination of chloroform was studied. Chlorination was prevented by the addition of ferric chloride to the chloroform, and this was shown to be due to the coloured solution absorbing the light rays determining chlorination.—David **Rotman-Roman**: The bostonites and camptonites of the Yemen.—M. E. **Denaeyer**: New observations on the geology of Tibesti - Djado - Kaouar.—Georges **Dubois**: Classification of the Quaternary of the north of France and comparison with the Danish Quaternary.—Mlle. Aimée **Camus**: New genera of Madagascan Bambusæ.—F. **Picard**: Observations on the solubility of the tannins and their extraction from plants.—Jean **Bathelier**: The development of *Eutermes matangensis*.—G. **Ramon**: The appearance of antibodies.

MELBOURNE.

Royal Society of Victoria, July 17.—Prof. Laby in the chair.—E. T. **Quayle**: Sun-spots and Australian rainfall. When the rainfall stations are arranged in climatic districts, both for the eastern and the western interior of the continent, the best rains occur during the "rising phase" of sun-spot activity and the poorest during the minimum phase. In the Northern Territory and Central Australia generally, the best rains occur later, or during the "declining phase," the lag amounting usually to 3 years, or in the case of Daly Waters possibly 4 years. The rainfall response to solar activity of the eastern and south coastal stations is generally so slight as to be almost negligible. For the rainfall increase over the eastern and western interior of the continent during the rising phase of solar activity, it is suggested that since these areas derive their rains almost entirely from air drifts of tropical origin, these must be of greater energy and frequency during this sun-spot phase. For coastal areas the maintenance of the rainfall during the minimum phase may be due to the greater frequency there of coastal cyclones. The increased rainfall in the Territory and Central Australia during the declining phase may be due to longitudinal changes in the loci of the southward tracks of tropical air drifts. The rainfall curves were smoothed by using 3-year means instead of the individual records, thus eliminating the effects of a possible 3-year period. The correlation coefficients of a number of these were computed. The correlations suggest that Bendigo and Daly Waters represent the maximum relations, both direct, but the former immediate and the latter delayed, and it may be that other stations show the double impulse in varying degree. With unsmoothed rainfall curves these two stations give lower correlation coefficients, +0·46 and +0·42 respectively, which suggests the probability of something like a 3-year period in their rainfalls. This is also suggested by breaking up the rainfall records into periods corresponding with those of the sun-spot cycles and taking the means of all the first, all the second, all the third (and so on) years of the cycle. For Bendigo there is for each the mean of six years. These results point to a tendency for droughts to occur every third year except during the rising period of sun-spot activity, which seems to have the effect of a forced oscillation.—J. A. **Smith**: On the graduation of circles. Reference was made to the work of Bird, Troughton, Ross, Ramsay and Swasey in the development of accurate methods of graduating circles.—G. F. **Hill**: Notes on *Mastotermes darwiniensis* Froggatt (Isoptera). After reference to the similarity of the ovipositor of the adult Mastotermes to that of the common American cockroach, the hitherto undescribed egg-mass of this termite is discussed. In all other termites, so far as is known, the eggs are extruded separately. Descriptions are given also of the third-form neoteinic king and queen and the first- and second-form nymphs. The seasonal appearance of the colonising flights and the distribution of this termite in tropical Australia are briefly discussed.—H. B. **Williamson**: Revision of the genus Pultenæa, Pt. iv. Two distinct forms have been included under *P. styphelioides*, one with alternate and the other with ternate leaves. The former is the true *styphelioides*; the latter is separated as *P. subternata*. *P. procumbens* is suggested as a low form of *P. styphelioides* and made a variety of that species. Two new species, *P. trichophylla* from Port Lincoln, and *P. pubescens* from Mt. Gambier and the Grampians, are described.—F. **Chapman**: New or little-known fossils in the National Museum. Pt. xxviii. Some Silurian rugose corals. Four genera are here discussed. Lindstroemia is held to be a well-defined genus, with the genotype indicated by Nicholson and Etheridge's figured *L. columnaris*. Five species are recorded from Victoria, all of which are new. In the presence of a weak bilateral symmetry, some of the species show that the genus has some affinities with the Zaphrentidæ. Cyathophyllum is represented by two new species, from the

Yeringian—*C. cresswelli* and *C. subcæspitosum*, the latter closely resembling the Devonian *cæspitosum* of Devonshire and the Eifel and helping to strengthen the Devonian element in the Australian Silurian. In Spongophyllum there are two new species, one from the Yeringian of Victoria, *S. stevensi*, related to *S. sedgewicki*; the other, *S. shearsbii*, from the Yass beds of New South Wales. The genus Columnaria is represented by a new species from the Melbournian, *C. flemingtonensis*, preserved as a faithful negative mould in a fine ferruginous mudstone.—Miss Leslie **Kerr**: The lignotubers of Eucalypt seedlings. The lignotubers are embryonic storage organs, and not pathological as was previously supposed. These basal inflations of the stem attain their maximum development in the species inhabiting the most arid areas, while six species inhabiting regions of high rainfall do not develop them.

August 14.—Prof. T. H. Laby in the chair.—E. **Kidson**: Some periods in Australian weather. Recent work was described in extension of Dr. Braak's theories regarding a three-year period, especially clearly shown in the pressure variations at Port Darwin. Strong evidence of an 18-months cycle in the atmosphere, of opposite phase in eastern and western hemispheres, equivalent to a nutation of the whole circulation system, was adduced. Characteristic annual variations of the velocity, pressure, and latitude of anticyclones were evolved. A high correlation was established between the annual latitude range of anticyclones and sun-spot numbers.—E. J. **Dunn**: The centenary of Selwyn the geologist.

Official Publications Received.

British Museum (Natural History). British Birds: Summer Visitors. (Set C.11.) 5 cards in colour. British Birds: Winter Visitors. (Set C.12.) 5 cards in colour. (London: British Museum (Natural History).) 1*s.* each set.

The British Mycological Society Transactions. Edited by C. Rea and J. Ramsbottom. Vol. 9, Part 4, August. (London: Cambridge University Press.) 7*s.* 6*d.* net.

British Museum (Natural History). British Flowering Plants. Series 3. 5 cards in colour. (Set F.6.) British Flowering Plants. Series 4. 5 cards in colour. (Set F.7.) (London: British Museum (Natural History).) 1*s.* each set.

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. 40, Fascicule 1: La détermination des plagioclases dans les coupes minces. Par L. Duparc et M. Reinhard. Pp. 149+13 planches. (Genève: Georg et Cie.) 20 francs.

The Physical Society of London. Proceedings, Vol. 36, Part 5, August 15. Pp. xxii+341-442. (London: Fleetway Press, Ltd.) 6*s.* net.

Decimal Metric Congress, London, July 9th, 1924. A Conference held for the Purpose of Considering the most effective Means of securing the adoption of Decimal Coinage and the Metric System. Pp. 48. (London: Decimal Association.)

Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. (New Series.) Vol. 6, Part 1. Pp. 114+lxii. (London: Williams and Norgate.) 5*s.*

Department of Mines: Memoirs of the Geological Survey of New South Wales. Geology, No. 8, Supplement: The Geology of the Broken Hill District. By E. C. Andrews. Supplementary Note on the Geology of the Broken Hill District. Pp. 27+9 plates. (Sydney: Alfred J. Kent.) 21*s.*

Memoirs of the Geological Survey of India. Palaeontologia Indica. New Series, Vol. 7, Memoir No. 4: An Incomplete Skull of Dinotherium, with Notes on the Indian Forms. By the late Capt. R. W. Palmer. Pp. ii+14+3 plates. 1.2 rupees. New Series, Vol. 9, Memoir No. 1: On the Blake Collection of Ammonites from Kachh, India. By Dr. L. F. Spath. Pp. ii+29. 12 annas. (Calcutta: Geological Survey of India.)

Bureau of Education, India. Indian Education in 1922-23. Pp. iv+45. (Calcutta: Central Publication Branch.) 8 annas; 9*d.*

Proceedings of the Royal Society of Edinburgh, Session 1923-1924. Vol. 44, Part 2, No. 16: On Mixed Determinants. By R. Vaidyanathaswamy. Pp. 168-184. 1*s.* 6*d.* Vol. 44, Part 2, No. 17: The Ultra-Violet Emission Spectra of the Halogens. By Dr. E. B. Ludlam and W. West. Pp. 185-196. 1*s.* Vol. 44, Part 2, No. 18: The Budde Effect in Bromine. By Dr. E. B. Ludlam. Pp. 197-201. 9*d.* Vol. 44, Part 2, No. 19: Apparatus to facilitate the Use of an Oxygen-Carbon Dioxide Mixture in the Treatment of Carbon Monoxide Poisoning. By Prof. Henry Briggs. Pp. 202-205. 9*d.* (Edinburgh: R. Grant and Son; London: Williams and Norgate.)

University of Liverpool Tidal Institute. Fifth Annual Report, 1924. Pp. 8. (Liverpool.)

Proceedings of the Geologists' Association. Edited by G. M. Davies. Vol. 35, Part 3, August 25th. Pp. 169-264. (London: E. Stanford, Ltd.) 5*s.*

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 1, No. 4, August. Pp. vi+137-239+49+46 plates (Kobe.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 34: Kemp Fibres in the Merino Sheep. By Prof. J. E. Duerden and Miss M. Ritchie. Pp. ii+18. (Cape Town.) 3*d.*

Prospectus of the Royal College of Art, S. Kensington, London. Session 1924-1925. Pp. iv+28. (London: H.M. Stationery Office.) 6*d.* net.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1923; with Report of the Geological Survey Board and Report of the Director. Pp. iv+173. (London: H.M. Stationery Office.) 4*s.* net.

The University of Birmingham: Faculty of Science. Careers to which Subjects may lead and other Information. Pp. 31. (Birmingham.)

Collective Index of the Journal of the Institute of Brewing, 1911 to 1923. Compiled by W. H. Bird. Pp. iv+330. (London: Harrison and Sons, Ltd.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Grenada, January-December 1923. Pp. iv+14. (Grenada: Government Printing Office.) 6*d.*

Merchant Venturers' Technical College. Calendar for the Sixty-ninth Session, 1924-25. Pp. 55+17 plates. (Bristol.) 6*d.*

Diary of Societies.

MONDAY, OCTOBER 6.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—E. Kilburn Scott: Pulverised Fuel.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Sir Lynden Macassey: Presidential Address.

TUESDAY, OCTOBER 7.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. A. E. Dunstan: Recent Development in the Art of Cracking.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—E. B. Cook: The Glory of the Garden.

WEDNESDAY, OCTOBER 8.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.), at 5.—Dr. R. Hutchison and others: Discussion on The Relative Values of Stone-milled and other Flours and Breads in relation to the Nutrition of the Growing Child.

NEWCOMEN SOCIETY (at Iron and Steel Institute), at 5.30. — Rhys Jenkins: A Sketch of the Industrial History of the Coalbrookdale District.—T. S. Ashton: The Discoveries of the Darbys of Coalbrookdale.—J. W. Hall: Notes on Coalbrookdale and the Darbys.

THURSDAY, OCTOBER 9.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Watergate House, Adelphi), at 7.30.

OPTICAL SOCIETY, at 7.30.—E. T. Hanson: Some Problems in the Theory of Optical Diffraction.—W. M. Hampton: (*a*) The Annealing of Glass; (*b*) The Re-annealing of Glass.

FRIDAY, OCTOBER 10.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. D. Johnston: Wonderlands of the Western Worlds.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—N. Thornton: The Design of Static Sub-stations, with some notes on their Equipment.

SATURDAY, OCTOBER 11.

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 3.—Prof. C. Spearman: The New Psychology of "Shape" (Gestalt).—S. A. Hamid: Some Factors of Effectiveness in Mental ("Intelligence") Tests.

PUBLIC LECTURES.

MONDAY, OCTOBER 6.

KING'S COLLEGE, at 5.30.—Prof. E. W. Scripture: What the Voice looks like. — Rev. Dr. F. A. P. Aveling: Introduction to Psychology. (Succeeding Lectures on October 13, 20, 27.)

TUESDAY, OCTOBER 7.

UNIVERSITY COLLEGE, at 5. — Prof. G. Dawes Hicks: Philosophy and Psychology.

KING'S COLLEGE, at 5.30. — Prof. H. Wildon Carr: The Philosophy of Bergson: Its Relation to Past Systems and to Present Science. (Succeeding Lectures on October 14, 21, 28, November 4, 11.)

WEDNESDAY, OCTOBER 8.

KING'S COLLEGE, at 4.30.—Dr. C. da Fano: The Histology of the Nervous System. (Succeeding Lectures on October 15, 22, 29, November 5, 12, 19, 26.)—At 5.30.—Prof. R. J. S. McDowall: The Human Body and its Function. (Succeeding Lectures on October 15, 22, 29, November 5.)

BEDFORD COLLEGE FOR WOMEN, at 5.15. — Miss Hosgood: Eastern Australia—Some Problems in Human Geography.

UNIVERSITY COLLEGE, at 6.—Prof. C. Spearman: The Current Views of Individual Differences in Ability.—At 7.—A. H. Barker: The Heating Equipment of a Large Country House.

FRIDAY, OCTOBER 10.

UNIVERSITY COLLEGE, at 5.—Prof. Borenius: History and Art: Painting in the Netherlands and Spain.—At 5.30.—Prof. S. L. Rashkovitch: Water Supply and its Purification. (Succeeding Lectures on October 17, 24, 31.)