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Population Problems.

IT would seem that the daily press is beginning to regard the facts and figures issued periodically by the Registrar-General as good copy. In any event, increasing prominence is given to them, and headlines direct our attention to a further fall in the birth-rate. But comment is withheld; the fall is not applauded. Presumably it is supposed that national prestige and numbers are somehow linked together, and that therefore a diminution in the number of Englishmen in the next generation cannot be a matter for congratulation. On the other hand, the fall is not bemoaned. We all know that there are more than a million unemployed. It is worth remarking that in pre-War days we knew only the percentage of the unemployed among a very small proportion of the wage earners. For a short time in 1857, 1879, and 1886, more than 10 per cent of them were unemployed, while the normal figure was nearer 5 per cent. But 10 per cent may not sound alarming. There are at present more than 11 per cent unemployed, and, if we still thought in percentages instead of in totals, the employment position would not seem so bad and the fall in the birth-rate might be a matter for unfavourable comment. (This should not be read as implying that the seriousness of the unemployment phenomenon is exaggerated; but it is its chronic nature rather than its amount which is unexampled.) We are now growing accustomed even to these huge figures, and there is perhaps some reason to think that we are on the verge of plunging into a population panic and are held back only by our realisation of the magnitude of unemployment. One day a further fall in the birth-rate may be greeted by panic headlines in the press. Meanwhile, the position seems to be that unemployment is functioning as an anæsthetic while birth control gains firmer hold.

Alarm is likely to be aroused when it is realised that the natural increase, or annual increment to the population by excess of births over deaths, will, things remaining as they are, rapidly diminish in the near future. Assuming things to remain as they were a few years ago, Prof. Bowley made certain estimates which, while well known to students, have not as yet become very familiar to the public. Assuming the annual number of births to remain as in 1921–23, the death-rate to remain as in 1910–12, and that there was no migration, he calculated that the population of Great Britain, which was about $42\frac{3}{4}$ millions in 1921, would reach about $45\frac{1}{3}$ millions in 1931, $47\frac{1}{4}$ in 1941, and $48\frac{1}{4}$ in

1951, after which it would remain approximately table. But things are not remaining as they were. The number of births in Great Britain was 895,209 in 1922, 870,033 in 1923, 836,833 in 1924, 814,719 in 1925, 797,347 in 1926, and 751,638 in 1927. The birth-rate, in fact, falls year by year. It was 16·6 per 1000 living at all ages in 1927, this being the lowest rate ever recorded. It is a remarkable fact that the number of births registered in 1927 was the lowest registered since 1855, although at the earlier date the population was less than half its present size.

During the same years there has been a considerable loss by emigration. The net loss by emigration to countries out of Europe from Great Britain and Northern Ireland was 91,262 in 1924, 84,259 in 1925, 115,538 in 1926, and 75,444 in 1927. The inference is obvious. Stabilisation of population will come sooner than was to be anticipated a few years ago. It might even be the case that, if Prof. Bowley's calculation were repeated, and the estimate of the annual number of births amended to compare with the present position, the result might show that a decline in the population is to be expected before many years have passed, even if the effect of migration is left out of account. Such a calculation, it may be remarked, is possible only with a census year as a basis, because it is only for a census year that we have the necessary information regarding the age distribution of the population.

The natural increase of the population is thus becoming less year by year. The excess of births over deaths in England and Wales was about 242,000 in 1926 and about 169,000 in 1927. At the same time migration is removing many thousands every year. However much our exporting industries may languish, we remain great exporters of men. A list of European countries arranged according to intensity of loss of population consequent upon overseas migration per 100,000 inhabitants from 1920 to 1924 shows the first five countries to be as follows: Irish Free State 425, Great Britain and Northern Ireland 327, Italy 274, Portugal 227, and Spain 206. We are in this respect associated with a group of countries with whom we do not commonly class ourselves. Owing to the combined effects of diminishing natural increase and loss by migration, the estimated populations of Scotland, Ireland, and the Irish Free State fell by some thousands each between mid-1926 and mid-1927. In England and Wales alone out of the four constituent areas of these islands did the estimated total in mid-1927 show an advance upon that for mid-1926. But it will not be long before the position in England and Wales approximates to that in the other three areas.

However much opinions may differ in other respects, there will be universal agreement about one factor in the situation—the death-rate. We shall continue to agree to attempt to reduce it. It is migration and the birth-rate which present problems. Should we encourage migration? Should we welcome a further fall in the birth-rate? Migration is a troublesome problem. It is advocated for two somewhat different objects. At times the primary object is said to be the relief of congestion at home. At other times emphasis is laid on the fact that, while population is dense in England, it is sparse in the dominions, and that migration would bring about a desirable redistribution of population within the Empire.

The facts themselves are none too clear. We know something about movement to non-European countries from Great Britain and Northern Ireland and from the Irish Free State respectively, but we know little about movement within these islands. Figures compiled by the Irish Free State Department of Industry and Commerce show that in 1927 there was an outward balance from the Free State of 20,688 persons in the traffic between that country and the remainder of the British Isles. Of this total, about 30 per cent was accounted for by migrants from the Irish Free State who travelled to non-European countries via British ports. It seems to follow that an addition of some 14,000 was made to the population of Great Britain and Northern Ireland during 1927 by emigrants from the Free State.

During the same period some 63,000 persons were assisted to emigrate from Great Britain under the Empire Settlement Act of 1922. Emigration is costly. Under this Act, up to three millions may be spent annually from national funds in support of approved emigration schemes, provided that at least half the cost of each scheme is met by some other authority, public or private. But this is by no means all, or even the greater part of the expense. There are government schemes for training men for emigration under the Ministry of Labour; there are numerous private agencies at work. Looking further back, there is all the expense of bringing up and educating men who, when of age to produce, are shipped off to another country.

One aspect of the present policy seems indefensible. If the object is to relieve congestion in Great Britain, it is foolish to allow the places of those assisted to depart to be filled by immigrants

from Ireland. Why not, it might be said, also raise a cry against the influx of Scotsmen into England? Is this not pure prejudice? The answer is that it is not a question of race at all but a question of finance. Scotland shares with England the expense of emigration. The Irish Free State does not. If it is said that the object is not primarily the relief of congestion at home, but the redistribution of population throughout the British Empire, then with equal force it may be urged that the financial burden is unfairly distributed, and that direct emigration of the Irish to the Dominions would be a less circuitous method than sending Englishmen from home and replacing them in part by Irishmen.

This matter, though not unimportant, is a side issue. A discussion of the main issue, however, raises so many matters of such complexity and obscurity that it is not possible to do more than indulge in vague generalisations. It must be remembered that a further decline in the birth-rate in Great Britain will not affect the employment position until fourteen years have passed. With the birth-rate at its present level, it is possible that the population will be stable, or at least not increasing, fourteen years from now. It does not seem unreasonable to hope that within that period we can get our population employed up to the pre-War level. With such facts and anticipations in mind, it would seem that the fall in the birth-rate of Great Britain has gone far enough. A restricted policy of assisted emigration for the next few years, provided that reasonable safeguards are provided to meet the difficulties mentioned above, seems reasonable, both because we are still faced with an annual increment of population in Great Britain for a few years, which we can scarcely be said to require, and because the sparsely populated Dominions are apparently capable of absorbing these emigrants at the present rate.

This does not mean, however, that it would be satisfactory if the birth-rate remained as it is in all respects. The birth-rate is an average figure for the population. The rate is lower than this figure among the comfortably situated, and highest among the least comfortably situated—the miners, for example. It is a curious fact that anyone who deplores this well-known phenomenon is assumed to do so wholly on the grounds that the stocks, with the most valuable biological endowments, are not reproducing themselves as they should. But whether this is so or not, we might surely all join in deploring it on the obvious grounds that those parents who by reason of their financial position are best able to provide children with a good upbringing and a decent education have the smallest families. Such information as we possess for Great Britain—and it is very scanty—does not tend to show that the contrast between the well-off and the badly-off in respect to size of family is growing less. There is evidence, however, from Sweden, and also from Holland and Germany, that in late years this gap has been closing. In Stockholm it is now apparently the case that the better-off parents have the most children, whereas not many years ago the situation was much as in Great Britain. There could scarcely be any investigation more profitable than one which would throw light upon the causes of so remarkable a change. It might then be possible to attempt to bring influences to bear which would lead to a similar change in Great Britain. A. M. C.-S.

Natural History and Literature.

(1) *Birds and Beasts of the Greek Anthology.* By Norman Douglas. Pp. vii+215. (London: Chapman and Hall, Ltd., 1928.) 7*s.* 6*d.* net.

(2) *Nature in the Age of Louis XIV.* By Phyllis E. Crump. Pp. xv+224. (London: George Routledge and Sons, Ltd., 1928.) 10*s.* 6*d.* net.

(3) *Tableau de Lilliput ou Essai sur les Infusoires.* Par Marcel Roland. (Collection de *La Grande Revue.*) Pp. 51. (Paris: Les éditions Rieder, 1928.) 6 francs.

(1) MR. NORMAN DOUGLAS has found in the famous collection of poems known as the Greek Anthology about six hundred references to wild animals, and to about a hundred and fifty different kinds. He discusses many examples in his scholarly way and with a pleasant wit; and his book is of interest in its disclosure of the mood in which many different minds looked at familiar animals through the long stretch of time which the Anthology covers. There are references to lions and lynxes, bears and boars, wolves and goats, but most of them are so trivial that we welcome the long-standing puzzle of the unicorn. Birds are happily represented by the eagle, the raven, the crow, and many others, but rarely with any insight, so far as we can discover from the quotations; and we are glad to come to the long-lived phœnix and the elusive halcyon. The interest is often not so much that of natural history or of poetry, but the 'akanthologous' fascination of thorny questions. Reptiles are represented by adders and asps, geckos and crocodiles; and amphibians by the vocal tree-toad or ololygon

and the common frog—"the muse of damp retreat."

Fishes seem to have been treated somewhat cursorily, but there is again the agreeable riddle of identification,—of the most self-contradictory skaros, for example, or the beauty-fish, kallichthys. There is mention of conger and red mullet, of sprat and shark, of mackerel and tunny; and if we include the dolphin among fishes, we may also mention the argonaut. The humbler creatures of the sea are occasionally referred to—the *Murex* yielding purple (and yet no mention of pearls or coral); the "crook-legged sand-diving crab, with two-clawed gear," the hermit-crab "that can never be made to walk straight"; and so on down to sponges, somewhat enthusiastically called "the blossoms of the sea." About a fifth of the references are to insects, such as ants, bees, and wasps. Mr. Norman Douglas has given much time to his labour of love, and we do not know how it could have been done better. Yet there is no blinking the fact that, good poets as many of the Greeks of the Anthology were, they are not seen at their best in their natural history references, which are too often trivial and prosaic. As regards both the natural history and the poetry, Mr. Douglas could have done much better himself; but of course that was not what he set out to do.

(2) Miss Crump's scholarly study of the attitude to Nature in the seventeenth century shows that this was more positive than has been hitherto believed. Apart from the fables of La Fontaine and the expressions of the pastoral ideal in the first thirty years of the century, it has been generally stated that there was no appreciation of Nature in France in the seventeenth century; and this has been explained as due to the non-existence of the theme in the Middle Ages and sixteenth century, and to the consequent lack of traditional foundation; to the prevalence of the mechanical view of Nature held by Descartes; to the fact that the feeling for Nature repressed in literature, for reasons of custom and fashion, found its compensatory outlet in pictorial art; and, finally, to the monotony of the landscape around Paris! These ingenious reasons, as Miss Crump shows, were invented to explain a phenomenon which does not really exist, for it is not true that there was an absence of a feeling for Nature in France in the age of Louis XIV.

The author marshals her evidence in a pleasant and convincing way, beginning with the enthusiasm for gardening—sometimes emancipated gardening—in the seventeenth century. She goes on to the evidence of a growing love of the country and to the expression of the pastoral ideal in drama and romance, eclogue and idyll. There is an appreciable development of a sense of the picturesque and a detectable tightening of the cords binding man to Nature. In not a few seventeenth-century writers there is a somewhat sophisticated emphasis on the charm of solitude and the value of a retreat from the Parisian world; but there is little indication of anything like an overwhelming love of the country. Something of this emerges clearly, however, in Madame de Sévigné and in La Fontaine, but they were outstanding exceptions. The author leaves us with the general impression that the love of Nature during the Louis XIV. period was still incipient, more than a little cold and conventional, somewhat distant and indicative of shallow acquaintanceship.

We wish the learned author had said something in regard to the influence of the re-awakening natural science which was beginning to disclose something of the veritable and verifiable wonder of the world. For one cannot have much depth of feeling towards an object in regard to which one had had no depth of experience. As regards man and animate Nature, it may be said that he loveth best who knoweth most.

(3) With these solid essays by two learned scholars we have deliberately linked a gossamer essay by Marcel Roland on the Lilliputian world of a drop of muddy water. What the scholars, in spite of their infective enthusiasms for their subjects, seem to us to have been forced to show (perhaps we are wrong) is the general poverty, triviality, and wooden conventionality of natural history allusions in literature when these have not behind them a well-informed sympathy. There are occasional poetic flashes among the natural history references in the Greek Anthology, and no one can doubt the insight of La Fontaine, but on the whole the Greeks and the French literateurs of the periods referred to do not distinguish themselves in their natural history allusions. Contrast with that the real thing, the reflections of an amateur naturalist, disciplined yet not too well up in his subject, a romanticist yet a devotee of the microscope as a window in the invisible. For Marcel Roland tells us, in a characteristically modern mingling of science, poetry, and philosophy, of the ongoings he has watched in the Lilliputian world of his drop of water.

The science of the muddy drop, with its tenantry of bacteria, infusorians, amœbæ, and so forth, has often been better done, yet the naturalist is

dull who cannot find suggestions in Roland's romantic reflections. The philosophy of the initiatives in living observable in the muddy drop,—the reactions and urges, the tropisms and experiments, now appearing so mechanistically describable and again so vitalistically apart, has been better done; yet how few philosophers ever deign to mention these infant school beginnings, and how few write of organisms as if they had ever watched any. Contrasted with what we find in Greek Anthology and Louis Quatorze literature, *as regards Nature*, we have here a delightful artistic expression. Roland knows his muddy drop, though we think he might know it better still; he is sympathetically intrigued by the behaviour of his Lilliputians; he strikes the modern note in his persuasion that they and he belong to the same kingdom; he takes them seriously enough to get to know their ways and look out for their intimations of immortality and love, of endeavour and sociality. Not unnaturally, the result is a very enjoyable work of art.

Scientific Societies in the Seventeenth Century.

The Rôle of Scientific Societies in the Seventeenth Century. By Martha Ornstein. Pp. xiv + 308. (Chicago: University of Chicago Press; London: Cambridge University Press, 1928.) 15*s*. net.

MARTHA ORNSTEIN was born in Vienna in 1878, and received her early education there. She went to the United States in 1895, and, after a year spent in perfecting her English, she passed the entrance examination at Barnard College with distinction in 1896. After taking her Master's degree in 1900, she specialised in mathematics for some years; then, turning to historical study, she wrote as her dissertation for the Ph.D. degree (conferred on her in 1913) the work now under review, which has been republished by her friends as a tribute to her memory. It was worth while, for the book is a sound piece of work, well-written (with scarcely a trace of a 'foreign accent') and well documented, and one which, within its compass, it would be difficult to improve upon. The prodigious amount of labour entailed can be judged by reference to the copious footnotes and to the bibliography at the end, covering no less than thirteen pages. The book is beautifully printed, and presents its fascinating story in a form which also delights the eye. We can only wish the publication the success which it richly deserves.

The writer observes that if the progress of a century is shown by a comparison of the state of knowledge which existed, say, in the first and last decades, no other century, perhaps, can show such an advance as the seventeenth. The essential task of the seventeenth century was the establishment of the experimental method in science, and, to appreciate the splendour of its achievements, it is sufficient to mention the names of such men as Galileo, Torricelli, Guericke, Robert Boyle, Harvey, Kepler, Pascal, Fermat, Descartes, Huygens, Leibniz, and Newton. We may draw a dividing line about the middle of the century. The first half accomplished through the work of a few men a revolution in the established methods of thought and inquiry; it created the experimental method, and produced its indispensable instruments, the telescope, the microscope, the air-pump, etc. The second half of the century saw the elaboration of the results obtained.

The first part of the book is devoted to individual pioneers such as Galileo, Torricelli, Harvey, Descartes. After a time the necessity of extending the scope, number, and elaboration of experiments involved expenditure in money and material beyond the resources of the private investigator, who then became dependent on the patronage of wealthy persons interested in science. Much service was rendered to science by wealthy amateurs, some of whom devoted their whole lives and resources to scientific research. There were in England, Robert Boyle, John Evelyn, Sir William Petty; in Ireland, William Molineux of Dublin, inventor of the hygroscope; in France, Peiresc; in Holland, Leeuwenhoek and van Helmont; in Germany, Guericke, Hevelius, and Tschirnhausen; in Italy, Ferdinand and Leopold dei Medici and Count Marsiglio. But the tendency quite early was for investigators to form themselves into groups, each contributing to the common stock, so that the benefit of intellectual co-operation was added to that accruing from the pooling of material resources. Hence the formation of the various societies which are the special subject of the book before us.

One of the very earliest of these societies was the Accademia dei Lincei in Rome (1600–30), founded by Fredrigo Cesi, which had for its device a lynx with upturned eyes tearing a Cerberus with its claws, and symbolising the struggle of scientific truth with ignorance. Della Porta, Peiresc, Galileo, and Fabius Colonna, the botanist, became members. Galileo was in very close relations with it, always referred to himself in the dialogues as Academicus, and added this title to his name in publishing his books. The "Gesta Lynceorum"

was the earliest recorded publication of scientific papers by any society. The first organised scientific academy was the Accademia del Cimento of Florence (1657–67), actually founded by the two Medici brothers Ferdinand II. and Leopold. Its leading spirits were the disciples of Galileo, Viviani, and Torricelli, and their pupils. The Italian societies form the subject of Chap. iii.; Chap. iv. gives the early history of the Royal Society of London, which arose out of informal meetings of scientific and learned men, first in London, then in Oxford (the "invisible College"), and then again in London, and received its charter as the "Royal Society" on July 15, 1662.

Chap. v. deals with the French Académie des Sciences, which also, like the Royal Society, arose out of informal meetings of scientific men. These meetings at first took place at the cell of the famous Minorite friar Morin Mersenne (1588–1648). Fermat, Roberval, Pascal, and Gassendi were among those who participated, entertaining themselves with astronomical observations, problems of analysis, physical experiments, new discoveries in anatomy and botany; they were often joined by foreign guests. Later they met every Thursday at various houses, including Pascal's, and later again at the home of Melchisedec Thévenot (1620–92). Colbert knew of their meetings, and proposed to Louis XIV. to give them an official status. The Académie des Sciences became, unlike the Royal Society, a government institution, and suffered the vicissitudes inseparable from direct government control. Until the death of Colbert (1683) it prospered; but under his successor, Louvois, it declined, as Louvois had no sympathy with pure science, and wanted to make the work of the Academy more practical. Chap. vi. deals with the German scientific societies.

Not the least interesting of the chapters is Chap. vii., on the scientific journals. Before the establishment of such journals, the only means of scientific intercommunication was private correspondence, for example, that of Mersenne, Peiresc, Collins, and Wallis. How unsatisfactory this medium was is proved by the numerous disputes about priority of discovery, for example, between Torricelli and Pascal, Hooke and Huygens, Newton and Leibniz. The way out of the difficulty was clearly indicated when Denis de Sallo published, on Jan. 5, 1665, the first number of the *Journal des Sçavans*. About two months later, on Mar. 6, 1665, appeared the first number of the *Philosophical Transactions of the Royal Society*; this was the first scientific periodical published under the auspices of a society which was destined to last to the present time. One or other of these two journals became the model for all later scientific periodicals.

Chap. viii., on science at the universities, makes melancholy reading, for the universities, clinging firmly to their old traditions, gave the cold shoulder to the new movement; indeed, they made little contribution to the progress of science in the seventeenth century, save in the faculties of medicine. Wallis left Cambridge for Oxford because the study of mathematics had died out at Cambridge! "It was," as the author says, "the unmistakable and magnificent achievement of the scientific societies of the seventeenth century, not only to put modern science on a solid foundation, but in good time to revolutionise the ideals and methods of the universities, and render them the friends and promoters of experimental science instead of the stubborn foes they had so long been." T. L. H.

Wave Mechanics.

(1) *Collected Papers on Wave Mechanics.* By Prof. E. Schrödinger. Translated from the second German edition. Pp. xiii + 146. (London and Glasgow: Blackie and Son, Ltd., 1928.) 25*s.* net.

(2) *Four Lectures on Wave Mechanics*: delivered at the Royal Institution, London, on 5th, 7th, 12th, and 14th March 1928. By Prof. Dr. Erwin Schrödinger. Pp. viii + 53. (London and Glasgow: Blackie and Son, Ltd., 1928.) 5*s.* net.

(3) *Selected Papers on Wave Mechanics.* By Louis de Broglie and Dr. Léon Brillouin. Authorised translation by Winifred M. Deans. Pp. vi + 151. (London and Glasgow: Blackie and Son, Ltd., 1928.) 15*s.* net.

IN the preface to the first of the above books, the author mentions a question asked him by a young woman friend: "When you began this work you had no idea that anything so clever would come out of it, had you?" This quotation certainly sums up the impression conveyed after reading (1). Schrödinger, however, uses it to bring out the point that in a set of papers in which a single theme is developed, the results of the later papers were more or less unknown when the earlier ones were written. This must be borne in mind when judging these collections.

During the short time of its separate existence, the new quantum mechanics has already branched out in several directions, two of the most important being roughly summed up as wave mechanics and matrix mechanics. As is shown both in (1) and (3), these two branches are mathematically reconcilable.

But from the point of view of the physicist who wishes to form some sort of mental picture of the processes involved, the wave mechanical method suggested to Schrödinger by the work of de Broglie has a direct appeal which the matrix method, simply because it stifles intuition, must fail to make. Moreover, in the wave mechanical method, the cardinal problem of atomic dynamics, the coupling between the dynamic process in the atom and the electromagnetic field is capable of a treatment in which the mechanical field scaler (ψ) enters into the unchanged Maxwell-Lorentz equations as the 'source' of the electromagnetic field vectors. In these works of de Broglie and Schrödinger we see the stages of the development of wave mechanics from the analogy pointed out by Hamilton between dynamics and optics, and how for the small scale dynamical system a mechanics founded on wave motion is just as necessary as is the wave theory of light in the case of small scale optical systems.

When we contrast the views of the two authors on the interpretation of micromechanical dynamics we at once meet a divergence. On Schrödinger's view we can no longer speak of a material particle describing a trajectory, yet, as de Broglie points out, an atom the dimensions of which are of the order 10^{-8} cm. can absorb a quantum of ultra-violet light (the photoelectric effect) the wave-length of which is more than 1000 times as great. From this it would seem that the region where the energy is localised must be a point even on the wave-length scale. To meet the difficulty, de Broglie has proposed the view that the material particle is an essential reality the motion of which is completely determined as that of a singularity in a propagated wave. By leaving the initial conditions arbitrary the ψ-wave can be regarded not only as a guiding wave by which the motion of the particle is controlled, but also as a probability wave which will give the probability of presence of the particle in a given element of volume when its initial position is unknown. This suggestion gives a glimpse of the way in which the continuous solutions of the wave equation can be applied to the admittedly atomic structure of matter and radiation. It would appear that the continuous solution provides a statistical view of phenomena the exact description of which would require waves possessing singularities. Here possibly lies a way of escape from the apparent indeterminateness of quantum mechanics.[1]

(1) This collection is particularly valuable, as it contains practically all the work of Schrödinger on wave mechanics published up to June 10, 1927. The style is clear and vigorous, but the too frequent use of italics rather spoils the effect. An abstract is given at the beginning in order to co-ordinate the nine papers which form the contents. Especially interesting is the author's treatment of the relation between his own work and that of Heisenberg, Born and Jordan.

(2) This contains the four lectures delivered by Schrödinger last March to a large and appreciative audience at the Royal Institution. A summary of these lectures has already been given in NATURE by the reviewer.[2] This little book of Schrödinger's is a small masterpiece of presentation, and gives a wonderfully clear idea of the present state of his work and what it has accomplished.

(3) The papers of de Broglie and Brillouin form a more heterogeneous collection. De Broglie has very definite views on physical interpretation, which are well brought out in his paper on the atomic structure of matter. A description of Kaluza's universe of five dimensions, in which the notion of force disappears entirely from mechanics, and is replaced by geometrical conceptions even in the case of a point charge moving in an electromagnetic field, forms one of the most interesting of the papers. Two of the three contributions of Brillouin deal with matrix mechanics and the application of statistical methods to quantum problems.

Taken as a whole, these three books form a valuable contribution to science. To be appreciated properly they should be read together.

L. M. MILNE-THOMSON.

[1] See NATURE, April 14, 1928, p. 580 *et seq.*

Our Bookshelf.

The Elements of Economic Geology. By Prof. J. W. Gregory. (Methuen's Geological Series.) Pp. xv + 312. (London: Methuen and Co., Ltd., 1927.) 10*s.* net.

THE outstanding feature of this book is the remarkable amount of cogent information which has been attractively compressed into its twenty-three chapters. The various principles and processes of the widely varied fields of mining, civil, and agricultural geology are illustrated wherever possible by examples that are personally known to the author; and as Prof. Gregory is a geologist and explorer of unrivalled experience, the book is particularly valuable both for its references to little-known sources of evidence and for the intimacy and vitality of the style in which it is written.

An unavoidable consequence of the brevity with which each topic is treated is that many of the conclusions are perforce stated dogmatically. The author attempts to disarm criticism in his preface

[2] NATURE, June 2, 1928, p. 885.

by writing: "If the book had been twice as long some views would not have been rejected with the apparent dogmatism rendered necessary by the limitations of space." The attempt fails, because if Prof. Gregory had wished, he could have made the book twice as long. We wish he had, for though its price is doubtless designed to attract the student, its views are not always those which will encourage teachers to recommend it. With fuller discussion these unorthodox views would themselves have become a source of stimulation, albeit to a more limited circle. Prof. Gregory regards most ores as having come from a zone lying between the barysphere and the lithosphere, "beneath the ordinary igneous rocks of the crust," and not from the igneous rocks themselves. Elsewhere he writes: "The primary mineral deposits are mainly due to ascending currents rising from the vast store of metals in the interior of the earth." Yet the vein-stones, including barite, are considered to have been largely contributed from the country rocks.

However, despite certain controversial matters such as these, on which indeed opinion is still in a state of flux, and a few careless phrases (such as "Tin is associated with hot acids appropriate to great depths"), the book is one which, in the reviewer's opinion, can be cordially recommended to every type of geological student. It is full of the life and vigour of a fascinating subject, and anyone, be he chemist or engineer, who is interested in the materials of the earth and the struggle of the elements, will dip into the book only to settle down, or to make an opportunity, to read it all. It could, perhaps, have been better still, but this is merely an appreciative criticism of its very real merits.

Visual Lines for Spectrum Analysis. By D. M. Smith. Pp. 34. (London: Adam Hilger, Ltd., 1928.) 5*s*. net.

SPECTRUM analysis, which at one time comprised the whole function of the spectroscope, has now largely fallen out of use. This is a matter for regret, for, when the principles of the subject have been understood and a little experience has been obtained, spectroscopic methods can occupy a place in analytical work which, from considerations of delicacy and in some cases of rapidity, cannot be taken by purely chemical processes. The causes of the neglect are not difficult to understand. In the early days, before the characteristics of spectra were fully understood, there was an apparent capriciousness in the manner in which a small quantity of one substance would make its presence known, while a larger quantity of another would remain undetected, and also in the occasional occurrence of some lines of an element without the others. Furthermore, the technique of spectroscopic processes was different from that of the ordinary chemical routine, requiring special appliances and modes of procedure, and the chemist was often unable or unwilling to acquire the necessary apparatus and skill.

These difficulties have now to a large extent disappeared. Our knowledge of spectra and the circumstances of their production has removed all uncertainty from their interpretation, and the qualitative results which, within the well-understood limitations of the method, they are capable of yielding, are at least as definite as those of the chemical reaction criteria. The apparatus and method of procedure also, thanks largely to the provision made by Messrs. Adam Hilger and other manufacturers, have been reduced to a simple form, and the chemist who continues to ignore the spectroscope does so greatly to his own disadvantage.

In the book under review, methods are described by which a considerable amount of analytical work can be performed visually and with great rapidity. The sensitive lines of 52 elements are recorded, and simple methods of obtaining and identifying them —largely derived from the wide experience of Sir Herbert Jackson—are described. Particular applications of the methods are dealt with, and the material is presented in a very convenient manner, with a blank page for notes opposite each page of tables, so that the worker may insert the fruits of his own experience for future guidance. Although visual work can never wholly take the place of photography, it is doubtful if its full scope has hitherto been realised, and the book before us should go far in making its possibilities known.

Green Manuring: Principles and Practice. By Dr. Adrian J. Pieters. (The Wiley Agricultural Series.) Pp. xiv + 356. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 22*s*. 6*d*. net.

THE growing inadequacy in the supplies of farmyard manure throughout the world has put a premium on the importance of green manuring, and much attention is being paid to the most profitable utilisation of this method of soil improvement. The actual practice is of very ancient date, but scientific interest in what really goes on in the soil when green crops are ploughed under has only been aroused comparatively recently. Dr. Pieters attacks his problem both from the theoretical and practical points of view, keeping the economic factor well before him. The effects of organic matter in the soil are both physical and biochemical, and the action of the soil micro-organisms encouraged by its presence may react favourably or unfavourably to crop plants according to circumstances. The turning under of much green material low in nitrogen may result in reduced crop yields, owing to the utilisation of the soil nitrates by micro-organisms, whereas leguminous or other material high in nitrogen benefits crops, owing to the release of ammonia which is converted into nitrates. As yet our knowledge of what actually happens in the soil is far from complete, resulting in frequent failures when green manuring is attempted under faulty conditions. Much more research is needed to enable cultivators to make the fullest and best use of this extremely valuable source of organic matter in the soil.

After due consideration of the theoretical side, the author considers the arguments for and

against the method from the practical point of view. Increased yields from green manuring are obtained with many crops, including corn, cotton, beets, potatoes, and sugar cane, but tobacco is more uncertain in its response. On the whole, the best results are obtained with hoed crops, for which it is specially recommended in the United States. Descriptions are given of various crops suitable for use as green manures, together with accounts of the practice of the method in various parts of the world. The volume concludes with a chapter on the economics of green manuring, indicating that various leguminous crops can profitably be grown for this purpose alone, to supplement short supplies of stable manure. A comprehensive bibliography is appended.

Survey of India. The Tides. Revised by Major C. M. Thompson. Pp. vi + 140 + 30 + 50. (Dehra Dun: Geodetic Survey of India, 1926.) 2 rupees; 3*s.* 6*d.*

THIS pamphlet forms Part 5 of the "Handbook of Professional Instructions" (Third Edition) for the Geodetic Branch of the Survey of India. The three chapters, which are separately paged, deal with "Theory and Computation," "Tidal Observations," and "The Tide-Predicting Machine." Tidal observations were commenced in India in the year 1873, and the Survey at once adopted the harmonic methods of analysis and prediction then being developed. The original methods, however, have been continued almost without modification to the present day, though there are in existence several methods of analysis which are more accurate and involve very much less labour. Similarly, in prediction, no use is made of the modern method whereby the phase-lags are modified once for all so as to use only one set of computed initial 'astronomical arguments,' instead of 40 sets, as in India. Thus it is unlikely that this volume will be used as a manual outside the Survey, especially as it would be impossible to use the instructions adequately without a supply of the printed forms used in India. Apart from this, of course, the volume appears to give a satisfactory account of the processes used.

It is now customary to run two 'curves' on the predicting-machine for heights and times respectively; the times are given by a 'gradient-curve' obtained by setting up on the machine constants resulting from differentiating the expression for the height-curve; when the gradient-curve passes through zero, the machine is usually stopped and the time read off. In India a permanent record is made electrically on a chronograph attached to the machine, and the "Instructions" give details of the mechanism and method.

From Crystal to Television, 'The Electron Bridge': a Simple Account of Wireless and Television. By Vyvyan Richards. Pp. xi + 116. (London: A. and C. Black, Ltd., 1928.) 5*s.* net.

YET another effusion dedicated to the long-suffering 'layman.' On reading through a book of this nature one cannot help wondering whether the layman would not find it much easier, and far more satisfying, to sit down to read a *confessedly* scientific or technical book, rather than to struggle through the bewildering medley of words which such a book as this contains.

The author has undoubtedly succeeded in impressing the reader that he himself is impressed with the importance and magnificence of his subject. But if perchance the reader had already formed any scientific opinions the result might be disastrous. When one learns at the outset that "there are three families of cathode rays, the alpha, the beta, and the gamma rays, these last being the X-rays that pass through our clothes and bodies and reveal our broken bones and the bullets and coins in us"; and a little later in Chapter i., "Strain is the idea that persists through all the manifestations of the ubiquitous force, electricity—a mystery which lies between matter and mind," one cannot help feeling slightly bewildered. An author who has no difficulty in drawing analogies between electric currents and human emotions, who glides from physics to psychology and metaphysics without an effort, is rather difficult for a poor layman to understand. In later chapters, however, after the metaphysical outburst has subsided and ordinary matters such as valves and gramophone 'pick ups' are under discussion, the author is obviously more 'at home.'

Aids to Biochemistry. By Dr. E. Ashley Cooper and S. D. Nicholas. (Students' Aid Series.) Pp. vii + 188. (London: Baillière, Tindall and Cox, 1927.) 4*s.* 6*d.* net.

THIS small volume contains much of the information that is found in the larger text-books on the subject: in addition, space is found for compounds which are more usually dealt with in works on organic chemistry as distinct from biochemistry. The authors state that the book is intended for purposes of revision, for which it appears eminently suitable. In addition to the theoretical treatment, the more important tests, preparations, and methods of estimation are included, so that the student can quickly revise both the practical and theoretical sides of his subject. Chapters are devoted to the chemistry of colloids, to the alkaloids, and to other compounds of general biochemical interest. The book is not intended for beginners in biochemistry: these would be well advised to read a larger manual first, in conjunction with their lectures, and only turn to this pocket volume in the last few months before their examination.

Harmonia Harmonica. By Clarence S. Hill. Vol. 2: containing Book 2—The Harmonic Chord as a Fundamental Agent in Creation; Book 3—The Harmonic Chord in Form and Design. Pp. 151. (Bournemouth: The Author, 33 Chigwell Road, 1927.) 21*s.*

THE author of this volume develops the thesis that the numbers 11 and 4/3 are the critical figures in music, the human body, the solar system, and the universe. The harmonic chord is regarded as the fundamental agent in creation, applying equally well to music, physics, chemistry, anatomy, or astrophysics.

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.*]

The Helium Lines in Stellar Spectra.

ALL the lines of neutral helium that can be observed in stellar spectra belong to some of the subordinate series. The ultimate lines ($1S - mP$) are in the far ultra-violet and cannot be photographed through the earth's atmosphere. The diffuse series of both the triplet system ($2p^3 - md^3$) and the singlet system ($2P - mD$) have nearly identical lower energy levels, the excitation potentials being 20·81 volts and 21·12 volts respectively (cf. H. N. Russell, *Astroph. Jour.*, **61**, 223; 1925). Accordingly, the corresponding lines of these two series should show identical intensity curves with respect to temperature, the intensity ratio of the triplet line to the singlet line remaining constant (cf. R. H. Fowler and E. A. Milne, *Mon. Not. R.A.S.*, **83**, 415; 1923).

This presupposes that the relative abundance of atoms capable of absorbing triplet or singlet lines remains unaltered by the varying physical conditions in the atmospheres of the stars. L. S. Ornstein, H. C. Burger, and W. Kapuscinsky (*Zs. f. Physik*, **51**, 34; 1928) have recently shown that this assumption is not necessarily correct. They have found that electrically excited helium shows predominantly singlet lines for pressures of between 0·01 to 0·3 mm.; for pressures between about 0·3 mm. and 1 cm. the ratio triplet/singlet gradually increases, reaching finally a constant value (approximately equal to 3 for the pair ($2p^3 - 3d^3$) and ($2P - 3D$)). They suggest that the observed changes in the relative intensities might be explained by the assumption that the initial probability of a transition from the ground-level $1S$ to one of the singlet levels is greater than to one of the triplet levels. Under low pressures the singlets will then predominate. However, under higher pressures a part of the excited atoms in the single states will lose energy by collisions with neutral atoms and will fall into the lower energy levels of the triplet system, without emitting radiation. This explains the increasing strength of the triplet lines for higher pressures.

I have recently made a considerable number of intensity estimates of the triplet absorption line λ4472 ($2p^3 - 4d^3$) and of the singlet absorption line λ4388 ($2P - 5D$). The laboratory intensities given by Russell are (6) and (3). My estimates were made from plates taken at the Yerkes Observatory.

The results for 312 *B*- and *O*-type stars show very considerable differences between the relative intensities in individual stars. Usually, λ4472 is appreciably stronger than λ4388, but there are a number of stars in which λ4388 is nearly equal to, or even slightly stronger than, λ4472.

Table 1 contains preliminary results for a few selected stars. The estimates are admittedly very uncertain, but they suffice to show the general character of the intensities. The probable error is of the order of 1 to 2 units, one unit corresponding roughly to a central intensity of 0·1 mag. The line-width is estimated on an arbitrary scale from 1 (very narrow) to 10 (very broad). The spectral types are taken from the Henry Draper Catalogue.

The observed differences in intensity (4472-4388) are much larger than can reasonably be attributed to errors of estimation or to instrumental errors, and they are almost certainly due to real differences in the atmospheres of the stars.

There is a slight indication that for the earliest spectral subdivisions, *O*-*B*2, the relative intensity of the triplet line is greater in the more luminous stars. If this should be the case, the triplet series would turn out to be stronger at lower pressures. This would agree with the great observed intensity of the triplet lines in the flash spectrum (cf. S. A. Mitchell, *Astrophys. Jour.*, **38**, 407, 1913; Davidson and Stratton, *Mem. R.A.S.*, **64**, Pt. 4, 1927; A. Pannekoek and M. O. J. Minnaert, *Amsterdam Akad.*, **13**, Pt. 5, 1928). If we are willing to admit that the pressure in the reversing layers of *B*- and *O*-stars is of the order of 10^{-1} to 10^{-3} mm. (10^{-4} to 10^{-6} atmospheres) and that the mean pressure in the chromosphere is much lower than this, the idea suggests itself that the ratio triplet/singlet again increases for the lower pressures after passing through the minimum observed by Ornstein, Burger, and Kapuscinsky. This would, of course, necessitate a revision of their theoretical explanation, as was also pointed out by Pannekoek and Minnaert.

TABLE 1.

Star.	Sp.	λ4388.	λ4472.	Width.
Stars with relatively weak λ4388.				
λ Orionis br.	*Oe*5	1	10	4
19 Cephei	*Oe*5	5	15	5
9 Camelop.	*Bo*	1	10	3
14 Cephei	*Bo*	0	6	5
9 Cephei	*B*2*p*	7	15	3
υ Orionis	*B*3	6	15	1
Stars with relatively strong λ4388.				
τ Scorpii	*Bo*	7	8	3
δ Scorpii	*Bo*	8	10	9
φ′ Orionis	*Bo*	8	10	2
β Cephei	*B*1	12	10	1
ν Eridani	*B*2	12	9	3
χ^2 Orionis	*B*2*p*	9	9	2
10 Monoc.	*B*3	10	10	4
ι Herculis	*B*3	10	10	2

Table 2 contains a summary of my estimates.

TABLE 2.

Sp.	No.	λ4388.	λ4472.	Width.	4388/4472.
O	9	2·2	6·7	5·9	0·33
BO	17	4·2	7·1	5·3	0·59
*B*1	14	6·8	8·1	4·3	0·84
*B*2	20	6·7	7·9	4·8	0·85
*B*3	92	4·8	6·7	5·8	0·72
*B*5	59	2·0	4·2	4·9	0·48
*B*8	66	1·3	3·1	4·3	0·42
*B*9	35	0·9	2·4	4·0	0·37

The maxima of the two intensity curves fall between *B*1 and *B*2. However, the curve for λ4388 is steeper than that for λ4472, the ratio 4388/4472 reaching a maximum between *B*1 and *B*2. The earliest spectral subdivisions show relatively very weak λ4388.

The mean intensity from all stars is 3·2 for λ4388 and 5·2 for λ4472, these values nearly agreeing with those of Russell. We conclude that while the relative abundance of atoms in the mp^3 and mP levels is subject to considerable variations in different stars, the average ratio triplet/singlet in stellar spectra is not very different from that observed in the laboratory under normal pressures.

OTTO STRUVE.

Observatory, Cambridge,
Nov. 15.

Striations in Explosive Flames.

IN a recent paper by Egerton and Gates (*Proc. Roy. Soc.*, A, **116**, 516; 1927), reference is made to peculiarities exhibited by certain flame photographs (not reproduced) obtained, on a rapidly revolving film, when mixtures $1C_2H_2 : 2{\cdot}5O_2 : 10N_2$ were ignited at one end of a closed cylinder 19 cm. long and of 10·7 cm. internal diameter, as follows: "Some of the photographs show distinct closely-spaced bands, indicating that the combustion has a vibratory character. The number of vibrations per second in the after-flame is about 2500, and the spacing is consistent with the view that successive sound waves are reflected from the end-plates."

The accompanying photograph (Fig. 1, a negative) shows striations in the flame (more particularly in the after-flame) of an explosion of a 3·35 per cent pentane-air mixture at 4 atm. initial pressure ignited at one end of a horizontal cylinder 38 cm. long and of 15·2 cm. internal diameter. A manometer of the diaphragm type, fixed at the end of the cylinder distant from the point of ignition, recorded the fluctuations of pressure within the cylinder simultaneously with the flame-photograph. The frequency of the striations is 1200 per second, a value which we have found to be independent both of the composition and of the initial pressure of the explosive mixture. When, by the rapid rotation of a fan, a high degree of turbulence was created within the mixture during its inflammation, the bands in the after-flame were less distinct, but their spacing was the same. These observations, together with the fact that the frequency of the striations observed by Egerton and Gates and by ourselves varies inversely as the lengths of our explosion vessels, seem to preclude the possibility of their being due to helical movement of the flames, such as has been shown by Campbell and Finch (*J. Chem. Soc.*, 2094; 1928) to occur during the explosion wave in certain gaseous mixtures. The most probable explanation of the striations in our photographs seems to be that given by Egerton and Gates for theirs, namely, a stationary wave compounded of sound-waves reflected from the opposite end-plates of the cylinder.

This striated appearance of the flame during an explosion invariably precedes a 'knock' in our closed cylinder which appears to be closely related to 'pinking' in an internal combustion engine.

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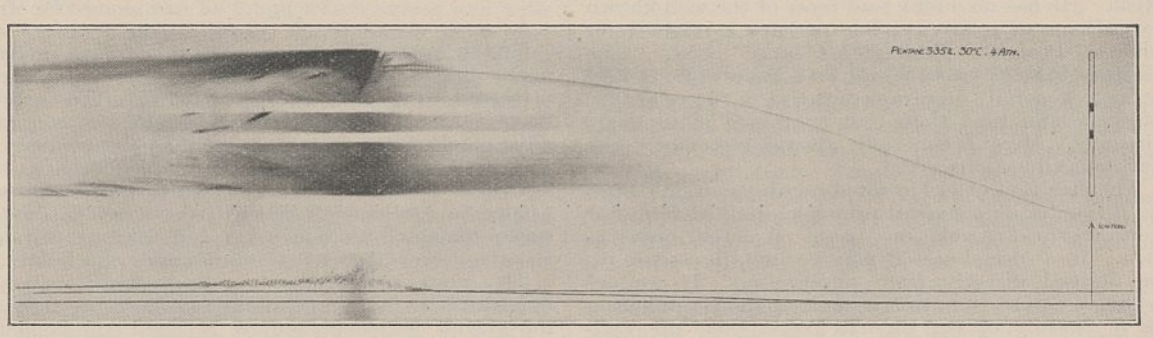

FIG. 1.—Flame photograph and pressure record of explosion of 3·35 per cent pentane-air. Time intervals, 1/100 sec.

The Understanding of Relativity.

I CAN understand a good deal of H. D.'s courteous reply to my letter (NATURE, Nov. 24, p. 808), for example, that there are degrees in understanding. But much remains as to which I should like information. I know I am ignorant, but since my state of mind is almost universally representative, it is important. Is knowledge of the fact that clocks in rapid relative motion do not keep time derived from abstruse calculation, or from actual observation? If the latter, is there any explanation of that which seems to the ordinary man unaccountable? I assume that the swing of the pendulum of the clock in motion is not disturbed by its speed, or by a changing pull of gravity; for such alteration would be due to simple mechanical causes, easily explainable, and not due to what I suppose is meant by relativity —a mystical conception which appears to result in contradictions.

What does "curvature of space" mean? I can understand the curvature of a given area of space, for example, that occupied by the earth. But we are within illimitable space. Is curvature of such space a necessary axiom of thought? If so, why? We are told of straight lines, and also of their curvature. To the ordinary man this seems a contradiction in terms. We are told of parallel lines and of their meeting. Again we have a contradiction. On earth we have curved lines of longitude; they meet, but are not parallel. We have curved lines of latitude; they are parallel and never meet—not even if we trace such lines round and round the earth, in the same latitudes to all eternity; or so it seems to me.

Suppose two observers, *A* and *B*, both gifted with supernatural powers of seeing, stood a yard apart, with eyes on the same plane, and gazed at spots, also a yard apart and on the same plane, situated on an immensely distant object (say a star), then their lines of sight would be parallel. But where would they meet? At a spot beyond the star? But suppose the observers gazed at points a yard apart at this other spot? And so on. I can conceive that the lines of light proceeding from the star might curve for some reason—gravity or what not—but the curvature of lines passing through space is one thing; the curvature of space itself is quite another thing. Must we assume that, even in theory, straight and

parallel lines are inconceivable. If this is not meant by our teachers, what then is meant ?

I cannot help thinking that at the back of all this apparent contradiction lies the essential common sense of science. Because of the character of the men who enunciate these seeming paradoxes, the ordinary man does not doubt. But he is puzzled when he is asked to believe, for example, that straight lines are not straight, or parallel lines parallel—even in thought. As always hitherto in science, I think it must be possible for the thinkers who seem to enunciate paradoxes to clear up the mystery by means of a few simple illustrations. It is profoundly wrong to state that the man who seeks to follow science must first believe. His belief is worthless unless he also understands. For him it is mere dogma when it is stated that clocks cannot keep time merely because one of them is in rapid motion, that straight lines curve, and that parallel lines meet. I hope H. D. will not think that I am carping at his article. I do not doubt the correctness of his opinions. But I do want to find a way through apparent contradictions, not all of which are his.

G. ARCHDALL REID.

20 Lennox Road South, Southsea.

IT is impossible in the space of a letter to deal adequately with all the points raised by Sir Archdall Reid. He has no doubt read most of the well-known expositions of relativity, but perhaps I might refer him to Professor Eddington's latest book, "The Nature of the Physical World." I know of no clearer or more generally admirable account of the relativity of space and time than that contained in its early chapters. Here I can only answer summarily the particular questions asked.

The idea that clocks in rapid relative motion do not keep time is, as a general principle, derived from not very abstruse calculations based on actual observation. In a special case it may be said, in a sense, to be derived directly from observation. If we are willing to accept an atom as a clock and its radiation as a measure of the time it keeps, then the well-known Doppler principle, verified by observations in the solar system, is a directly measured testimony to the idea. But other factors also are involved here, and perhaps it is scarcely fair to regard it as observational proof. The idea is not mystical—except in the sense in which, I suppose, every fundamental physical fact is mystical—and it certainly does not result in contradictions.

The 'curvature of space' is a symbolical expression representing the idea that if one proceeds in a certain direction he will not continue indefinitely to recede from his starting-point; he will ultimately, without changing his direction, approach it again, just as one does in travelling on what we ordinarily regard as a 'curved' surface, *e.g.*, a sphere. The idea is not a "necessary axiom of thought," although it originated, as a possibility, long before the theory of relativity. What relativity has done is to make it probable that the physical space of our experience has 'curvature.' If parallel lines are defined as lines which always keep the same distance apart, then obviously they cannot meet, but the 'parallel' lines which are said to meet if sufficiently prolonged are not so defined. The geometrical definition of parallel lines has been that they are straight lines which meet at infinity. In the space contemplated by relativity, straight lines, as ordinarily imagined, and infinity (which belongs to hypothetical, euclidean space, and is of course quite inconceivable) do not exist, and a new definition is necessary, which mathematicians, if they regard the conception of parallelism as a useful one, have no doubt provided themselves with. Subject to correction by them, I would suggest that in 'spherical' space, parallel lines might be defined as 'straight' lines which intersect at two points the distance apart of which is the greatest possible, where by a 'straight' line is understood one of which any portion lies along the shortest (or longest) distance between its ends. The portions of such lines which we, in the minute terrestrial region of space, recognise as parallel would then be analogous to the almost infinitesimal arcs of two meridians of longitude at the equator, and not to elements of two circles of latitude.

The lines of sight of Sir Archdall Reid's two observers would therefore not be 'parallel,' although, if the star were among the near ones, their deviation from parallelism would be too small to be detected. I do not know if the preceding paragraph will clear up all Sir Archdall Reid's difficulties on this point, but it should at least make it clear that the contradiction with which he is troubled does not exist. Relativity or no relativity, lines cannot both meet and never meet.

I quite agree that "It is profoundly wrong to state that the man who seeks to follow science must first believe," but this statement was not made or implied in the original article. The contention was that what is called lack of understanding of relativity is usually unbelief; the article put forward a diagnosis of a complaint, not a prescription for keeping well.

H. D.

THERE appears to be a rather interesting reversal in the direction of our minds between cause and effect in regard to some of the problems involved in relativity. The Michelson-Morley experiment was originally intended to detect the absolute movement of the earth through space; and it failed because the anticipated shift of the interference bands did not occur; and because it failed the movement through space remained undetected; and various physical theories were suggested to account for the failure.

The whole situation is now approached from the opposite end. The impossibility of observing absolute movement is elevated into a fixed fundamental principle which we are asked to accept without being too curious or insistent in demanding a physical explanation. We are free, if we like, to regard it, as we regard the point of maximum density of water, as an evidence of beneficent design, since it is on this principle that the uniformity of Nature, or the invariance of general laws, depends. The Michelson-Morley 'failure' is now recognised merely as an illustration, a direct and inevitable result, of this principle. The same principle is applied to the relativity contraction of measured lengths and the slowing of clocks as between two systems S and S'. We are discouraged from attempting to explain or explain away, on any physical basis, the apparent paradoxes which most paradoxically have accompanied the expression of Nature's invariance in mathematical form.

This new point of view for the study of relativity will be welcomed even by those who believe that a real though quite undiscoverable Fitzgerald contraction, due to absolute movement, underlies and to a large extent accounts for the relativity contractions and differences of clock rates and synchronisation which appear in the transformation formulæ. Belief or disbelief in this contraction only modifies our ideas, and does not affect experimental facts. The application of the principle that *absolute movement cannot be observed*, affords a satisfactory 'reason why' to much that must otherwise remain perplexing to the ordinary man.

H. C. BROWNE.

Dublin, Dec. 7.

The Isotope Effect in the Spectrum of Chlorine.

THREE strong bands in the absorption spectrum of chlorine have been analysed and the rotation constants for the normal and excited states of the chlorine molecule determined. These bands have been allocated by Kuhn (*Zeits. f. Phys.*, **39**, 77; 1926) to one vibration progression having a common initial level (probably 2) in absorption, the final states being denoted by the arbitrary numbers 5, 6, and 7. The $2 \longrightarrow 5$ and $2 \longrightarrow 7$ bands consist of single P and R branches from which a set of term differences can be found for each band, some twelve of one set being in good agreement with the corresponding members of the other set. The $2 \longrightarrow 6$ band appears to consist of a single series of lines, each of which must, however, be in reality double, since on that assumption a set of term differences can be found which agrees well with the previous ones. These three bands show the phenomenon of alternation of intensity in the lines comprising them, as is to be expected in a symmetrical molecule. The ratio of intensities is approximately 1·4 : 1. There are indications that there may be a progressive diminution in this ratio in going from F_2 through Cl_2 and Br_2 to I_2, and it is hoped that work on Br_2 now in progress in this laboratory (Prof. J. Patkowski) may throw further light on this question.

A fourth weaker band which is displaced about 9·6 cm.$^{-1}$ with respect to the $2 \longrightarrow 6$ band has been observed and analysed, and is found to have the same structure as the $2 \longrightarrow 6$ band (*i.e.* superposed P and R branches) but slightly different rotation constants; this is ascribed to one of the isotopes of chlorine. Since this element has isotopes 35 and 37 present in the ratio 3·35 : 1, three kinds of molecules, $Cl_{35}Cl_{35}$, $Cl_{35}Cl_{37}$, and $Cl_{37}Cl_{37}$, must exist in the proportions 11·2 : 6·7 : 1 respectively. The three strong bands must be due to absorption by the most abundant molecule $Cl_{35}Cl_{35}$, and the weaker companion of the $2 \longrightarrow 6$ band due to $Cl_{35}Cl_{37}$. Similar companions in the case of the $2 \longrightarrow 5$ and $2 \longrightarrow 7$ bands have been observed, but not yet fully analysed on account of the complexity of the spectrum in these regions. Hitherto the isotopic band due to $Cl_{37}Cl_{37}$, which must be very weak, has not been observed.

The nuclear separations of the $(2 \longrightarrow 6)_{35\text{-}35}$ and $(2 \longrightarrow 6)_{35\text{-}37}$ bands have been calculated and are found to agree closely both in the normal and excited states (see table of constants), although the values of the rotation constants differ appreciably in the two cases.

The most interesting feature of the $(2 \longrightarrow 6)_{35\text{-}37}$ band is that, unlike the other bands, no alternation of intensity in its lines can be observed. This result provides direct confirmation of the theoretical conclusion that alternating intensities arise from equality of the nuclei, since the nuclear masses in $Cl_{35}Cl_{37}$ are unequal, whilst in every other respect this molecule is identical with the symmetrical molecule $Cl_{35}Cl_{35}$. Photometric measurements made on the least confused lines in the $(2 \longrightarrow 6)_{35\text{-}35}$ and $(2 \longrightarrow 6)_{35\text{-}37}$ bands indicate that the ratio of the intensity of the $(2 \longrightarrow 6)_{35\text{-}37}$ band to the mean intensity of the $(2 \longrightarrow 6)_{35\text{-}35}$ band is approximately that to be expected from the relative numbers in which the molecules exist, namely, 1 : 1·7.

The absolute values of the upper vibration quantum numbers have been calculated from the isotope effect and are found to be 17, 18, and 19 for the bands in which this number has been previously denoted by 5, 6, and 7 respectively. The available vibrational data are not sufficiently exact to decide whether half-integral vibration quantum numbers should be used, as is predicted by the wave mechanics.

CONSTANTS.

Band.	B''.	B'.	I''.	I'.	r''.	r'.
$(2 \longrightarrow 17)_{35\text{-}35}$	·2412 cm.$^{-1}$	·1254 cm.$^{-1}$	114×10^{-40} gm. cm.^{2}	220×10^{-40} gm. cm.^{2}	$·991 \times 10^{-8}$ cm.	$1·38 \times 10^{-8}$ cm.
$(2 \longrightarrow 18)_{35\text{-}35}$	·2412 ,,	·1209 ,,	114 ,,	228 ,,	·991 ,,	1·40 ,,
$(2 \longrightarrow 18)_{35\text{-}37}$	·2337 ,,	·1164 ,,	118 ,,	237 ,,	·993 ,,	1·41 ,,
$(2 \longrightarrow 19)_{35\text{-}35}$	·2412 ,,	·1166 ,,	114 ,,	237 ,,	·991 ,,	1·43 ,,

In the above table, r is half the internuclear distance. The constants in the upper and lower electronic states are denoted as usual by $'$ and $''$ respectively, and the absolute values of the upper vibrational quantum number are used in place of the arbitrary ones.

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Cosmic Radiation and Radioactive Disintegration.

A THEORY of radioactivity has been proposed by Perrin, who suggested that the disintegration of the radioactive elements may be due to their absorption of cosmic radiations. Former efforts to verify this theory have resulted in unsuccessful attempts to alter the rate of disintegration by subjecting radio-elements to intense gamma radiation and also by shielding them from external radiations.

However, to test the hypothesis further, the activity of a source of polonium has been actually measured by me at 1150 feet below the surface of the earth, at the bottom of the New Jersey Zinc Company's mine, Franklin, N.J. At this depth, it is thought that enough of the cosmic radiation would be absorbed to insure a change in the radioactivity of the specimen if that activity were a phenomenon produced by this radiation. The apparatus used comprised an ionisation chamber arranged to deliver a saturation current into a single-fibre electrometer of sensitivity 15 divisions per volt. The current was compensated by a measured current supplied by altering the potential of the external member of a standard condenser the internal member of which was connected to the electrometer. The results of the measurements showed that the activity did not change by more than about one per cent (which was the limit of accuracy of the experiment) when the polonium was taken from the surface of the earth to the bottom of the mine. The activity of the rocks of the mine was found to be small in comparison with the activity of the polonium, and therefore did not produce appreciable errors in the measurements.

We thus conclude that if Perrin's theory is to account for radioactive disintegration, the cosmic radiation responsible for the disintegration must be of such a penetrating power that it remains practically unabsorbed in going about eleven hundred feet through the earth and must yet have the property that it can be appreciably absorbed by relatively small amounts of radioactive elements.

L. R. MAXWELL.

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In view of the foregoing interesting experiments of Dr. L. R. Maxwell, the following considerations will be of interest since they suggest that a modern view of the nature of cosmic radiation would render highly improbable any measurable effect of such a radiation in the matter of stimulating radioactivity.

According to the experiments of Millikan and Cameron, the absorption coefficient of the cosmic radiation is of the order of magnitude of 0·1 per metre of water, and, according to Dirac's formula (*Proc. Roy. Soc.*, **111**, 423; 1926), corresponds to such a frequency of radiation as would cause an individual cosmic ray to have an energy of about $1{\cdot}3 \times 10^{-4}$ ergs and be capable of producing about $0{\cdot}54 \times 10^{7}$ ions in air. If, following Millikan, we assume that the cosmic radiation produces on the average (through its direct and secondary (indirect) radiations) 1·4 ions per c.c. per second, we see that on the average there should only be about $1{\cdot}4/(0{\cdot}54 \times 10^{7})$, *i.e.* $2{\cdot}6 \times 10^{-7}$ primary cosmic rays absorbed per c.c. per second, or about $1{\cdot}3 \times 10^{-4}$ primary cosmic rays per gram of absorbing materials. The saturation current due to the polonium in Dr. Maxwell's experiment was about 0·3 e.s.u. and corresponds to about 10^{-11} grams of polonium. It is therefore clear that we should only expect a cosmic ray to be absorbed by one of these atoms once in about 10^{15} seconds, *i.e.* once in twenty million years. This consideration would appear to render very improbable a direct effect of the cosmic radiation in stimulating radioactivity even in the most favourable case where the volume of the preparation under examination was much larger than that used by Dr. Maxwell; for, while radioactive disintegration does take place with discontinuities, the process is sensibly continuous as compared with such an enormous period as that calculated above.

W. F. G. SWANN.

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A Function of the Adrenal Cortex.

If both adrenal bodies be extirpated in a cat, the animal dies in three or four days. If the same operation be carried out in a decerebrate cat (brain removed to the level of the corpora quadrigemina) death ensues in less than an hour—usually within half an hour. The fatal result is due to failure of respiration, and may be indefinitely postponed by artificial respiration.

Close behind each adrenal is constantly found a lymph node, united to the cortex of the adrenal by a plexus of lymphatic vessels. If this plexus be torn across, or if the lymph node itself be removed, the animal will succumb with the same symptoms and within the same time as if both adrenal bodies had been removed. Further, if the lymph be prevented from reaching the blood-stream by tying both innominate veins we get a similar series of events.

In several experiments, when the breathing has only stopped for a short time and the heart is still beating strongly, we have succeeded in temporarily restoring the respiratory function by means of fresh watery extracts of the adrenal cortex.

Destruction of the medulla of the glands produces no such results. Numerous controls of various kinds have been carried out. Extirpation of the semilunar ganglia and section of all nerves in the region are without effect, so long as the arterial supply to the gland is not seriously interfered with.

There seems to be no escape from the conclusion that some substance, which we propose to call *pneumin*, essential for respiration, is manufactured in the adrenal cortex and discharged into the circulation through the lymphatics. The conviction that cortex and not medulla of the gland is concerned is based upon the well-known fact that it is the cortex and not medulla which is essential for life, and that in the present series of experiments destruction of the medulla by cauterisation produces none of the results described above.

SWALE VINCENT.
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Copper in Antiquity.

With regard to the British Association Research Committee's interim report on the sources of Early Sumerian copper (and bronze), referred to in NATURE of Dec. 8, p. 886, I should like to direct particular attention to the ancient workings for tin about Rooiberg and Blaubank in the Transvaal. The quantities of bronze now known to have been employed in early times would have involved very considerable ancient workings of copper nickel deposits if the nickel found in such bronzes had been mixed with the copper.

The few deposits of nickel and copper in Europe are not associated with ancient workings, whilst the chief ancient workings for copper in Europe and Asia are not associated with nickel.

In the Transvaal, on the other hand, nickel occurs in the same areas as the tin, and ancient smelting has been carried on there on an immense scale. An examination of the slag by H. S. Gordon has shown that the ancients smelted there for the direct production of bronze, *i.e.* they brought their copper ore to the tin- and nickel-bearing areas of the Waterberg.

Some investigators have estimated the production of bronze and tin in the Transvaal as totalling millions of tons. Such a production is utterly in excess of any possible local demand and indicates a distribution of the metals throughout the Old World.

It is the large scale of production in Southern Africa (in one single area there are said to be remains of forty-three furnaces) which points most to this area being the main source of the production of bronze in early days. No large ancient slag heaps from the smelting of tin *and* copper have been found elsewhere. A reprint of the papers already published locally on these workings, and a special request for more local information, would afford an interesting item for discussion at the forthcoming meeting of the British Association in South Africa next year.

BERNARD W. HOLMAN.

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A Neglected Aspect of Scientific Research.

There are thousands of workers and scores of secretaries of scientific societies in Great Britain alone who might admire and accept the value of the contentions in the excellent leader in NATURE of Dec. 15 on this subject, *but* what they want is the name and address of some person to whom they can refer the problem which is set to them by every technical paper, lecture, or note with which they are confronted.

"How do I index THIS?" is the question they ask—for they are quite unversed in the science of indexing. In a few months of practice, under the guidance (say by telephone) of a skilled indexer, the tyro will acquire the necessary knowledge and will not improbably thereafter continue to contribute to the world's store of available scientific records. The editors of scientific journals might, for example, mark each article with a bracketted numeral, being the correct Brussels Classification number of the subject discussed.

MERVYN O'GORMAN.

The *Dana* Expedition.

IT is just a little more than fifty years since H.M.S. *Challenger* came home, with Wyville Thomson and Moseley aboard, and a young assistant of the name of John Murray. Only a few of our older men remember the fitting-out of that goodly ship, or even her homecoming; but many remember the busy years when naturalists all the world over divided the spoil and shared the harvest of discovery. The quickening impulse of that celebrated expedition lasted long; but in all the past half-century no other ship has sailed from a British port to explore the oceans of the world. The deep sea has been studied here and there so far as scanty opportunities permitted; British home waters have not been neglected, the Indian Ocean has had its turn, and even over the great depths of the ocean. Moreover, as a Government ship, the *Dana* is all the while in touch by wireless with her base, and the staff in Copenhagen know what she is doing day by day, even in the middle of the Pacific. Add to all this the vastly improved methods of preserving specimens, compared with the simple but far from inefficient means in use aboard the *Challenger*. Surely the scientific harvest of a deep-sea expedition should nowadays be rich indeed.

The voyage now in progress is the greatest which the *Dana* has undertaken, though her leader made a preliminary cruise over the greater part of her route some three or four years ago. The ship left Copenhagen last June, took a zigzag course to

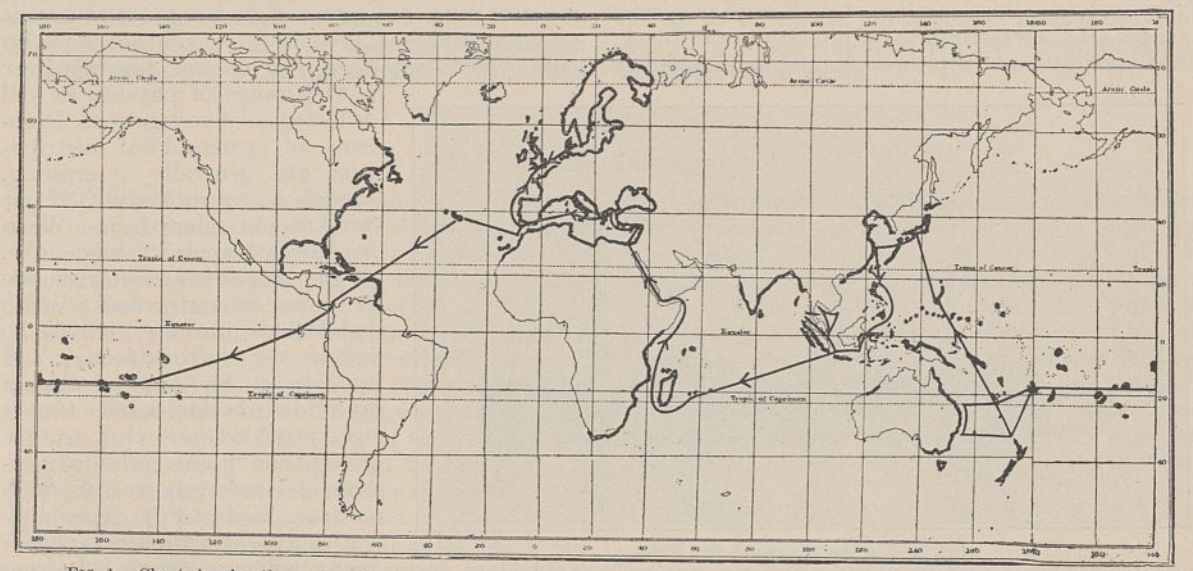


FIG. 1.—Chart showing the projected cruise of the *Dana*. The blackened parts show the distribution of the eels. After Schmidt.

the *Discovery* expedition is no small thing. But, after all, it is Germany and Norway, and Denmark in particular, that have carried on the work of the *Challenger*. The Danes have been especially fortunate. In Dr. Johannes Schmidt they have a skilled investigator and a born leader of men. They have a ship, the *Dana*, built and planned for scientific work, and equipped with every modern device and invention to that end; the Danish Government seems always ready to put her in commission, and the rich Carlsberg Fund is always at hand to defray the heavy cost of a voyage.

To explore the ocean in such a ship is a very different thing from the old days of the *Challenger*. Then the ship's company toiled all day long and far into the night over the clumsy winches and great hempen cables to get the deep-sea dredge aboard. Now dredge or trawl come up handsomely, with the easy help of an electric winch, on a light wire-rope of phosphor-bronze. As for the deep-sea soundings, there is neither lead-line nor even Lord Kelvin's pianoforte sounding-wire any more; but all day and all night long Echo keeps calling the depth, Panama, is now somewhere between Tahiti and Noumea, and is due to reach New Zealand soon after New Year's day. There Dr. Johannes Schmidt will join his ship for the rest of her long cruise, to the western Pacific, the Indian Archipelago, and home, some time in 1930, by way of Madagascar and East Africa. Dr. P. Jespersen, Dr. Th. Mortensen, Prof. Ove Paulsen, and Dr. J. N. Neilson will accompany the ship, some for part and some for all of her long voyage.

The *Dana's* route is planned, and the whole expedition is devised, for the further study of the natural history of the eel. Whatever other men have done (Grassi in particular, and Hjort and others) to unravel the life-history of the eel, it is Johannes Schmidt who has for many years been without question the chief student and highest authority in this matter. The story which we all learn is the story as he has told it. We know, from him, how from the rivers of Great Britain the eels hie away to ocean-depths over by the Sargasso Sea, and spawn and afterwards perish there; and how their offspring journey slowly homeward to homes which

they never saw, undergoing their strange transformation on the way. Not the least curious thing which he has told us is that the European and American eels have not only similar habits but also resort to the same breeding ground: from which the offspring of the latter turn westward and take the short road home, while the European eel-fry have all the broad Atlantic before them.

Some fifty years ago that first-class ichthyologist, Dr. Günther, believed that there were two species of eels in Europe and three in America, one species being common to both sides of the Atlantic; we now know, from Dr. Schmidt, that there is but one species on the west and another on the east side of the North Atlantic. The southern oceans, on the other hand, contain many species, and somewhere in the western Pacific lie the headquarters of the tribe. The general distribution of the genus *Anguilla* is very curious and interesting. Our European species ranges all the way from the White Sea to the Black, and is said even to slip through the Suez Canal now and then; but apart from such chance immigrants the Red Sea and also the Persian Gulf are barren of eels. In India two species are common, one with long fins and one with short; and there are several more in the tropical parts of the Indian Ocean, one of them extending to East Africa. There are eels in Madagascar, Mauritius, and all the other islands in the western part of the Indian Ocean, and so there are on the other side, all the way from the Andamans to Sumatra, Java, and New Guinea; but (with a trifling exception) they are lacking on the whole of the north, west, and south-west coasts of Australia. There are eels in China and Japan, in the Philippines and throughout Polynesia (except in the Sandwich Islands)—all the way from North Japan to New Zealand; save only that they become scarce in the inner waters of the Malay Archipelago, between Siam and the northern coasts of Sumatra and Borneo. On the other hand, they are plentiful on all the coasts or islands (save that part of Australia already mentioned) which face the deep waters of the Indian Ocean or of the Pacific. In New Zealand, in Tahiti, and in many other Pacific Islands they are very abundant and grow to an enormous size; but on the other side of the Pacific, all the way from Kamtchatka to Cape Horn, eels are conspicuous by their absence.

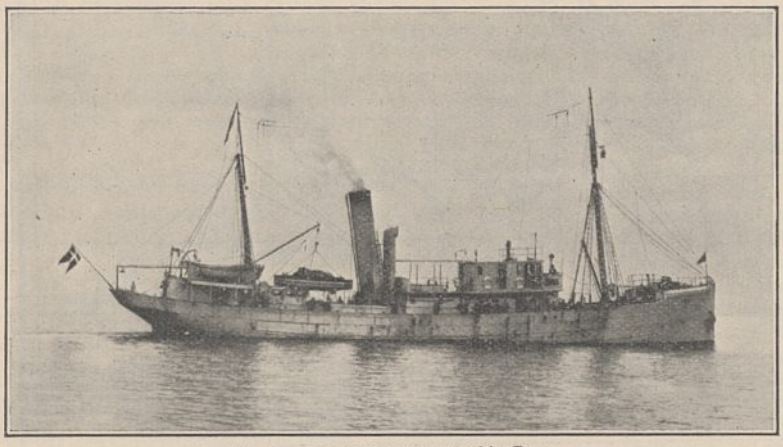


FIG. 2.—The Danish research ship *Dana*.

This is a very striking fact, and not less striking is their total absence from the South Atlantic. They are plentiful (as we all know) on both sides of the North Atlantic, and on the western side they extend through the West Indies as far as the north coast of South America; but there they stop, and none are found either on the east coast of South America or on the opposite coast of Africa south of Morocco.

Here is a complicated problem. Why are eels plentiful throughout the western Pacific, but absent from all the eastern half of that ocean? Why are they present on both sides of the North Atlantic ocean, but absent from both sides of the South Atlantic? Why are they plentiful on one side of Australia and absent from the other? In the strictest sense one may call such a problem as this an interesting one, because it is plain that it can be only solved by putting two and two together over a wide range of physical as well as biological investigations. Problems of geographical distribution are generally interesting, though we are often put to our wits' end to solve them. When we find the tapirs, the king-crabs, or the lung-fishes each with two or more separate and remote habitations, we are content to invoke the 'historic factor,' and to take it for granted that a wider distribution in some former age preceded and led to the present conditions. The distribution of coral reefs we can more or less satisfactorily explain by existing hydrographical phenomena, with again some help from the historic factor of geology. Most of the deep-sea fishes seem to roam the wide world over, as though the general uniformity of the great depths of the sea set no barriers in their way. But the eels, though capable of travelling immense distances, nevertheless have their well-defined areas of distribution, both for this or that particular species, and for the family as a whole. The *Dana* goes out to study the habits and the distribution of the various eels, but there is nothing in the chemistry and physics of all the oceans which need be thought alien to that biological problem: hydrography is a great and an indispensable part of her work.

The Japanese eel, the eel of the North Pacific, is closely akin in habits and otherwise to the two eels of the Atlantic; and, just as the young of our own eels traverse the shallows of the North Sea to enter British rivers, so do those of the Japanese species cross the shallows of the Yellow Sea on their way to the rivers of China. In all probability they breed in the deep warm water south-east of Japan, in the region where the Kuro Siwa takes its rise, under conditions somewhat like to (though somewhat cooler than) those which obtain in the Sargasso Sea. But there is no eel in the north

Pacific which takes the longer journey (as the European eel does) from these warm waters to the eastern side of the ocean. A very similar patch, or tongue, of warm water runs far to the eastward from the Queensland coast, to the northward of New Zealand, and here possibly, and even probably, is the chief breeding place of the southern eels. At the same time the comparatively limited distribution of some of the Pacific eels goes to show that these are poor travellers, and are somehow or other hedged in by unknown barriers. We begin to see what a wonderful field of investigation Dr. Johannes Schmidt has made his own. For a score of different eels the breeding place of each has to be determined and the routes followed by old and young have to be mapped out; agreement with the known habits of our own eels has perchance to be verified, or perchance to be disproved. Every locality and route must be studied in regard to its hydrographical features, and what they have in common must be made clear. In the end general truths and common features may emerge, giving an insight into the history of the eel-tribe and the sources from which their strange habits or instincts came.

There is a curious little point, to which Dr. Johannes Schmidt has directed attention, in the name which the eel receives among many remote races of men. It is called 'Tuna' by the Maori, and its name in Samoa, the Philippine Islands, and even in Madagascar is but a slight variant of the same word. This looks like a page from that early history of the migrations of seafaring men of which Prof. Elliot Smith and others have told us. When we find in the Semitic languages and in Greek what looks very like the same word in θύννος or *tunny*, though it be used of another fish, I should not scout as impossible a connexion between all of these; for we begin to see that a few animal names are so old as to care little for linguistic boundaries, and are perhaps the oldest of all old words surviving in the speech of men. D. W. T.

Oil and the Oil Engine.

SINCE the foundation of the mineral oil industry many a prediction of an oil shortage to occur within the lifetime of the prophet has been made; but in spite of the astounding increase in the use of oil as a fuel within the last two decades, a consumption which is certainly still far from having reached its peak value, there is not the remotest reason to anticipate an oil shortage within the next hundred years. Indeed, in view of the known reserves of oil in hitherto untapped fields, and of the vast quantities still remaining underground in partially exploited districts, future generations should be secure against an oil shortage for at least a thousand years. To-day, the world's output of oil is far below the capacity of wells actually in production, and were it not for output-limiting agreements between oil-producing interests the market would be flooded.

The crude mineral oils do not reach the consumer as such, for being complex mixtures of hydrocarbons of widely varying volatility, they must first be subjected to distillation and other processes whereby the crude product is divided into four main groups, the boiling-point ranges of which serve for their chief market classification. Petrol is the first of these fractions, distilling over at temperatures up to 150° C., and constitutes the main supply of the world's motor spirit. Kerosene or paraffin oil, distilling between 150° and 300° C., is chiefly in demand as an illuminant. The heavy fuel oils, boiling between 300° and 350° C., are burnt directly for steam raising or in engines of the Diesel type. The fourth and final fraction supplies mainly lubricants, waxes, and pitch.

The relative proportions of these four fractions vary with the nature of the crude oil; petrol is most in demand and therefore commands the highest price. So much is this the case to-day that the petrol fraction, although in the best of oils never amounting to more than 20 per cent of the total distillation products, pays for practically half the total oil production and refining costs. Thus there is every incentive to increase the yield of petrol by the thermal decomposition or 'cracking' of the heavier fractions. So successfully have such methods been applied that, to-day, the price of petrol shows the least increase since 1913 of any of the commodities in everyday use, and this in spite of greatly increased costs of production and refining.

The remarkable development within the last fourteen years of cracking processes is clearly brought out in the following table:

PETROL PRODUCTION IN THE U.S.A. IN MILLIONS OF GALLONS.

Year.	By direct Distillation.	By Condensation from Natural Gas.	By Cracking.	Petrol Production in per cent of Crude Oil.
1914 .	1112	..	..	18·2
1919 .	2601	95	320	25·9
1923 .	4461	175	1120	30·4
1927 .	6213	1029	3239	36·7

But for this development in cracking and other processes it is clear that, in order to meet the demand for petrol as a motor spirit, production would have had to be practically doubled, with the result that the petrol fraction would have had to bear some 80 to 90 per cent of the total crude oil production and refining costs, and the market price of petrol would have been doubled or even trebled. Thus the increased efficiency in refining, which is chiefly a result of the introduction of cracking processes, has not only kept down the price of petrol to the consumer, but has also prevented a wasteful flooding of the market for heavy oil, so that the price obtained for this fraction is more proportionate to production and refining costs than would otherwise have been the case.

Even so, the relative prices of petrol and heavy oil, when compared on an energy content basis, are approximately 3 or 4 to 1. There is thus every incentive for the development of heavy-oil-burning engines suitable for use under conditions in which the petrol driven motor has hitherto reigned supreme. A move in this direction has already been made by the introduction of the Diesel-type heavy-oil-burning engine for the purposes of motor road transport.

Diesel engines can be conveniently classified into three main types, according to the speed at which they are designed to run. Low and medium speed Diesel engines which develop their full power at speeds below 500 and 1000 r.p.m. respectively are, chiefly owing to considerations of weight per unit of power developed, practically restricted to use in stationary installations or for marine purposes, and to a less extent in railway locomotive practice. High speed Diesel engines running at speeds of more than 1000 r.p.m. have the advantage of higher power-weight ratios than those possessed by the lower running types, and are being successfully employed for heavy road transport. It is probable that the use of such engines will, in time, be extended to the lighter classes of road transport vehicles and even to aircraft.

In addition to the great saving in fuel costs, the use of the Diesel engine offers further important advantages such as greater efficiency, compression ignition, less volume of fuel carried for a given mileage, practically eliminated fire risks, and a reduction in the size and area of the cooling system. The ultimate successful application to road and air transport of the high-speed Diesel engine will, however, depend largely upon the extent to which the designer is successful in reducing its inherent disadvantages, the chief of which are low power-weight ratio, starting difficulties, the offensive nature of the exhaust gases, oil creepage, and heavy transmission stresses. It remains to be seen, if and when the heavy oil engine has been sufficiently developed to compete successfully with the petrol motor, whether the resulting demand for heavy oil will not lead to such a levelling out of prices for the respective fuels that the Diesel engine will be robbed of one of its chief merits.

These recent developments in the heavy oil engine and its uses are a strong incentive to continued improvement in the petrol motor. Until the gas turbine has become a working proposition, the main line of improvement in the reciprocating type of engine lies in the direction of an increase in the compression ratio, an upper limit to which is set by the incidence of the well-known phenomenon of 'knock.' In attacking this problem two lines are being actively pursued. Some classes of motor spirit, such as benzol and other aromatic hydrocarbons, do not give rise to knock, no matter how high the compression ratio may be; but by far the larger bulk of our petrol supplies are rich in paraffins which are notorious offenders in this respect. To reduce the trouble the chemist is engaged in studying the effect of blending these different classes of spirit and has also attacked, with considerable success, the problem of treating bad petrols with substances such as lead tetraethyl, small additions of which suffice to reduce their tendency to knock, so that the 'doped' fuel can be burnt in engines of a considerably higher compression ratio than would otherwise have been possible.

Further, the engineer has not failed to realise that correct cylinder head and piston design is an important factor in suppressing knock. It is now well known that, other conditions such as turbulence, freedom of the explosion chamber from hot spots, etc., being equal, the incidence of knock is largely controlled by the distance of unimpeded travel of flame through the explosive mixture near the beginning of the firing stroke. Thus the same petrol can be burnt without giving rise to knock at a higher compression ratio in a small cylinder than in one of a larger capacity. Likewise a central position of the sparking plug, or, better still, multiple point ignition, materially assists in its suppression.

The expenditure in Great Britain on petrol alone is about £60,000,000 per annum, and is steadily increasing. Practically the whole of these supplies are imported, and there is little or no prospect of home-produced spirit materially affecting this state of affairs. There is, therefore, a great inducement to use solid fuels for road transport purposes. That the coal or coke fired steam-driven lorry continues to hold its own in spite of its exceptionally low thermal efficiency is a clear indication of the vast possibilities open to a motor which would combine the efficiency of the internal combustion engine with the low cost of coal. Intensive experimental work and exhaustive tests on road vehicles fitted with internal combustion engines running on gas generated in suction producers are now being carried out in Great Britain and other countries with much promise of success.

The Ice Age and General Drayson's Theories.

FROM time to time theories claiming to be scientific are put forward, most frequently in the domain of astronomy, which fail to secure the recognition of the orthodox. For the most part they pass quickly into deserved oblivion and are heard of no more. The fate of Gen. Drayson's ideas is quite peculiar. They have been kept alive by a devoted band of disciples, but no qualified astronomer who has considered the theories can profess more than the mildest interest in them. This attitude has led to resentment, and the Draysonians have not been slow to make accusations of obscurantism against the astronomers. As the world owes its release from the tyranny of dogma to nothing so much as the development of astronomy, and as in no science is the co-operation

between professional and amateur so cordial, fruitful, and freely acknowledged, such accusations may well be dismissed with amused indifference.

About the middle of the last century Capt. A. W. Drayson, R.A., after a course of study at Greenwich Observatory, was appointed to the staff of the Royal Academy at Woolwich and gave instruction in surveying and practical astronomy for about fifteen years. Sir John Herschel's "Outlines of Astronomy" had been adopted as the official textbook, and Drayson followed its teaching for a time, evidently without appreciating the nature and limitations inherent in even an admirable example of that type of work. Eventually he became dissatisfied with Herschel's exposition of the subject of precession. At that point he might have referred to the mathematical theory, of which the results were available to him only in the barest outline. Instead of doing so, and perhaps deterred by the difficulty of such a course, Drayson embarked on a geometrical reconstruction of the precessional motion as observed over a considerable period of time. In this task he showed no little ingenuity, but the outcome was doomed to futility. Everywhere in the Draysonian literature nūtation is simply ignored. Now the real problem which has to be solved is the motion of the earth's axis as a whole, and the purely empirical description of a part of it can never be satisfying. Further than this, the description, such as it is, is devoid of any dynamical basis.

The attitude of Drayson and his followers to the theory of gravitation is undefined. They are not apparently in declared opposition to it altogether, but they claim to ignore its application to the problem of precession. What they overlook is that the astronomer is not free to select. He cannot remove the rotation of the earth from the operation of a natural law, and at the same time use that very law to predict the position of the sun and moon. What Drayson found was the osculating circle to the path of the earth's pole, and it represents a fair approximation to that path over a time which is quite long in one sense but short in comparison with the precessional period. The fact that it accords with the positions on which it is based affords no justification for extrapolation beyond them, and this is the fatal defect of the theory.

Here the story might have ended, for popular interest in the subject of the earth's precession would not by itself have sufficed to keep the cult alive. This vitality has been brought about by attaching the theory to the problem of an Ice Age.[1] Drayson's next step, in fact, was precisely to indulge in that process of unlimited extrapolation which lacks all valid foundation. For what is in effect the osculating circle to the path of the earth's mean pole he found the centre 6° from the pole of the ecliptic, together with a period of nearly 32,000 years. Here, then, in a large periodic change in the obliquity of the ecliptic, is an explanation of a glacial cycle ready to hand. By this means what might have passed as a crude version of astronomical data within a limited range of time was brought into a field where uncertainty as to the facts reigns supreme and any theory enjoys unwonted freedom from critical tests.

Much of course has been written on this subject from several points of view. The difficulty is that the evidence is not so precise, coherent, and complete as to present a definite problem to astronomy at all. The demands on the geologist are heavy. He must first agree on the approximate dates when the successive glaciations happened. Then, for those dates, he must define the whole areas affected simultaneously over the whole surface of the globe. Finally, he must be prepared to state what was the distribution of land and water, and more precisely what was the elevation of the land areas, for these are constantly changing, over all past geological time. It is only when a clear statement on all these points is forthcoming that the problem will reach a stage of closer interest. For then it will pass into the hands of the meteorologist, and he will state in terms of his science how far he can go in explaining the phenomena without requiring any help in the form of exceptional or overlooked astronomical conditions. It appears quite likely that he will need no assistance at all. Those interested in this phase of the subject will find it discussed in a popular form in a recent work by Dr. C. E. P. Brooks, "Climate through the Ages." If at the end of all this there is an outstanding balance for the astronomer to settle, and he has no other means of disputing it, there is always a fund on which he can draw without disturbing his account of invested theory. For when it can be established beyond doubt that there have been times when the earth's surface has received a deficiency of heat, the obvious inference will be that the sun's radiation has fluctuated in intensity. There is no reason to assume that the sun has always produced heat at a uniform rate, but rather the contrary. Unfortunately, the geological evidence at present is too ambiguous to turn a fruitful inquiry in this direction. In the meantime, this is a state of affairs which presents excellent opportunities for those casual coincidences so fatally attractive to undisciplined minds.

If, however, as suggested, the facts are neither so clear nor so detailed as to present a plain problem for solution, yet the occurrence of ice ages, though rather vague in time and distribution over the earth's surface, is common knowledge. Hence the alternative is to approach the problem from the astronomical end and to see where it may lead. The pioneer in this course was James Croll, and a very clear idea of the relevant conditions may be gained from Sir Robert Ball's little book, "The Cause of an Ice Age." A very important contribution to the subject from this point of view is due to Prof. C. V. L. Charlier in a publication from the Lund Observatory. His conclusion, as a matter of fact, is that accepted astronomical principles do point to the recurrence of conditions favouring an ice age at dates which he assigns. But it is of the essence of the astronomical explanation to find the

[1] "The Ice Age: its Date, Duration, and Astronomical Cause as Investigated by the late Maj.-General A. W. Drayson and recently confirmed by the Error in Timing the 1927 Solar Eclipse." Pp. 32. (Lewes, Sussex: W. E. Baxter, Ltd.) 6*d*. net.

cause in the slow changes in the eccentricity of the earth's orbit and not in large changes in the obliquity of the ecliptic. This theory also requires the ice ages in the two hemispheres to occur alternately, not simultaneously. It is hard to assess how far these acknowledged changes in the astronomical conditions have been effective, as it is to judge how far their influence may be needed to supplement all the other meteorological factors operating in past ages. If there is any reason for insisting that the ice ages have run concurrently in both hemispheres, it is far easier to find the cause in the body of the sun than in any peculiarity in the motion of the earth. H. C. P.

News and Views.

THE report of the Right Hon. W. G. A. Ormsby-Gore, M.P., Parliamentary Under-Secretary of State for the Colonies, on his visit to Malaya, Ceylon, and the Dutch Colony of Java during the year 1928, was presented to Parliament last week. This is the fourth report on Colonial development based on personal tours of the non-self-governing dependencies of the Crown for which Mr. Ormsby-Gore has been partly or wholly responsible. In 1922 he accompanied Mr. Edward Wood (now Lord Irwin) to the British West Indies and British Guiana. In 1924, Mr. J. H. Thomas (then Colonial Secretary) appointed him chairman of the Parliamentary Commission of Inquiry which visited East and Central Africa. Two years later he toured the four British Colonies in West Africa. Reports on each of these tours were presented to Parliament. Each of them is a valuable contribution to our knowledge of the countries coming within the scope of his inquiries. Considered as a whole, they constitute an almost complete summary of the facts related to the geography, history, economic development and administration of most of the countries for which Great Britain has assumed responsibility but to which it has not yet granted complete self-government. The common characteristic of the four reports is the emphasis laid upon the education, public health, and scientific and technical services as factors in the development of the resources of the tropics. Hitherto, there has been a tendency on the part of local governments to regard such services as luxuries to be afforded only in times of their prosperity. This fallacy is dealt with adequately. The scientific and technical services are shown to be the basis of economic advance. The importance of extending the public health services to prevent the enormous wastage of life and loss of physical efficiency of the peoples of the tropics is stressed, but above all it is shown that the work of such services will be largely abortive unless our subject races can appreciate what is being done and can co-operate with us. Hence it is imperative to build up greatly improved education services throughout the colonial empire.

ON his last tour, Mr. Ormsby-Gore took the opportunity courteously offered to him by the Governor-General of the Dutch East Indies to make himself acquainted with the work done by the Dutch in the colony of Java, the most densely populated part of the East Indies. He is thus able to compare Dutch with British colonial administration, and it must be confessed that the comparison does not show up British administration in a favourable light. It would appear that the Dutch administration has a greater appreciation of the beneficent influence of scientific research than we have. In the island of Java alone there is a Government central research institute at Buitenzorg and several other well-staffed and well-equipped research stations wholly maintained by the industries concerned in different parts of the island. Of the system of agricultural education in force, Mr. Ormsby-Gore speaks with the highest admiration. The public health services are also highly developed, but in this respect the British efforts to combat malaria in Malaya are warmly commended. The whole report is worthy of the closest scrutiny, and we hope to discuss it in detail in later issues of NATURE.

A MEMORANDUM has recently been issued by the New International Association for Testing Materials (N.I.A.T.M.) concerning the present position and activities of the Association and some recent decisions arrived at by the permanent committee of the Association held in Paris on June 21 last. The main object of the Association is to hold periodical congresses, but experience has shown that it is not satisfactory at a single congress to discuss subjects concerning the whole range of the testing of materials. It has therefore been decided to confine attention at each congress to a relatively small number of specially important subjects in each of the sections. On the other hand, undue specialisation in international discussions is to be avoided. To solve the task of selecting subjects for the next congress, to be held in Zurich in 1931, all participating countries were asked to forward suggestions. Sixteen countries have responded, and the outcome of their suggestions is an invitation to each country to prepare a number of preliminary summary reports on a small number of selected subjects and to appoint reporters. It is proposed to publish these preliminary reports early in 1930, in either English, French, or German. When the permanent committee receives these preliminary reports it will be in a better position to consider the final selection of subjects for the congress of 1931. The British committee, the offices of which are at 28 Victoria Street, S.W.1, is taking steps to secure widespread membership among those interested in the testing of materials, and it is anticipated that Great Britain will be adequately represented when the reports are published by the International Association.

MR. BHUDEB MOOKERJI, who has recently published the first two volumes of his work entitled "Rasa-Jala-Nidhi" or "Ocean of Indian Chemistry and Alchemy," has now issued a pamphlet entitled "Indian

Civilisation and its Antiquity" (41a Grey Street, Calcutta; price 2 rupees). He treats the subject under three heads, namely, phallism and the spread of Indian culture, the gypsies and the spread of Indian culture, and Indian chemistry and its antiquity. Mr. Mookerji has clearly lavished much effort upon his theses, but both his natural science and his etymology are, to say the least, heterodox. He says, for example, that Darwin's theory "is no longer accepted by the most distinguished of the modern scientists and philosophers," Dr. Martineau and others having proved it to be untenable "and established its utter worthlessness by a volley of irrefutable logic." As to the date of the origin of Indian civilisation, Mr. Mookerji places this about 1950 million years ago. Sir James Jeans estimates the age of the earth itself at only 50 million years more, so that we are bound to agree with Mr. Mookerji's own disarming statement that "this will appear incredible to many people." Still, in spite of exaggerations of this kind, the author has managed to make out a case for the respectable antiquity of Indian chemistry, and the pamphlet should be examined by historians of science. The sources of Rhazes' chemical knowledge are considered at some length, Mr. Mookerji giving several reasons for believing that Rhazes was indebted to the Indians for his knowledge of the chemistry of metals. If we might make a suggestion, it is that Mr. Mookerji should associate himself with some European scholar trained in the methods of historical criticism; the collaboration would probably produce interesting and valuable results.

AT a meeting of the Royal Statistical Society on Dec. 18, Mr. H. E. Soper, of the National Institute for Medical Research, read a paper on the interpretation of periodicity in disease-prevalence. Amongst the various theories put forward to account for epidemic recurrence, the most favoured presents a picture of a rise and fall in the new cases of a contagious disease as consequent upon a glut and dearth of susceptible persons; the action may be supposed to go after the manner of a pendulum, where, as the energy of flow becomes exhausted, the energy of potential activity gets stored up, to be released again when motion recommences. The stored energy is the accumulation of susceptible children, by birth. This view of the origin of the surgings of measles epidemics has been carried now a little beyond that already reached by the investigations of Sir William Hamer. A simple supposition in regard to the delayed or lapsing infectivity of an infected person, combined with a constant inflow by birth of susceptible children, leads, by invoking the statistico-chemical law of mass-action, to a periodic wave, the period of which can be interpreted. These idealised waves do not, however, give a very true replica of the curve of monthly cases of measles as presented by an actual chart. Curves very similar to the actual curves of measles cases in Glasgow would be the foreseeable consequence of combining the natural epidemic swing with a forced seasonal impulse of a certain form, the maximum of which coincides with fair truth with the time of assembly of schools after the summer vacation.

IN the early days of electrical distribution the only source of revenue was the lighting load. As the amount of plant required depends on the maximum demand at any particular time, it was necessary to instal expensive storage batteries if the capital cost was to be maintained low. The high price charged for the lighting service was due to the poor use made of the capital invested. In order, therefore, to encourage consumers to provide a load during the period when there was little demand for lighting, energy for motors and for cooking and heating was offered at a low price. Complicated tariff systems of charging have been devised with the object of encouraging consumers to use electricity at times when the demand is small. For various reasons, however, these have not proved attractive. In a paper read to the Institution of Electrical Engineers on Dec. 7 by W. Holmes, stress is laid on the importance of encouraging consumers to store thermally the energy they receive during the slack periods of the day, the house being heated and supplied with hot water continuously. Several electric companies offer to supply current for this purpose at very low rates. By suitable electric devices the current is switched on and off automatically at any desired times. Recent tests show that the electric hot-water storage tank is wonderfully efficient. A domestic thermal storage cylinder will retain its useful hot water for more than a week after the supply is switched off A 100-gallon storage tank takes 50 units to heat it from 42° F. to 212° F., and the efficiency of the conversion from electrical energy to heat is more than 99 per cent. On a 24-hour basis the efficiency is about 94 per cent, with a capital cost of £60, and a life of above thirty years. As more than 50 per cent of the revenue of electric stations comes from the domestic load, an increased demand for electric heating would enable them to reduce substantially their charges.

THE report by a committee of the Illuminating Engineering Society on the progress made in electric lamps, which appears in the Society's *Journal* for December, is instructive, as it shows the large reductions that have been made during the last ten years in the cost of lighting. The report of the Electricity Commissioners shows that the average revenue per unit sold by supply companies for domestic purposes has fallen 33 per cent during the last ten years. The reduction of the price to the consumer is due partly to the reduction of the price per unit. For example, the Metropolitan Borough of Hampstead now charges only 3*d.* per unit for lighting. It is largely also due to reductions in the price of electric lamps and their increased efficiency. These two factors result in a great increase of candle-power hours for the same expenditure in lighting. Gas-filled lamps are now replacing the less efficient vacuum lamps, as their price is practically the same, and obscured lamps, which avoid glare, are replacing clear lamps for general lighting. Numerous small lamps are used for lighting rooms instead of a few large lamps. In particular, there is a considerable demand for lamps rated at 15 and 25 watts. In the opinion of the committee, the

further co-operation of architects in arranging the lighting of houses is desirable. Very few houses are equipped with wall plugs to which standard lamps can be connected. The committee thinks that surfaces lighted either by reflection or by transmission through diffusing media are definite architectural elements in the design of a dwelling-house.

WHEN we consider what is happening in various countries in connexion with their broadcasting services, we have reason to be satisfied with that in Great Britain. In the *Canadian Magazine* for September last appears an interesting paper by D. H. Copeland and P. Dorté entitled "A Radio Voice across the Land." They state that broadcasting in Canada is now almost in a state of chaos, and that a remedy is urgently needed. It seems that there is not a single broadcasting station in operation either in the United States or Canada which exists purely for the purpose of entertaining the public. All of them have ulterior motives, self-interest being the mainspring of the broadcasting industry. Advertising is only one of the ways in which this is expressed. An official of the National Broadcasting Company of New York has recently stated that the activities of the company have resulted in a loss of half a million dollars, and yet it is still apparently flourishing. The authors give as the reason that the company is associated with the Radio Corporation of America, and that the sale of millions of dollars' worth of apparatus has been greatly to its benefit. Advertising by radio is now a fine art, and it pays well. The public associates the name of the advertiser with the excellent entertainment he provides. The authors discuss whether it would be advisable to inaugurate a new system. They consider that the English system would be inapplicable in Canada. If a key station was made in Toronto and began its programme at eight o'clock in the evening, it would be received at Winnipeg at six o'clock, in the foothills of the Rockies at five o'clock, and on the west coast at four o'clock. A key station at Toronto would not be welcomed at Montreal. The language difficulty is a real one. Increasing the tax on broadcast reception would cause political difficulties, and the question of compensating existing broadcasting companies would be serious. They suggest having two main stations, one in eastern and one in western Canada, with an associated train of relay stations. The main difficulty is the financial one, and they state that the only solution appears to be a sound, business-like development of the advertising field.

THE December issue of the *Scientific American* contains major articles dealing with a great variety of scientific topics, from the surgery of the early Egyptians, the biology of Dominica, a study of the bladderwort, a petrified forest near San Francisco, to the practical themes of hydro-electric aqueducts of wood, the anti-efficiency influence of noise, the economic development of Canada, unique methods of dam construction, and many more. These articles are of a high standard, written for the general reader, yet comprehensive in scope, and accurate and up-to-date in their information. In addition to the longer articles there are close on a hundred minor notes containing all sorts of odds and ends of scientific news. No British magazine fills the place of the *Scientific American*, and part of its attraction lies in the number and character of its illustrations. To take the biological side alone, there are reproduced a prehistoric scene in Mongolia, by Miss Alice Woodward, illustrating some discoveries of Chapman's 1928 expedition to Central Asia; Charles Knight's new paintings, presenting the evolution of life, from the Field Museum in Chicago; photographs of petrified trees in California; of Dominican animals; of Canada's herds of bison and reindeer; and half a dozen drawings of the bladderwort. That a magazine of such a stamp can be produced for 35 cents and can boast that it is in its eighty-fourth year of issue, gives some indication of the number of Americans generally interested in scientific things.

AN exhaustive article on 'sleeping sickness' is contributed to the December number of *The Nineteenth Century* by Dr. Lyndhurst Duke, formerly chairman of the League of Nations Commission on Sleeping Sickness. This disease, which has been prevalent in Africa but is now largely controlled, is conveyed by species of biting flies, the tsetses. Dr. Duke's remarks on the relation of the big game to the disease are of special interest. As the game recedes into the wilderness the tsetse, which feeds upon it, has either to retreat with it or to adopt a new food supply. "Wherever man is seriously drawn upon by game-tsetses for food, sleeping sickness will be found; but where the primitive balance between man and the game persists, the disease is either exceedingly rare or absent altogether. . . . When man appears in sufficient force to establish himself successfully his presence inevitably drives away the game. From the biological point of view, therefore, man is not likely to serve as an essential food animal for the game-tsetse, except perhaps for relatively short periods during the retreat of the game before advancing human settlement."

IN the Hancock Museum in Newcastle and its collections, the north of England, as well as the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, possess a valuable heritage. The report of the Council for 1927–28 indicates that the Museum is appreciated locally, for close upon 22,000 persons visited it during the year, and a very encouraging response was made to the appeal of the president, Viscount Grey, for a sum of £1500, to aid in the upkeep and improvement of the building and its fittings. Actually £694 was collected, and £480 promised still remains to be garnered, but it is clear that an excellent opportunity of subscribing still awaits those who have forgotten to send their donations. The council appears to have made good use of the funds it has received, and it is encouraging to note that the membership of the Society, which, next to interest on investments, forms the mainstay of the upkeep, shows a moderate increase. The accounts printed with the report do not, curiously enough, give any statement of the capital sums from which the main revenue is derived.

THE autumn issue of *The Fight against Disease*, the quarterly journal of the Research Defence Society,

contains a review by Sir Leonard Rogers of the Report of the Vaccination Committee of 1928. This article supplies the public with a clear and reasoned statement in regard to the present-day problem of vaccination. Before the Act of 1907, which rendered it much easier to obtain exemption, somewhat more than half the children born were vaccinated. Afterward the proportion vaccinated fell, reaching a minimum of 25 per cent in 1920. With a *sixty-six fold increase* of smallpox in England and Wales in the six years to August 1927, the proportion vaccinated has risen again to 33 per cent. Smallpox is once more very prevalent (there were 15,000 cases in 1926–27 in England and Wales) and appears to be on the increase. Fortunately, the type is mild and mortality low, but, as Sir Leonard Rogers points out, the disease is subject to sudden variations in severity, and no one can foretell the continuance or otherwise of the present mild form.

PREHISTORIC toothache is yielding its secrets to modern investigation. The Museum at Los Angeles contains more than a thousand jaws of the sabre-toothed tiger from the asphalt pits of Rancho la Brea, and although few of the jaws retain their full complement of teeth, sufficient remain to yield interesting results to X-ray examination. Caries has not been found in the sabre-tooth jaw, although there are many teeth which are much worn. Pyorrhœa is probably present, but rare. Impaction, the bane of modern 'wisdom tooth' sufferers, is clearly shown in some of the jaws, as well as alveolar abscesses. Dead teeth occur, always blackened, in which the root canal is filled in, and in some cases the root has become bulbous and acquired excessive growths.

THE annual report and statement of accounts for the year 1927–28 of Livingstone College, Leyton, has been received. The College gives elementary medical instruction to missionaries in order that they may better care for their own health and that of the people among whom they work when far from qualified medical aid. The College is largely dependent upon donations and subscriptions, for students' fees do not nearly cover current expenses, and further help of this kind is urgently needed.

THE Royal College of Surgeons of England has issued a "Catalogue of Manuscripts" contained in its Library, compiled by the Librarian to the College, Mr. Victor Plarr. It records the titles or the descriptions of all written documents in the College Library, with the exception of the John Hunter Manuscripts, which have already been set out in Bailey's "List" published in 1891. The chief treasures indexed in this Catalogue are the manuscripts and letters of Clift, Cooper, Lister, Owen, Paget, Quekett, Home, and Jenner.

THE Ministry of Health has issued a memorandum on the accommodation for the sick provided at certain public schools for boys in England, compiled by Capt. W. Dalrymple-Champneys (London: H.M.S.O.). The first part of the memorandum surveys the existing sick accommodation provided at a number of well-known public schools. In the second part, the principles that should guide schools in extending existing, or providing new, accommodation are considered, with illustrative plans; this should be of considerable service to school authorities.

THE Survey of India has begun the issue of a new series of publications, which will describe the work of the Geodetic Branch, excluding the work of the Drawing Office (Survey of India: Geodetic Report, Vol. 1; Dehra Dun, 1928; six rupees, or 9*s*. 9*d*.). The geodetic work was formerly published in the series of *Records of the Survey*, which also dealt with topographical work. This first volume of the new series covers three seasons, 1922–25, but future volumes will deal with only one season's work. The volume covers a wide range of subjects—levelling, gravity and latitude, tidal observation and prediction, magnetic field and observatory work (which were much reduced during the period), and solar photography, since discontinued.

THE Buchan Prize of the Royal Meteorological Society for 1929 has been awarded to Dr. Harold Jeffreys for papers contributed to the *Quarterly Journal* of the Society during the years 1924–27 on cyclones, fluid motions produced by differences of temperature and humidity, dynamics of gepstrophic winds, and other subjects. The medal will be presented to Dr. Jeffreys at the annual meeting of the Society on Jan. 16.

THE November issue of the *British Journal of Actinotherapy* (vol. 3, No. 8) contains a full summary of the papers read at the recent International Conference on Light and Heat. There are also original contributions by Prof. Leonard Hill and Dr. Katherine Spence, abstracts from recent literature, and the first of a series of articles on the scope of actinotherapy in general practice by Dr. Annandale Troup.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A visiting teacher of house painting and decorating, at the L.C.C. Camberwell School of Arts and Crafts—The Education Officer (T.1.a.), County Hall, Westminster Bridge, S.E.1 (Jan. 4). An instrument maker at the Bradford Technical College—The Principal, Technical College, Bradford (Jan. 12). A lecturer in engineering (Grade I.) for the subjects of electrotechnics, mathematics, machine construction and drawing, etc., in the Technical College, East London, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Jan. 14). A keeper of the department of vertebrate zoology of the Liverpool Museums—The Director, Free Public Museums, William Brown Street, Liverpool (Feb. 10). An assistant lecturer in chemistry at Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11. A resident lecturer in mathematics in the Church of England Training College, York—The Principal, Church of England Training College, York. An assistant in the mechanical engineering section of the engineering department of the Municipal Technical College, Halifax—The Principal, Municipal Technical College, Halifax.

Research Items.

SKILL.—The nature of skill is discussed by Prof. T. H. Pear in the October issue of the *Journal of the National Institute of Industrial Psychology*. He begins by defining skill as an integration of well-adjusted performances, and distinguishes it from capacity and ability; it shows itself in the rapid adjustment to a changing environment and to unforeseen circumstances. Skills may be classified as (i) collections of imperfectly adapted responses, for example, much domestic work and the skill of most workers in semi-skilled trades; (ii) perfectly adapted responses which do not exhibit personality, for example, movements on parade of the perfectly drilled soldier; (iii) responses resembling habits, but less specific and automatic; (iv) responses like those in (iii) but exhibiting in their totality a pattern characteristic of the individual; (v) creative skill. Prof. Pear then discusses the possibility of the transfer of training between motor abilities. Although experiment is very difficult in this field, yet there does seem to be experimental evidence in favour of the belief that manual habits acquired during training do not transfer to other activities. Prof. Pear suggests that the reason may be because in many low-grade industrial tasks only minimal attention is required: transfer might therefore not be expected between this almost 'insulated' entity and the rest of the personality. Although the belief in transfer is widespread and the problem is an old one, yet whenever attempts have been made to obtain experimental evidence, that evidence so far has been negative.

RESPONSES OF CORALS TO ENVIRONMENT.—In the *Bernice P. Bishop Museum Bulletin No. 45*, Mr. Charles Howard Edmondson records the results of his work in a paper entitled "The Ecology of an Hawaiian Coral Reef." A section of the Waikiki Reef was specially studied, situated on the south shore of Oahu, close to the Marine Biological Laboratory of the University of Hawaii, where most of the experimental work was carried out. The responses of the corals to temperature and salinity, silt and sunshine, were studied. Rising and falling temperatures completely inhibit the feeding responses of Hawaiian shallow water corals within a few degrees of their death points. On the reversal of temperature after complete inhibition of the feeding responses, feeding is resumed much more quickly from a condition of heat paralysis than from that of cold rigor. The corals show greater resistance to decreasing than to rising temperature, although resistance varies according to the species. *Leptastrea Agassizi* and *Favia Hawaiiensis* live within the widest range of temperature, enduring extremes of both heat and cold, provided the thermal change be gradual. Exposure of 30 minutes to fresh water is fatal to nearly all species of these shallow-water corals, but by a process of gradual accommodation many can live in greatly reduced salinities, the planulæ of *Cyphastrea ocellina* being capable of enduring a 50 per cent dilution of sea water for 25 times as long as the adult. The corals adapt themselves less easily to increased salinities. Of the 23 species buried under 4 inches of sand and silt, all but 2 survived a period of 12 hours, less than 50 per cent. endured it for 24 hours, and only 3 species were alive after 5 days. It was interesting that some individuals of *Favia Hawaiiensis* and *Leptastrea Agassizi* survived after 10 days. *Favia* seems to be strongest of all and most resistant in every way. Although 50 per cent of the species die within 30 minutes if entirely removed from sea water and exposed to the direct rays of the sun during the hottest part of the day, if the bases of the colonies remain submerged those with porous skeleton may live much longer, and sunlight is important in the life of the shallow-water corals. About 50 per cent die in 18 days if cut off from direct sunlight.

MARINE OSTRACODS.—In the *Occasional Papers of the California Academy of Sciences*, **15**, August 1928, Mr. Tage Skogsberg continues his "Studies on Marine Ostracods," Part I having been published in 1920. The present part (Part 2) deals with the external morphology of the genus *Cythereis*, and describes twenty-one new species. Of these, five are from California, the remainder having been taken in the Antarctic regions by the Swedish Magellan Expedition in 1896, or by the Swedish Antarctic Expedition in 1901–03. *Cythereis* has a thick shell usually with elaborate sculpture, both shell and sculpture being very variable. It was raised from a subgenus of *Cythere* to a separate genus by Baird in 1850, the shell only being then known, and in 1865, G. O. Sars described the appendages of certain species. The present author finds that a subdivision of the genus on the basis of the shape and structure of the shell is not practicable. He therefore bases it on the structure of the appendages and of the penis, the differences in the latter organ being of importance. Three subgenera are recognised, and the descriptions of the species are detailed and elaborate. The paper is well illustrated by text figures by the author, and plates by Mr. G. Liljevall.

NEW COMMENSAL COPEPODS.—Mr. H. R. Seiwell has discovered two new species of copepods living as commensals in the branchial chamber of the compound ascidian Amaroucium commonly known as 'Sea Pork.' These he describes in the *Proceedings of the United States National Museum*, vol. 73, art. 18, 1928, No. 2739. "Two New Species of Commensal Copepods from the Woods Hole Region." Both copepods belong to the Harpacticidæ, and are of the genera *Tisbe* and *Amphiascus*, and both occurred abundantly. The branchial chamber of ascidians is a favourite habitat for copepods, and probably much new material might be found if a careful search were made.

DISEASES OF *GAMMARUS*.—Dr. H. Pixell Goodrich (*Quart. Jour. Micr. Sci.*, Oct. 1928) records the occurrence in *Gammarus pulex* of *Thelohania* and *Nosema*, and gives a full account of observations on a yeast-like organism, *Cryptococcus gammari*, which may be so abundant that the blood appears almost solid and the amphipod has an opaque whitish appearance. The yeasts are ingested by phagocytes, and some of the latter secrete a chitinoid substance which envelops them. By co-operation of phagocytes, large chitinoid nodules may be formed which afterwards become dark brown and may be seen through the body wall. The chitinoid secretion of the phagocytes is not identical with true chitin of the exoskeleton. There appears to be a tendency for the yeasts to accumulate in the tips of the appendages, and such infected appendages have been observed in process of being thrown off autonomously, separation from the body taking place at a joint across a plate of chitinoid substance secreted by phagocytes which had collected in that region. A similar chitinoid substance by which wounds are closed in *Gammarus* is also a product of the leucocytes.

AGALINIS AND ALLIES IN NORTH AMERICA.—The first part of a survey by Francis W. Pennell (*Proc.*

Acad. Nat. Sci. Philadelphia, vol. 80, p. 339-449) of the North American species belonging to the hemiparasitic Scrophulariaceous genus *Agalinis* and its allies deals with the taxonomy and distribution of seven of the nine genera. A full consideration of the phylogeny of the group based on a comparison of the several genera with a hypothetical prototype points to *Aureolaria* as approaching most nearly to the ancestral type, and *Anisantherina*, in which morphological specialisations indicate a closer affinity to a series of Old World genera than to any other American genus, as the most highly evolved. The largest genus, *Agalinis*, is counted of recent origin in the United States. The relationship of the genera shows their common origin, and the occurrence of the most primitive species in Mexico is adduced as evidence for that area being the geographical centre of the American species.

THE 'HYBRIDISATION NODULES' OF SWEDES.—On certain cultivated cruciferous plants, tumour-like outgrowths or nodules occur upon the roots which are very reminiscent of the well-known 'finger-and-toe' disease caused by *Plasmodiophora Brassicæ*, but in many of these growths no parasitic organism has been found. These excrescences frequently give rise to adventitious buds from which colourless leafy shoots push up through the soil. Such nodules were very fully discussed by Helweg in his investigations of hybrids between the swede and turnip. He concluded that the tendency to form these nodules is a hereditary character that appears in certain hybrids. Since this work such structures have been described as 'hybridisation nodules,' but this point of view must be revised in the light of A. W. Bartlett's paper in the *Transactions of the British Mycological Society*, vol. 13, Parts 3 and 4, Oct. 1928. Swedes bearing nodules of this type occur frequently in the fields around Newcastle-upon-Tyne, and under microscopic examination, whilst the nodule itself was free from any parasite, a species of *Olpidium* was found in abundance in the cells of the rootlets that were springing from the base of the nodule. Both temporary and resting sporangia of *Olpidium radicicolum* de Wildeman were usually obtained, this being the first record of this species for Great Britain. It appears to be very destructive to seedling plants of swede and turnip, and Bartlett supplies experimental evidence that it may be responsible for the appearance upon the diseased host plant of the so-called 'hybridisation nodules.'

EUCALYPTS IN CALIFORNIA.—A key by Eric Walther to the species of *Eucalyptus* grown in California has been published in the *Proceedings of the California Academy of Sciences* (4th Ser. vol. 17, No. 3; 1928). "Of California's cultivated trees," the author writes, "the most striking are easily the several species of Eucalyptus. Their towering, serried ranks dominate the landscape and lend it a unique, exotic flavour totally lacking in other parts of the United States." The only species generally seen and planted to-day is *Eucalyptus globulus*, but during the boom a few years ago many other species were tried. It was apparently not realised that Australia had a great diversity of climate with fairly moist as well as dry regions, some 350 species of the genus being found there. The consequent variation in requirements of different species probably accounts for the want of success attained in California with many of the species made use of. In the author's opinion, before further planting was undertaken or new species introduced into the country, it was necessary to collect statistics regarding the species already to be found in California and their relative status. It is with this object that he undertook the work of preparing his key, and it may be conceded that he appears to have admirably succeeded in his task. Species and varieties to the number of one hundred are actually growing in California to-day, more especially in Golden Gate Park, San Francisco, on the University Campus at Berkeley, and at the former Experiment Station at Santa Monica, and elsewhere. In his paper the author has closely followed the late J. H. Maiden's comprehensive work, "A Critical Revision of the Genus *Eucalyptus*." The method adopted in the preparation of the key to the species appears simple, and should readily enable the user to run down the species he is interested in. Following the key an alphabetical list of the species is attached. The author also appends a list of the names of no less than 77 species, which he states "have been reported at various times as grown in California, or seed has been offered. No opinion can be expressed as to the correctness of these names until sufficient material for their determination becomes available." Mr. Walther may be congratulated on a paper of much general utility.

TERTIARY SHELLS FROM JAPAN.—Prof. Matajiro, Yokoyama, continues his researches into the Tertiary mollusca of Japan, and contributes two more papers to the *Journal of the Faculty of Science of the Imperial University of Tokyo* (Sect. 2, vol. 2, pt. 7). The one on the "Pliocene Shells from Hyuga," in the island of Kiushiu, deals with specimens collected in the neighbourhood of Takanabé. Upwards of a hundred species are recorded, including many that are new. These last, as well as some rare or important species, are specially described and illustrated on two plates. The other paper concerns "Neogene Shells from the Oil-field of Higashiyama," in the province of Echigo, Main Island. Nearly a hundred species are tabulated, nine being regarded as new, and figured on two plates.

A NOVEL VISCOSIMETER.—A new viscosimeter, resembling the well-known Engler pattern, is described in the *Chemiker-Zeitung* of Nov. 7, in which the special feature is a double system of corrugated radiator plates attached radially to the inner wall of the outer vessel and to the outer wall of the inner vessel respectively. By means of this device, uniform distribution of heat is secured without the use of a stirrer, and it is claimed that very satisfactory tests extending over a number of years have been made. The outer bath is protected from rapid loss of heat by radiation by means of an asbestos covering and a double-walled cover is provided. Other fittings include a levelling device, a special outlet valve for the oil, and a stopcock by means of which the heating-bath can be drained. The readings are the same as with Engler's viscosimeter, so that no correction is required. The apparatus is supplied by the firm Emil Dittmar and Vierth of Hamburg, and can be adapted for heating by gas or electricity. Viscosimeters of older pattern can also be fitted with the new radiators.

THE SPECTRA OF HAFNIUM.—A large gap in descriptive spectroscopy has been filled through the publication by W. F. Meggers of a list of wave-lengths of some fifteen hundred lines of hafnium. The investigation was made at the United States Bureau of Standards, and is described in the issue of the Bureau's *Journal of Research* for August. The purest available samples of hafnium salts, presented by Profs. Bohr and Hevesy, were used, but the spectroscopic examination showed that even these were considerably contaminated, in particular with zirconium and columbium. In spite of this, however, and the added difficulty of unravelling the arc lines from a prominent band spectrum, presumed to be that of an oxide, a satisfactory separation of the lines was made into those originating with the neutral atom (Hf. I), and

with the singly charged ion (Hf. II), whilst some lines in the ultra-violet probably came from multiply charged ions (Hf. III or Hf. IV). The *raie ultime* of the neutral atom has been tentatively identified as a line in the violet at 4093 A., but it does not appear amongst Rowland's list of the solar Fraunhofer lines, although there are some lines of the first spark spectrum amongst the latter. No analysis of these spectra has yet been effected, although it is stated that this is being attempted, and since on Hund's theory the fundamental term of the spectrum of the neutral atom is only an F triplet, it is to be anticipated that the problem will not present any insuperable difficulties.

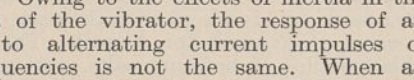
THE STRUCTURE OF MOLECULES.—The fourth of Dr. F. Hund's papers on the significance of molecular spectra has appeared in the issue of the *Zeitschrift für Physik* of Nov. 12. The results which he has obtained are closely similar to those recently published by Prof. Mulliken, the electronic states of a number of light diatomic molecules being deduced by application of the same principles that have been used with such conspicuous success for single atoms, but Dr. Hund's analysis is rather more general than Prof. Mulliken's, and he has also added a few remarks on the structure of polyatomic molecules. When there are more than two nuclei in the compound, he has shown that in all probability not more than two electrons can occupy each quantum path, although with diatomic molecules as many as four electrons may be equivalent in this respect. He has also pointed out that the tendency of some atoms and radicles to form chains —for example, atomic oxygen in the oxy-acids of chlorine, and the group CH_2 in numerous organic compounds—is closely connected with the fact that the atom or group contains eight electrons, which tends to preserve a general similarity of the electronic grouping in the molecule to that met with in the inert gases. This, again, would indicate that such compounds should be diamagnetic, which seems usually to be the case, although, as is emphasised, the occurrence of diamagnetism is not an infallible criterion for the existence of these particular arrangements of electrons, Some of the ideas which are being developed by Dr. Hund and Prof. Mulliken in this connexion are admittedly not new, but they do now take on the aspect of logical consequences of the fundamental concepts of the quantum theory.

CONSTANTS OF AN ELECTROMAGNETIC OSCILLOGRAPH.—An oscillograph records photographically the wave form of the electric currents or the discharges that pass through it. They are of two types: first, the electronic or cathode ray type; and secondly, the electromagnetic oscillograph, under which heading is included also the electrothermic instruments. In a paper communicated to Volume 67 of the *Proceedings of the American Philosophical Society*, Dr. A. E. Kennelly describes a new method for determining the constants of the electromagnetic instrument. He discusses mainly its performance when used to record alternating currents which have reached the steady stage. Owing to the effects of inertia in the moving parts of the vibrator, the response of an oscillograph to alternating current impulses of different frequencies is not the same. When an oscillogram is analysed into a series of Fourier components of different frequencies, it is known that a correction factor should be applied to each component to eliminate the error due to inertia. The magnitudes of the various corrections depend on the frequency. The author has shown in his book on "Electrical Vibration Instruments" that if the resonant frequency of an oscillograph vibrator could be identified experimentally and also its 'quadrantal frequencies,' then the correction factor for any recorded frequency could be evaluated. Recently, however, improved methods of supplying a wide range of alternating current frequencies to an oscillograph for testing purposes have become available, and this simplifies the determination of the correction factors: The behaviour of an oscillograph at all frequencies is completely specified when its resonant frequency, its 'specific deflection,' and the 'bluntness of the resonance' are known. The 'specific deflection' is the deflection per unit of testing current taken at some convenient frequency of reference, such as 60. The 'bluntness of resonance' is simply the reciprocal of the sharpness. The method given is mainly useful when the time which the observer can devote to the calibration of the instrument is limited.

ACTIVE NITROGEN.—The relation of the formation of iron nitride in the iron arc to the presence of active nitrogen is discussed by E. J. B. Willey in the *Journal of the Chemical Society* for November. The amount of nitride present in the arc appears to decrease from 12-15 per cent. at the metal-vapour zone to about 6-8 per cent. at the outer edge of the arc. Examination of the arc light by means of a Hilger spectrometer failed to detect the presence of the nitrogen afterglow spectrum. It is suggested that either the reaction between the iron vapour and the active nitrogen is so rapid that the concentration of the latter remains exceedingly low, or that the chemically active nitrogen is present in a non-luminous form.

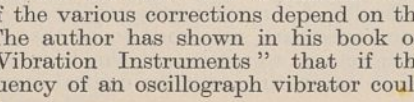
CRYSTAL STRUCTURE OF SILVER SUBFLUORIDE.—Sub-compounds are of interest chiefly because of the peculiar valency relationships involved. The crystal structure of one of the best defined of these compounds, silver subfluoride, Ag_2F, is described by H. Terrey and H. Diamond in the *Journal of the Chemical Society* for October. The substance was prepared by the electrolysis of a concentrated solution of silver fluoride at 60°, and was examined by the power method. The structure appears to resemble that of cadmium iodide, and the density indicated that there is only one molecule in the unit cell, which is hexagonal and has the dimensions, $a = 2{\cdot}989$ A. and $c = 5{\cdot}710$ A. The authors suggest that perhaps in the molecule of subfluoride two silver atoms partly share their uncompleted electron rings, leaving between them the one electron required by the fluorine atom. Such a hypothesis affords some explanation of the metallic properties of silver subfluoride.

THE CO-ORDINATION NUMBER OF COBALT.—According to Sidgwick, elements up to the end of the first long period in the periodic classification do not have a covalency higher than six. This rule appeared to be violated by the existence of a cobalt allylamine, prepared by Pieroni and Pinotti (1915), in which the cobalt apparently had a co-ordination number of eight. The *Journal of the Chemical Society* for October contains an account of the re-investigation of this compound by W. R. Bucknall and W. Wardlaw. Their analysis differs considerably from that of Pieroni and Pinotti in the value for cobalt, and they have carried out molecular weight and conductivity measurements. Bucknall and Wardlaw conclude that the compound probably has the formula



$[3\text{al} \cdot \text{Co}(\text{O}_2)(\text{OH})_2\text{Co} \cdot 3\text{al}]\,\text{Cl}_3$,

thus assigning the normal covalency of six to the cobalt. A second allylamine, also prepared previously, was examined, and this is believed to be



$[3\text{al} \cdot \text{Co}(\text{O}_2)(\text{OH})_2\text{Co} \cdot 3\text{al}]\,(\text{NO}_3)_3$.

METALLIC CORROSION.—G. D. Bengough, J. M. Stuart, and A. R. Lee have given an account of some further experiments which they have made on the etching of zinc by potassium chloride, in the presence of oxygen, in which they have found, *inter alia*, that hydrogen may be formed in the reaction under some conditions (*Proc. Roy. Soc.*, A, **121**, Nov. 1). They have now collected a considerable body of results, most of which they have summarised in a convenient tabular form, and they conclude that these support quantitatively the newer version of the electrolytic theory of corrosion. An important practical question that they have raised is that of the time-period to be adopted in carrying out laboratory tests to determine relative corrodibility. The relation between the amount of corrosion and the time is usually not linear, and the reduction of results to any such form as a weight of metal corroded per unit area per day is thus not very significant. The convection of the etching fluid is also not usually properly controlled, and this, in their opinion, is one of the chief reasons why tests of this kind are not reproducible. Their remarks in this connexion should, however, apply strictly only to cases in which the oxygen exerts the main control; the formation of films, which is in other cases at least as important, is to be dealt with in a later paper. These researches have been carried out for the Corrosion of Metals Research Committee of the Department of Scientific and Industrial Research.

PROPERTIES OF PERMINVARS.—When iron, nickel, and cobalt are melted together in certain proportions the resultant alloys, after definite heat treatments, are found to possess very unusual magnetic properties. A group of these nickel-iron-cobalt alloys is found to possess practically constant permeabilities when subjected to moderate magnetising forces. The constancy is better than that of soft iron, although the initial permeability is very much greater. In the *Bell Laboratories Record* for September, G. W. Elmen describes the discovery of these alloys and points out some of their peculiarities. When the hysteresis loop for a sample of these alloys is carried up to very intense magnetisation, it is found to have a characteristic but unusual shape. It is something like an ordinary hysteresis loop with the two sides of the loop touching at the centre, so that there is no remanence and no coercive force. The characteristics of these alloys are unique, and it is proposed to call them perminvars, a name constructed from 'permeability' and 'invariable.' The perminvar properties are obtained by heat treatment. The alloys are heated at 1000° C. for a short time and then cooled. It is found that the rate of cooling from 600° C. to 400° C. determines the degree of the development of the characteristic properties. The best results are obtained when the alloy is cooled through this range in five hours. When the cooling is rapid the perminvar properties disappear altogether. The results obtained with a 45 per cent nickel, 25 per cent cobalt, and 30 per cent iron alloy specially heat-treated, are given. For magnetising forces not exceeding 1·7 gauss the permeability is practically constant, the variations being well within one per cent. This is a very remarkable result, as the permeability is nearly 500, which is nearly double that of iron for low magnetising forces. When armco iron was subjected to the same range of magnetising forces, its permeability increased from 250 to a maximum of 7000, which it had when the force was 1·3 gauss. It then decreased to 6000.

POWER UNITS IN AGRICULTURE.—The report of the conference held at Rothamsted on power for cultivation and haulage on the farm, held in 1928, has now been published (London: Ernest Benn, Ltd. 2*s*. 6*d*.). It consists of six papers by leading experts, an account of the discussion, and a résumé by Dr. B. A. Keen. There are five forms of power in use for agricultural purposes in addition to that obtained by horses, namely, steam, gas, petrol, low-grade fuel, and electricity. In the near future there seems little likelihood of the horse being replaced by mechanical forms of power, owing to its great adaptibility to all kinds of work. When steam power is used it is generally obtained by hiring from contractors. The development of steam wagons for general road haulage has not yet spread to agriculture. A few stationary gas engines are employed, but their number is decreasing. Petrol engines are those most commonly employed in farm work, and recent types are very economical compared with those in use before the War. A successful form of light tractor using a Diesel-type engine consuming low-grade fuel has been introduced. The electric motor is by far the simplest form of prime mover, only the two main bearings and the brush holders requiring occasional attention. The cable that has to be wound and unwound as the implement passes across the field is a drawback. The petrol-electric system is worthy of serious consideration, as it combines the advantages of electric drive with freedom from fixed cables. Increased speed of work is of great use for cultivation as well as in connexion with road haulage. Owing to the great developments in the imported meat trade, the policy of laying down land to grass in periods of agricultural depression may need revision. An alternative is the intensification of arable farming by paying special attention to vegetable products of a semi market-garden type. This would necessitate an extended use of power for farming methods.

ELECTRIC KILNS FOR CERAMICS.—Experiments on electrically heated kilns for use in the ceramic industries have been in progress for the last ten years, but it is only recently that improvements have been made which promise that they will be useful in commerce. A reduction in the price of electricity would widely extend its use for furnaces. The great purity of the atmosphere in an electric furnace makes it ideal for decorated pottery. A normal coal-fired muffle furnace requires about 19 hours before a satisfactory result can be obtained. According to S. R. Hind in *World Power* for December, better results can be obtained in half the time by an electric furnace. The exceptional accuracy with which the temperature of the furnace can be controlled and what may be called the 'availability' of the energy as compared with that obtained from fuels, leads to excellent results. In British potteries the technique associated with the heat treatment of the higher grades of clay wares has grown up almost entirely by rule-of-thumb trials. The results obtained in this way have been transmitted traditionally amongst a special privileged class of craftsmen. The ends aimed at were to use solid fuel to the best advantage and to reduce the cost of the necessary labour. Hence for high temperature work very large ovens were used. For the manufacture, however, of the insulators used for the 'grid' electrical transmission scheme, which is being constructed in Great Britain, it is found that very steady heating is required. The specifications for these insulators are very strict. The porosity, for example, must be less than a tenth of one per cent. They have to withstand a combination of very severe electrical and mechanical stresses. Sufficient time, therefore, must be allowed for the temperature to become uniform throughout the thickness of the ware. Vitrification must proceed uniformly and the recrystallisations and conversion of its constituents must proceed evenly and without strain. Hence the temperature of the furnace has to be closely regulated.

Sugar Beet Growing in East Anglia.[1]

DESPITE the fact that there were 222,000 acres under sugar beet in Great Britain in 1927, the crop must still be regarded as being on trial. The rapid increase in its acreage is due in large part to the action of the temporary subsidy on home-grown sugar, and we have still to learn whether it will take its place as a considerable factor in British agriculture of the future. The amount of trustworthy information about the crop in its various aspects is still quite small, and therefore the recently published work on the sugar beet crop in the eastern counties of England during 1927 from the Farm Economics Branch of the Department of Agriculture of the University of Cambridge has an added value.

The conduct of a close investigation, covering 100 farms and some 2300 acres, situated in eleven counties, must always be a matter which requires daring in conception and steady perseverance in execution. The Cambridge team has attacked the business in a pioneering spirit, and where the standard methods of agricultural costing have not met new requirements, they have been modified to suit the occasion. The results, which form the investigation of what is described as the "largest sample that has ever been made," are bound to be interesting, and both interest and confidence increase when it is realised that each of the stages of the work has been handled with care and common sense.

The final tables upon which the whole of the detailed work converges show that the average yield obtained on the land under consideration was 7·711 tons per acre of washed beet, and that the average net cost of this to the grower was £2 : 4 : 5½ per ton, or £17 : 2 : 8¾ per acre, and this is worked down to a standard error of mean net cost of only 5*s*. 6*d*. per acre. The extremes of cost over the 182 fields involved situated on many different soils vary from £10 per acre to £31 per acre, and these point to the fact that the individual accounts in the appendices should be studied in conjunction with the averages before conclusions are drawn about any one type of farm or class of soil as being suitable for sugar beet.

From the climatic point of view 1927 was not a good season for sugar beet, and 7·711 tons per acre is not a good yield, though it exceeds the national average for that year by about 1 ton. Despite this, the average net profit shown in the investigation was £4 : 4 : 1 per acre, or 10*s*. 10¾*d*. per ton. Of this net profit, by far the larger part, £3 : 18 : 7½, is represented by credits to the crop for tops, residual value of manures, and extra cultivations, and in this light the crop appears as one which enables the arable farmer to get his expensive cleaning shift for nothing, rather than as one which brings a large cash supplement to his bank account. The main factor in deciding the cost per ton of washed beet on the various holdings involved has been, of course, the yield per acre, and the first result of this investigation is to point to the need for higher average yields if sugar beet is to flourish as a real cash crop, and not to languish as a cleaning crop rather less expensive than swedes or mangolds.

The design of the investigation has allowed for the examination of a number of the steps taken by growers in producing the crop, and some figures are produced which throw a new and sometimes surprising light on the value of such things as farmyard manure, subsoiling, rates of seeding, and field spacing. These figures, while they cannot be considered as the basis for final dicta, are of real interest to growers of the crop.

It is satisfactory to know that the investigation is being continued in the present year, and that there will be a second set of results to test and add value to those already published. C. H.

[1] "Sugar Beet in the Eastern Counties, 1927: being an Investigation into the Financial Results obtained on One Hundred Farms, and some of the Factors influencing them." By R. McG. Carslaw, C. Burgess, G. Ll. Rogers. (University of Cambridge, Department of Agriculture, Farm Economics Branch, Report No. 9.) Pp. xii+94. (Cambridge: W. Heffer and Sons, Ltd., 1928.) 3*s*. net.

Salmon Disease.

FURUNCULOSIS, an epizootic disease causing considerable mortality among salmon and trout from time to time, has only recently spread into Scotland and the north of England, though it was known in central Europe so long ago as 1894. It has been investigated independently in Great Britain by Dr. F. H. A. Clayton (*Rep. Dove Marine Lab.*, New Series, **16**, p. 49; 1927) and Miss Isobel J. F. Williamson (Fishery Board for Scotland, *Salmon Fisheries*, No. 5, 1928. H.M. Stationery Office, 1*s*. 3*d*. net.)

Miss Williamson finds that the characteristic superficial lesions ('furuncles') are areas of subcutaneous necrosis, not comparable to the pus-producing lesions of warm-blooded vertebrates. Both authors obtained similar results by inoculation of experimental animals, such as brown trout, salmon and sea-trout smolts, blenny and plaice (Clayton), frogs, trout, and other fishes (Williamson). Inoculation through the open mouth and direct application of the culture to scarified areas of skin proved pathogenic to trout and other species, which died in one to four weeks, and the causative bacillus, *B. salmonicida* Emmerlich and Weibel, was recovered from the heart-blood. Characteristic symptoms were observed, including the furuncles and the loss of orientation shortly before death (Williamson). Infection of the water was longer in taking effect. Both authors infected salt-water fish, and whereas Miss Williamson recovered *B. salmonicida* in a Zoarces which died from other causes, Dr. Clayton found the disease lethal to the same fish.

Dr. Clayton makes an important contribution to the subject by his discovery that one of two codling, internally inoculated, harboured the bacillus for at least a month in perfect health, and points out that an immune or partially immune sea-going salmon might act as a carrier, and introduce the disease into other rivers, since it is now known that the salmon does not always return to its native river to spawn. In culture the organism appears to be less viable in salt than in fresh water, and Miss Williamson's experiments with polluted natural waters from various sources have failed to reveal any connexion between these conditions and the spread of the disease. Her view is shared by Dr. Clayton, and both point out its common occurrence in rivers like the Coquet and upper tributaries of the Tay, where there could be no question of pollution. That furunculosis is spread by immune individuals or 'carriers' seems to be the most probable explanation.

Examinations and Ability.

IN an examination in any school subject, the maximum mark being 100, different distributions of the candidates among the hundred-and-one possible marks or percentiles are possible; different distributions are in fact found to result from two examinations of the same pupils in the same subject. The views expressed by Mr. B. C. Wallis in a privately printed pamphlet, "Mass Methods of Examining Children," a copy of which has reached us, may be stated as three propositions, of which the first two are: (1) an examination mark is not in general a measure of the ability of the candidate, but merely a symbol by means of which the candidate's rank in order of merit can be determined; (2) in order to obtain a mark that is a measure of the candidate's ability the examiner's marks must be adjusted to an appropriate standard distribution, the same for all cases.

Mr. Wallis reasons the matter cogently and with many illustrations of the effects of different distributions. He has in mind one of the school certificate examinations. If the one in question is that in which the percentage of passes varies throughout the range between 30 and 40, his complaint is thoroughly justified. When an examination deals with thousands of candidates, the constancy of the average candidate is assured and variation of the percentage of passes through such a range is inevitably due to variation in the standard of the questions and of the valuing.

Mr. Wallis's third proposition is that the standard distribution to which every examiner's marks are to be adjusted is the straight line distribution, on which there are the same number of candidates at every percentile. The only alternative with which he compares the straight line distribution is the cocked-hat distribution. The cocked-hat distribution, however, goes to infinity in both directions, and is unsuitable for a phenomenon that stops abruptly at both ends like examination marks. Suitable distribution curves for such phenomena are well known and may be found in Palin Elderton's "Frequency Curves." One type is the straight line; in another type the candidates are bunched at the two ends or at one end; in a third type they are bunched somewhere about the middle.

Mr. Wallis says truly that it has never been proved that marks on the cocked-hat distribution are measures of ability. It is equally true that it has never been proved that marks on the straight line distribution are measures of ability. The matter cannot be put to the test directly until precise information is available as to what the school aims at doing and as to what the examination aims at testing. But many investigations have been carried out in the Galton Eugenics Laboratory on physical, intellectual, and temperamental qualities, and the distribution is found in general to be bunched about the middle. Moreover, every examiner does his imperfect best to make his marks measure ability, and it can scarcely be a mere coincidence that in statistics kept for half a century the distributions have, with the rarest exceptions, been found to bunch about the middle.

Accordingly, while in complete agreement with Mr. Wallis in the view that examination marks ought to be adjusted to a chosen standard distribution, we are of opinion that a distribution bunched somewhat at the middle will furnish a truer measure of ability than the straight line distribution.

Potential Gradient at Great Heights.

IN June 1926, M. P. Idrac published in the *Comptes rendus* of the Paris Academy of Sciences a short description of the apparatus which had been devised for recording potential gradient at great heights and gave some account of the results which had been obtained.

Further details are now available in a paper which has been published by the Office National Météorologique de France. The system adopted was invented by M. l'Abbé P. Lejay, and depends on the use of a valve with four electrodes.

The whole apparatus is very compact. A balloon two metres in diameter can carry up the electrograph as well as a barothermograph. In practice two smaller balloons tied together are used instead of one large one. The apparatus hangs about twelve metres below the balloon, and there are at different levels two fuses, one of which is connected to the filament, the other to the grid of the valve. The difference of potential between these fuses determines the strength of the current flowing through the valve. This current passes through a recording milliammeter, the readings of which can be interpreted as giving the potential gradient. To allow for recording negative potential gradient, considerable grid bias is necessary, but to save weight the grid bias battery is frequently dispensed with and some of the records fail where they should show negative gradients. Between May 1926 and the end of 1927 there were 60 ascents, of which 44 have given useful results. These are all set out diagrammatically in the paper. The fluctuations in potential gradient in the various cases are remarkable, but some good records were obtained both for the ascent and the descent of the balloon, and the agreement in the curves inspires confidence in the system.

With so much variation from day to day it is not surprising that the averages given for the three groups, ascents made by night, in the morning, and in the afternoon are not very smooth. According to the averages for the afternoon, the potential gradient over Trappes at a height of 2 km. is 43 volts per metre. The gradient falls off to 11 volts per metre at 5 km., but at 7 km. it is 25 volts per metre, and at 9 km. it is 30 volts per metre. There is a sudden drop, presumably on entering the stratosphere, to 2 volts per metre, another rise begins at $12\frac{1}{2}$ km. and a maximum of 16 volts per metre occurs at 14 km. The diminution to practically zero gradient at 20 km. seems to be based on one record only. If we may interpret the observations in the light of Coulomb's Law it appears that in the afternoon the air is positively charged up to 5 km., negatively charged between 5 km. and 9 km. There is a considerable positive charge just below the stratosphere. The stratification by night and in the morning is found to be somewhat simpler.

As M. Idrac emphasises, more observations are required before trustworthy generalisation can be made. It is to be hoped that the new line of research will be followed up in many parts of the world. It is only by learning about the conditions in the upper air that we can consolidate our knowledge of the processes of atmospheric electricity.

The Vegetation of Kamchatka.[1]

THE vegetation and flora of Kamchatka are still very little known, and the book by V. L. Komarov, recently published by the Russian Academy of Sciences, is therefore of considerable interest. The flora of Kamchatka may be divided into three groups: (1) That of central Kamchatka, with its spruce and larch forests; (2) flora typical of the peninsula, for the greater part composed of *Betula Ermani*; (3) the subalpine and alpine flora. The variety of species is limited, phanerogamous plants and filicoids together scarcely exceeding 780 species. This peculiarity is chiefly due to severe climate and frequent volcanic activity.

The main portion of Kamchatka is stocked with plants of alpine and subalpine character, but the vegetation of the plains, represented by coniferous forests, may be found around the valley of Kamchatka River. Larch groves consisting of *Larix dahurica* Turcz. are replaced by forests of *Picea ajanensis* Fischer. The larch attains its maximum growth in the driest parts of river alluviums. The spruce of Ajan prefers mountain slopes, and is frequently interspersed with aspen and white birch; its boundaries are not known. The larch emerges from the valley in three places only, namely, at Kronotzk Lake, in the region of the lower course of the Kamchatka River, and near the foot of Glavny Khrebet. *Populus tremula* L. is found with the above-mentioned species, but its distribution is strictly confined to the central region. Erman birch composes the rest of the Kamchatka forests. It grows on the borders of forests near the river of Three Sisters and spreads as far as the Isle of Koraginsk.

The wide-spreading crowns of the birches prevent them from growing close together, leaving sufficient room for development of a dense carpet of herbaceous plants. The normal growth of Erman birch is impeded by heavy snowfalls. It avoids alluvial soils, and is invariably found near the sea-shores, where it suffers from wind, frequently forming impassable thickets. The white birch, similar to the Japanese variety (*Betula japonica* Sieb. var. *kamtschatica* (Rgl.) H. Wiucl.), grows in alluvial soils and is an integral item of mixed coniferous forests.

The subordinate part of the Kamchatka forests consists of the bird-cherry, the sorb, the hawthorn (*Cratægus chlorosarca* Max.), while the riverside forests are composed of *Alnus hirsuta* Turcz., *Populus suaveolens* Fisch., *Salix macrolepis* Turcz., *S. sachalinensis* Fr. Schmidt, and *S. Gmelini* Pall.

Shrubby brushes are also widely distributed in Kamchatka. The first place among them is occupied by alder plots (*Alnus fruticosa* Rupr. var. *Kamtschatica* Rgl.). Its branches are usually pressed to the ground, forming densely interlaced thickets. *Pinus pumila* Rgl. occupies the second place. It grows in the same manner as the alder, attaining the height of 5 metres in the forests, and decreasing to 1 metre on mountain ridges. The third place is occupied by *Sorbus sambricifolia* Roem., which forms close walls and attains its maximum height at the upper border of the mountain forests. *Spiræa Salicifolia* L. and *Rosa amblyotis* Cam. are frequently found in large river valleys.

The following shrubs are found growing in groups: (1) *Lonicera cærulea edulis* Turcz., (2) *Spiræa betulifolia* Pall., and *S. media* Schmidt, (3) *Salix fuscescens*, *S. oblongifolia*, *S. Pallasii* Anderss., (4) *Lonicera chamissoi* Bge., (5) and, more rarely, *Daphne kamtschatica* Max. Dwarf forms of willow are encountered in the Alpine region; amongst them are *S. berberifolia* Pall., *S. arctica* Pall., *S. chamissonis* Andrss., *S. cuneata* Turcz., and *S. reticulata* L. var. *orbicularis* Andrss.

The herbaceous plants *Filipendula*, *Heracleum dulce* Fisch., *Senecio palmatus* Pall., and *Urtica angustifolia* Fisch. develop fully, reaching great heights in the vicinity of river banks. *Angelica ursina* Max. is found on dry meadows. The *Calamagrostis Langsdorffii* Trin. are the most developed of the gramineous herbs, but *Spiræa salicifolia* L. and *Carex Lyngbyei* are also abundant. Groups of *Fritillaria kamtschatcensis* Gawl. are found in dry meadows, and *Lilium avenacium* Fisch. at the outskirts of forests.

The prevailing species of the alpine flora are the following: *Arnica*, *Diapensia*, *Hierochlœ*, *Papaver*, *Alsine*, *Dryas*, *Pedicularis*, *Saxifraga*, *Rhododendron kamtschaticum* Pall., *Phyllodoce*, *Bryanthus*, *Loiseleuria procumbens* Desf., and *Cassiope lycopodioides* G.

Though from a botanical point of view Kamchatka may be considered as an island, it has no sharply defined endemic vegetation. The flora is far from being unique, consisting mainly of circumpolar plants. Violent volcanic catastrophes and ice masses have displaced and deteriorated the ancient vegetation, which united the flora of Kamchatka with the neighbouring parts of America and Japan. The coniferous forests of the centre are the sole remains of floristic antiquity. After the glacial period Kamchatka was stocked with Arctic elements from Anadyr, or from shores which were elutriated by sea currents. Plants migrated from the continent are found on the north-west shore, while plants carried over from Japan are encountered in the southern part of the peninsula. Scarcely more than 50 species, or 6 per cent of the whole flora, are typical or endemic species, which are peculiar to Kamchatka. About 380 species, or 50 per cent of the whole flora, are represented by species bearing close affinities to European plants. There are only 25 species, or 3·73 per cent, which are found in America. These are confined to the narrow strip of the Bering Sea shores. The number of species indigenous to the country is 752: *Filicineæ* 42, *Coniferæ* 5, *Monocotyledons* 240, *Archichlamideæ* 291, *Metachlamydeæ* 174. The remaining 40 per cent are those of eastern Asia. *Cyperaceæ* and *Compositæ* occupy the first and the third places, respectively, among the largest of families. This obviously indicates the comparatively great marshiness of the country.

The book contains a full list of the plants of Kamchatka, with keys for their determination and specific diagnoses.

[1] "Flora Peninsulæ Kamtschatka." By V. L. Komarov. Pp. 339+13 plates. (Leningrad: Academy of Sciences, 1927.)

Triangulation of France.[1]

THE old triangulation of France is considered as having been begun in 1811 by a body of military surveyors known as 'Ingénieurs Géographes.' The work, however, was really a continuation of that executed by Delambre and Mechain between 1792 and 1801, when the old Arc of Meridian was measured from Dunkirk to Barcelona. Under Brousseaud, Bonne, Hossard, Levret, Perrier, and other 'Ingénieurs' of the Dépôt de la Guerre, the triangulation was carried over France and linked with the surveys of Italy, Belgium, Britain, and Germany. The origin for latitudes, longitudes, and azimuth was taken at the Panthéon, whence geodetic latitudes and longitudes

[1] *Bulletin Géodésique*, No. 12 and No. 16, "Formules pratiques pour le calcul des coordonnées géodésiques." By Lieut.-Col. E. Benoit. (Paris: J. Hermann; 1926 and 1927.)

were computed throughout the country from the sides and angles of the triangulation.

Puissant, following Legendre, had derived expansions for working up these extended latitudes, longitudes, and azimuths, but unfortunately the engineers had limited the expansions to terms of the second order. The result was that the errors due to computation alone frequently amounted to 0·03″, say 1 metre.

The object of the methods set out in the two numbers of the *Bulletin Géodésique* is to bring these old formulæ of the engineers into line with modern accuracy. In a preface by General Perrier it appears that the methods were devised at Saigon in 1905 by Lieut.-Col. E. Benoit. The latter has not only modified the old spheroidal factors, always tabulated, but has also introduced corrections to the terms last computed, so as to take the terms of the third order into the reckoning. These corrections are calculated by the aid of two supplementary tables, II. and III. The result is that the maximum error in latitudes below 70° is reduced to 0·002″, say 2½ inches, even when the side of the triangulation is 60 miles in length.

In *Bulletin* No. 12 the methods of derivation of the formulæ are described and the spheroidal factors are tabulated for every 10 sexagesimal minutes of the quadrant. In No. 16 the same factors are shown on the centesimal system, the figure of the earth employed being that of Hayford. The author is to be congratulated on the success of his accomplishment; the formulæ now rank with others of modern times.

G. T. McC.

University and Educational Intelligence.

LONDON.—The Rhodes Trustees have made a donation of £5000 to the fund which Mr. F. C. Goodenough is raising in order to build a Hall of Residence for Overseas and British Students at the University, and have provisionally undertaken to set aside a sum of £5000 towards the building of a Students' Union.

The following doctorates have been conferred: D.Sc. in medical statistics on Mr. Major Greenwood, University professor of epidemiology and vital statistics, for a thesis entitled "Laws of Mortality from the Biological Point of View"; D.Sc. (engineering) on Mr. J. N. Long (Imperial College, City and Guilds College) for a thesis entitled "Heat Transmission: A Series of Investigations into the Phenomenon of Heat Flow in an Air Stream, in relation to some of its Industrial Applications."

Prof. L. N. G. Filon has been appointed for a period of five years to be Director of the University Observatory, and Mr. C. C. L. Gregory to be Wilson observer at the Observatory.

WE have received from the Rhodes Trust a copy of a statement for the academic year 1927–28 regarding the Rhodes scholarships. The number of scholars regularly resident at Oxford during the year was 187, namely, 94 from the British Empire and 93 from the United States of America. Natural science and medicine claimed 43 of them, mathematics 7, and economics 7. Among distinctions won by former Rhodes scholars, mention is made of the following appointments: J. J. Tigert (Tennessee), lately United States Commissioner of Education, to be president of the University of Florida; S. K. Hornbeck (Colorado) to be Chief of the Division of Far Eastern Affairs in the Department of State, Washington; and P. H. Rogers (New South Wales) to be a Justice of the Supreme Court of New South Wales. Thirty-one of the Rhodes scholars represented Oxford against Cambridge in athletic contests, and three represented their Dominions at the Olympic games. Of 37 books known to have been published during the year by Rhodes scholars, twenty-five were published in the United States, eleven in the British Empire, and one in Germany. Only three were on scientific subjects.

SCIENCE teaching in rural secondary schools in America is criticised by the professor of rural education, Cornell University, in an article published in the September number of *School Life*, an official organ of the United States Bureau of Education. Teachers have, in general, been too intent upon "drill in dry facts and principles of a formal science which creates no enthusiasms and which should follow an interesting initiation." There has been a general disregard of the connexions between the science studied and the economic, social, æsthetic, and other aspects of rural life, the courses of study and text-books having been planned and written largely from the point of view of the city and its institutions. In the same number of *School Life* another aspect of science teaching is discussed in an article on "Social Hygiene Work by the Parent Teacher Associations." The value of the study of biology has lately been emphasised by the National Congress of Parents and Teachers and American Social Hygiene Association. These bodies are actively engaged in promoting the systematic instruction of children in the facts of human reproduction, and a pamphlet has just been issued by them in which these facts are presented in such a way as to help parents to take their proper share in this task, for which, moreover, parent-teacher study groups are organised for reading and monthly discussions on such topics as "The Way Life Begins," "Sex and Social Health," etc.

SPEAKING of "Science, Industry, and Humanism," in the Taylorian Lecture, 1928 (Oxford: Clarendon Press, 1928), Dr. Abraham Flexner enlarged upon the peculiar function of humanism as the assessor of values. Science and industry have in the past two hundred years transformed the face of the civilised world and profoundly modified human conceptions of the past, present, and future, but neither science nor industry, as such, is concerned to consider in respect of any of its doings, whether it makes for the weal or the woe of mankind. It is for the humanist to elaborate a rational system of values appropriate to the conditions not only of past ages but also of to-day and to-morrow, and thus to influence the direction of human development; and in proportion to the magnitude of the changes wrought by science and industry is humanism's burden heavy. Science has vastly enlarged the scope of human knowledge, human effort, human thought, human imagination: it has given wings to the human spirit. But it ministers also with absolute impartiality to the worst that is within us. Humanism must, it is true, use scientific method in procuring data, in generalising and in interpreting, and in the last century the scientific side of humanistic studies has been strongly emphasised, but the attitude of detachment and indifference proper and necessary to science, must give place in the humanist to the attempt to see things in perspective, to measure, albeit tentatively, the works and doings of the human spirit, scientific, practical, and humanistic as well. The humanist is the custodian of the human ideals evolved through the ages, and he fails to rise to the height of his opportunity if he shrinks from attempting to appreciate the situation of the world of to-day.

Calendar of Customs and Festivals.

ADDENDA. December 24.

A rite practised on Christmas Eve as well as on New Year's Eve in many parts of Great Britain, but especially in the south and west, was that of wassailing the fruit trees. A bowl of cider and a cake from the ritual meal of Christmas Eve or New Year's Eve was taken to the orchard; the cake was placed on a branch of the tree and the cider poured over the trunk. This ensured the fertility of the tree in the coming year. In Sussex a doggerel set of verses—the relic of a charm—was sometimes said as the cider was poured out, while the line, "Give earth and she'll not fail," which occurs in the Hampshire song, clearly shows the intention of the rite.

An interesting example of a blending of pagan and Christian is seen in the Cornish belief that on Christmas Eve the 'little people' (fairies) gathered at the bottom of a mine and celebrated a midnight mass.

December 25.

On Christmas Day a branch of the flowering thorn at Glastonbury was brought to London for presentation to the king and queen. This thorn was the staff of Joseph of Arimathea, who, on arriving at Glastonbury, thrust it into the ground on Dec. 25, when straightway it budded, bloomed, and withered. Henceforth on every Christmas Day it burst into bloom.

Owing to the change in the calendar, some confusion arose in the popular mind as to the date on which the festival of Christmas should be celebrated. This is still seen in the observation of Old Christmas Day on Jan. 6. In Yorkshire, to solve the difficulty, it was customary to listen at the hives of bees, as they began to buzz at the very hour on which Christ was born.

December 31.

NEW YEAR'S EVE.—A number of customs practised on Christmas Eve also appear on New Year's Eve. Such is the custom of 'wassailing,' when children or sometimes young girls go from house to house carrying a wassail bowl decked with ribbons and evergreens, which they offer to the inmates, as they sing a wassail song. Sometimes the wassail bowl was celebrated in the household, when the head of the family prepared a bowl of spiced ale from which he drank the health of the family and then passed it to each member, who did likewise. In Derbyshire this was combined with a form of divination. A cold posset was brewed of milk, ale, currants, eggs, and spice, in which was placed the wedding ring of the hostess. Each one present ladled up the posset. The one fortunate enough to 'catch' the ring would marry within the year.

HOGMANAY.—In Scotland it was customary on the last day of the year, known as Hogmanay, for children to go from door to door to receive gifts. In remoter parts a sheet was worn, doubled up in front to serve as a pocket in which the doles of oaten bread were placed. On coming to each door the children cried 'Hogmanay,' and sometimes a hogmanay song was sung.

The derivation and meaning of the word hogmanay is uncertain. It is recorded that it was an ancient custom in Franconia for the youth of both sexes to go about for two or three days before Christmas singing carols and wishing a happy New Year, for which they received gifts of pears, apples, nuts, and money. It has therefore been suggested that the name of the similar practice in Scotland and the north of England has been derived from a French greeting to the mistletoe, *Au guy l'an neuf*, itself to be traced to the Druids. In France on New Year's Eve bands of young people of both sexes roamed the country in fantastic dress, collecting money for "the lady in the straw," under a leader known as Rollet Follet. As they disturbed the vigils they were forbidden to visit the churches in 1598, and were finally suppressed owing to their disorderly conduct in 1668. Their cry, *Au gui menez tiré liré maint du blanc et point du bis*, has been suggested as the origin of the Scottish "Hogmanay trololay, gi' us o' your white bread and none o' your grey." More learned derivations from the Greek and Hebrew are even less convincing.

Apart from the derivation of its name, the meaning of the custom is clear. It is one of the communal processional customs in which the gift ensures prosperity to the donor, similar to the wassail and the St. Stephen's day procession of the wren. In the Highlands the Hogmanay custom included a sacrificial victim. A man was dressed in the hide of a bull, and was attended by young men, each armed with a staff on which was a piece of raw hide. They ran three times round each house in the direction of the sun, the young men beating the hide of the bull, and at the same time striking the walls of the house. This ensured the incidence of good luck. When they entered the house they uttered a blessing on it, and then singeing the piece of raw hide attached to their staves in the fire, they held it under the nose of each individual and each animal in the house, this ensuring freedom from misfortune, disease, and witchcraft.

In addition to the hogmanay, *guisarts*—boys with blackened faces and in fantastic dress—performed plays, similar to the English mumming plays, including a combat and the death and resuscitation of a principal character. This custom was suppressed by the influence of the Scottish church.

In the north of Ireland, children ensured good luck by going round and throwing twisted wisps of straw in at each door, a custom which may be connected with St. Brigid.

FIRE CUSTOMS.—At Biggar, in Lanarkshire, the old year was 'burnt out.' The day was spent in collecting brushwood and other combustible materials, which were lighted at the 'cross' at nine o'clock at night. Fires were also lighted on the adjacent hills. Everyone present threw some additional material on the flames when the fire had been lighted. The fire was made big enough to last until New Year's morning, so that anyone whose domestic fire had gone out could relight it from the embers, as no one would give a light for a fire on New Year's Day for fear of bad luck.

An even more interesting custom was that of the 'clavie' at Burghead, on the Moray Firth, when a fire of tar and wood was made in a barrel fitted on to a stone pole. It was first lit on the shore, and then, when burning freely, was carried around the bounds of the town. At one time all the fishing-boats were visited. The 'clavie' was then carried to an artificial eminence on a promontory and placed in a hollow in the centre of a pile of stones. After a few minutes the 'clavie' was cut down and the burning embers scattered among the crowd, who snatched them up and carried them home as a protection against witchcraft. With this last act may be compared the custom of preserving a part of the Yule log as a good-luck charm.

In the Isle of Man it was customary for the housewife to rake the ashes of the fire smoothly over the floor of the kitchen before retiring. If in the morning the ashes showed the footstep of a fairy pointing towards the door, it portended a death, but if the heel was in that direction, it betokened an addition to the family.

Societies and Academies.

DUBLIN.

Royal Dublin Society, Nov. 20.—**L. B. Smyth**: On the structure of *Palæacis*. Study of the coral *Palæacis axinoides* sp. nov. (previously recorded as *P. obtusa* Meek and Worthen) from the lower carboniferous rocks of Hook Head, Co. Wexford, revealed the presence of several features not hitherto observed. The young coral attached itself to a shell fragment, or other foreign body. A tissue of unique structure covers the outside of the colony. This tissue, as it increased in thickness by addition to its outer surface, gradually extended over the supporting object, finally enveloping it completely. A complex canal system is present.—**H. M. Fitzpatrick**: Coniferæ: keys to the genera and species, with economic notes. A detailed study has been made of the foliage characters of Conifers, and an identification key based on the external features and arrangement of the leaves, buds, and branchlets constructed.—**J. Reilly** and **D. McSweeney**: William Higgins: A pioneer of the atomic theory. An account was given of the life of the Irish chemist, William Higgins, F.R.S. (1766–1825), with particular reference to his work on atomic chemistry. Throughout a book published in 1789 he uses an atomic notation and anticipates many of the principles and details of Dalton's theory. He was the first chemist to recognise the law of multiple proportions and recognised in some cases the volume law of Gay-Lussac.

LEEDS.

Philosophical and Literary Society, Dec. 4.—**S. Brodetsky**: Equiangular and equilateral polygons in space. Given that an equilateral polygon in space is also equiangular, and given the angle between successive edges, to discover the possible forms for polygons of five and six edges respectively, and whether these forms are rigid or are capable of continuous variations. The problem is considered from the point of view of spherical trigonometry. The results agree with those obtained by Wightman constructionally.—**J. R. Wilby**: Gravitational fields in orthogonal co-ordinates. The problem is to find the natural geometry of a region of space-time, containing a distribution of matter, in the special case in which the space-time is a quadratic form of orthogonal type, and the potentials are functions of two of the independent variables. The problem is considered both for the originals and for the modified forms of the equations of the gravitational field.—**J. Ewles**: On the relation between luminosity and concentration in luminescent solid solutions. The Bruninghaus formula $I = ACe^{-nC}$ is a special case of the formula

$$I = \frac{AC}{(1+C)^{n_1}} + \frac{BC}{(1+C)^{n_2}} + \text{etc.},$$

deduced from simple assumptions in accord with modern views of the luminescent centre. Here C is the atomic concentration of the active atom in the transparent lattice, and n_1, n_2, etc., the number of positive atoms in a luminescent centre. The formula has been tested experimentally with the solid solution phosphor CaO(Bi), and found to be in excellent agreement with the results.—**E. C. Stoner**: Cosmic rays and a cyclic universe. The only source of energy compatible with the observed radiation and Jeans's estimated ages of stars is the annihilation of matter. The interpretation of Millikan's cosmic ray results depends on the absorption formula used. With that of Klein and Nishina the smallest absorption coefficient corresponds closely with the annihilation wave-length. Even if it is assumed that there is an upbuilding of atoms, and the purely speculative possibility of crystallisation of radiation into electrons and protons is admitted, a complete cycle for the universe would involve other improbable processes.—**Mrs. K. Lonsdale**: The symmetry of naphthalene. Carbon atoms having two A and two B valencies can be built up into a naphthalene molecule which has a centre of symmetry only, in agreement with X-ray investigations on naphthalene. The molecule so found also accounts satisfactorily for the differences in the absorption spectra of the ten dichlornaphthalenes.—**J Grainger**: An infectious chlorosis of the dock. Fernow, in America, has described a 'virus disease' on *Rumex obtusifolius*. Experiments have been made on docks with the chlorosis found in England.—**A. Eccles**: The formation of methyl sodiochloromalonate and its reaction with iodine, with remarks on the stability of halogenoethanes. Methyl sodiochloromalonate reacts with iodine solution to yield methyl ethylenetetracarboxylate, no methyl-1 : 2-dichloroethanetetracarboxylate being formed. The instability of compounds of the latter type, and of poly-halogeno-ethanes in general, is explained by an application of the supposition (due to Ingold and Ingold) that the reactivity of the halogen atoms is determined primarily by the relative displaceability of the shared electrons in the carbon-halogen bond.—**Miss R. M. Tupper-Carey**: The development of the hypocotyl of *Helianthus Annuus* considered in connexion with its geotropic curvatures. To account for the two opposite geotropic reactions of the hypocotyl of this plant, a correlation is suggested between the first positive geotropic curvature, induced by nutation, with a stage of active division in the vacuolating cells behind the apical meristem; and between the negative geotropic reaction, which follows slightly later in the same organ, with a region where cell extension only is in progress.

PARIS.

Academy of Sciences, Nov. 26.—**E. Bataillon** and **Tchou-Su**: The anastral mitoses of activation.—Auguste Lumière was elected a *Correspondant* for the Section of Medicine and Surgery.—**G. Cerf**: The elimination of the constants and the singular solutions of a class of Monge's equations.—**H. Roussilhe**: The complete solution of the problem of the map in space.—**R. Audubert** and **Mlle. M. Quintin**: The study of imperfect contacts in continuous currents. The contact silicon-carbon, as well as detectors of the silver sulphide and lead sulphide type, present characteristics composed of two parabolic branches. By its stability and reversibility, it has been proved to be especially simple for the study of the phenomenon of rectification.—**Pierre Lacroute**: The spark spectrum of sulphur, S II, in the Schumann region.—**Paul Soleillet**: The polarisation of the light emitted during fluorescence.—**R. Dubrisay** and **Astier**: Kaolin suspensions. Experiments on the relations between the velocity of sedimentation of kaolin suspensions and the pH of the liquid.—**A. Smits**: The allotropic modifications of phosphorus. Remarks on a recent communication by Nicolaïeff on the same subject. The author does not admit that the curves given by Nicolaïeff prove a fourth allotropic modification of phosphorus.—**A. Travers** and **Malaprade**: Attempts at the isolation of new fluoborates. Boric acid and potassium hydrogen fluoride react in cold, concentrated aqueous solutions, giving crystals which on analysis prove to have the ratio B/K = 1 and F/K = 3.—**Georges Brus** and **G. Peyresblauques**: The ozonide of nopinene. The ozonide $C_{10}H_{16}O_3$ was isolated as a colourless viscous oil, and this, on prolonged boiling with 5 per cent potash solution, gave hydrogen peroxide,

formaldehyde, and nopinone, $C_9H_{14}O$. The yield of nopinone is good, more than 50 per cent.—**Raymond Ciry**: The structure of the southern edge of the primary massif of the Asturias.—**P. Fallot** and **R. Bataller**: Geological observations on the region of Velez-Rubio (Prov. of Almeria).—**Léon Moret**: The post-Hercynian stratigraphy of the southern slope of the High-Atlas in Glaoua (Morocco).—**J. Thoulet**: Deep submarine volcanoes and the double oceanic circulation. There exists in the ocean a double circulation between the upper and lower zones, one of solar origin and the other of internal volcanic origin, and the chemical and physical homogeneity of the sea water is caused by this double circulation.—**R. Combes**: The influence of traumatisms on the migration of substances in plants. In a recent communication the Sachs' method has been proved to be untrustworthy, due to the removal of portions of the leaf, and the effects of this traumatism on the exchanges of material between the organs.—**P. Gavaudan**: The presence of a parasitic fungus in the antheridia of *Marchantia polymorpha* and its action upon gametogenesis.—**Aug. Chevalier**: The origin of the Brazilian campos and the rôle of Imperata in the substitution of prairies for tropical forests.—**R. Leriche** and **R. Fontaine**: The existence in Vieussens ring of fibres sensitive to pressure effects. The importance of this for the surgical treatment of angina pectoris.—**Jean Saidman** and **Roger Cohen**: The properties of rays of wave-length 4–8 A. Clinical experiments show a marked difference between the action of rays of 6–8 A. and filtered rays of about 4 A. The effects of the latter resemble those produced by ordinary X-rays.—**L. Mercier**: The polymorphism of the male (pœcilandry) in *Cynomyia mortuorum*. Its signification.—**P. Bunau-Varilla**: Verdunisation in the contest against yellow fever. The application of the same prophylactic measures in the Gulf of Mexico and in western Africa have given different results: in the former there is an almost complete disappearance of the infection, whilst in the latter recurrence is frequent. The author gives reasons for supposing that the superiority of the American results is due to the chlorine treatment of the drinking water.—**Mme. Phisalix**: Vaccination against viper poison and experimental rabies by virus-venom mixtures with the virus in excess.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (2nd class, Natural Sciences and Medicine), Nov. 23.—**Zd. Frankenberger**: A study on spermatogenesis of reptiles (Part 2).—**E. Votoček** and **F. Valentin**: Rhamnoconvolvulic acid. Separated from 'resina jalapæ e radice ponderosa' by the action of baryta, the new well-defined, crystalline glycosidic acid, $C_{52}H_{92}O_{32}$ yields on hydrolysis, with 10 per cent sulphuric acid, 1 mol of a di-hydroxypalmitic acid, 4 mols of *d*-glucose and 2 mols of *l*-rhamnose.—**R. Lukeš**: Some derivatives of lævulic acid. A new method of preparation of fatty acids.—**R. Lukeš** and **V. Prelog**: Aryl-substituted amines of lævulic acid. The synthesis of some hydropyrrolic derivatives from *p*-dibromobenzene treated with Grignard's reagent. A contribution to the refracto-chemistry of lactones.—**V. Posejpal**: Resonance spectra and the Raman effect. The 'resonance' spectra of iodine and sodium vapour verify the author's assumption that in fluorescence and phosphorescence an effect analogous to Raman's is exhibited by an infra-red absorption band of iodine at 45·86–55·90 μ and one of sodium at 64·9–75·0 μ.—**K. Zavadský**: The statocysts of Amphipoda.—**Fr. Němejc**: Some interesting discoveries of fossil plants from carboniferous basins of middle Bohemia.—**K. Cejp**: Contributions to the anatomy and morphology of respiratory organs of some Marchantiaceæ.—**J. Mirovský**: Results of statistical methods on the variability of two species of *Closterium*.

ROME.

Royal National Academy of the Lincei, June 17.—**G. Armellini**: Variations in the diameter of the sun from 1901 to 1911, according to observations at the Royal Campidoglio Observatory. The horizontal radius of the sun has shown a regular increase from a minimum of 960·70″ in 1897 to a maximum of 961·88″ in 1908, after which it diminished, regularly except for the year 1910, to 961·67″ in 1911.—**L. Lombardi**: Measurement of the local dissipations of energy in a circumscribed part of the magnetic circuit.—**A. Angeli** and **R. Poggi**: The mobility of certain halogen atoms. The fact that aromatic compounds of the form $CH_3O \cdot C_6H_4 \cdot CH_2Cl$ and the analogous aliphatic compounds $CH_3O \cdot CH_2Cl$ readily lose the halogen as hydrogen chloride when treated with water or alcohol, is attributed to the linking of the halogen to the alkoxyl residue to give an oxonium derivative. The spontaneous loss of methyl chloride by chlorotrianisylmethane, with production of an amorphous substance, finds a parallel in the behaviour of the compound $CH_3O \cdot C_6H_4 \cdot CH_2Cl$, which similarly yields a complex substance having the characters of synthetic resins. The formula of hydrated formaldehyde, $OH \cdot CH_2 \cdot OH$, which exhibits a marked tendency to polymerisation, is analogous to that of salicyl alcohol, which readily forms resinous compounds.—**N. Parravano** and **G. Malquori**: Thermal decomposition of Bayer alumina. The thermal decomposition of Bayer alumina, Al_2O_3, $3H_2O$, results in the formation of lower hydrates, possibly Al_2O_3, $2H_2O$ and certainly Al_2O_3, H_2O, before the anhydrous oxide is reached.—**P. Vinassa**: Symmetrical electronyls and polyatomic molecules. Application of the considerations previously advanced in regard to monatomic molecules to the case of nitrogen, the halogens, and oxygen, which cannot have monatomic molecules, indicates that allotropy is confined to substances with other than monatomic molecules. Allotropy must, indeed, be regarded as due to varying peripheral electronic grouping in the polyatomic molecule.—**Vladimiro Bernstein**: Additions to the note on interpolation by means of holomorphic functions in a semi-plane.—**E. Gugino**: The profile of rotating bodies the deformation of which is not disturbed when the bodies are cut into sections by planes normal to the axis.—**H. Geppert**: Progressive waves of permanent type in circular vessels.—**N. Mouskhelichvili**: The fundamental problem of two-dimensional hydrodynamics.—**L. Masciotti**: Investigation of the thread of the micrometer screw of the Ertel meridian of the Royal Campidoglio Observatory.—**A. Rostagni**: Application to geophysical investigations of T. Levi-Cività's theory relating to the influence of a conducting screen on the electromagnetic field of an alternating current parallel to the screen.—**F. Rasetti**: Wave mechanics of an alkaline atom in the electric field (2). The theory, previously developed, of the perturbation due to an external electric field on an atom of an alkali metal, is applied to the case of lithium. Lack of experimental data prevents checking of the results attained, but the known order of magnitude of the dielectric constants of vapours of alkali metals coincides with that deduced.—**A. Carrelli**: Width of certain lines of the mercury spectrum. The breadths of eleven mercury lines, especially of the anomalous *mP* series, are considered in relation to the internal and azimuthal quantic numbers.—**P. Misciatelli**: Separation of thorium from uranium by means of ether. If anhydrous ether and anhydrous salts (dried at 120°) are used,

complete separation of uranium nitrate from thorium nitrate may be effected, provided that the procedure is such that the ethereal solution becomes saturated with the uranium salt at that temperature. The increase in solubility of the thorium as the temperature falls may be due to the formation of complex compounds.—**G. Natta** and **M. Strada**: Spinels of tervalent cobalt: cobaltous cobaltite and zinc cobaltite. Zinc cobaltite, $ZnCo_2O_4$, may be prepared by calcining a mixture of zinc and cobalt nitrates. Comparison of the X-ray photograms of this compound and of cobaltous cobaltite, Co_3O_4, shows that the two are isomorphous, both crystallising in the cubic systems with a lattice of the spinel type. The unit cells have identical dimensions, the side being $8{\cdot}06 \pm 0{\cdot}005$ A., and the respective calculated densities are 6·11 and 6·27.—**P. Agostini**: Heats of formation of double chlorides of copper and potassium. The mean value obtained for the heat of solution of $CuCl_2$, 2KCl is −1·63 Cal. and the heat of formation from the constituent chlorides, +4·09 Cal. For $CuCl_2$, KCl, the corresponding values are +2·181 Cal. and +4·59 Cal.—**F. De Carli**: Heats of formation and hydration of cobalt potassium carbonate and copper sodium carbonate. The following results have been obtained: $K_2CO_3 + CoCO_3 = K_2CO_3$, $CoCO_3 + 5{\cdot}76$ Cal.; K_2CO_3, $CoCO_3 + 4H_2O = K_2CO_3$, $CoCO_3$, $4H_2O + 11{\cdot}37$ Cal.; $Na_2CO_3 + CuCO_3 = Na_2CO_3$, $CuCO_3 + 10{\cdot}33$ Cal.; Na_2CO_3, $CuCO_3 + 3H_2O = Na_2CO_3$, $CuCO_3$, $3H_3O + 9{\cdot}296$ Cal.—**S. Berlingozzi**: Derivatives of *d l*-asparagine.—**A. Ferrari** and **A. Baroni**: Importance of crystalline form in the formation of solid solutions. (2) Thermal analysis of the anhydrous system $LiCl - CdCl_2$. Thermal analysis of this system reveals the existence of the compound $3CdCl_2$, 4LiCl, melting at 522° and confirms that of 3 $CdCl_2$, 2LiCl, melting at 516°. Complete miscibility in the solid state exists between these compounds and the pure chlorides.—**N. A. Barbieri**: Physiological culture.—**A. Quilico** and **E. Fleischner**: Sulphonic derivatives of unsaturated compounds. The use of aminosulphonic acid as a sulphonating agent has been applied to the preparation of sulphonic derivatives of styrene, anethole, isosafrole, and isoapiole.—**L. Scremin**: Variations in the ionic equilibrium as factors in pharmacological action. Widely varying proportions of calcium chloride are necessary to inhibit the action of different convulsant drugs, pyramidone being highly sensitive to this salt.—**O. M. Olivo** and **E. Slavich**: Frequency of mitosis in the embryonal heart of the chicken in various stages of development and in cultures *in vitro* of the same material.

SYDNEY.

Linnean Society of New South Wales, Sept. 26.—**W. D. Francis**: Features of the vegetative anatomy of the Australian white beech (*Gmelina Leichhardtii*). The anatomy of the tree is outlined. Hesperidin or a hesperidin-like substance, which was found in the branchlets and leaves, may be a secondary product of photosynthesis and it may be used in the construction of wood. Gmelinol may be a partial decomposition product of the wood.—**A Théry**: A new buprestid from Australia. Description of a new species of *Mastogenius* from Victoria. The genus, now first recorded from Australia, is known from Chile, Brazil, United States, Grenada, and Transvaal.—**G. H. Hardy**: Third contribution towards a new classification of Australian Asilidæ. An account of the prothorax in the Dasypogoninæ. Two new tribes are proposed, one left unnamed pending further information, but under it the genus *Cryptopogon* White is redefined, a second species, *C. obscurus*, being incorporated as new. Laphriini, a tribe previously formed and regarded as complex, is now divided, a new tribe following a group previously proposed by Hermann.—**A. B. Walkom**: Fossil plants from the Esk District, Q. Twenty-two species are dealt with, of which eight are described as new, and three others are recorded for the first time from the Esk Series. The new species confirm previous determinations of the age of the series as Upper Triassic (possibly Rhætic).

VIENNA.

Academy of Sciences, Oct. 18.—**W. J. Müller** and **K. Konopicki**: The theory of passivity phenomena. (3) The current-density time curve in the case of covering passivity.—**R. Weiss** and **W. Knapp**: The action of *o*-phthalyl-chloride on *p*-cresol-methyl-ether and *p*-thio-cresol-methyl-ether.—**A. Müller** and **P. Bleier**: Reduction of cyclo-hexa-nonisoxim (α-keto-hexa-methylene-imin).—**A. Kailan** and **E. Leisek**: The decomposition of persulphates in aqueous solution. Coefficients were found for the decomposition of sodium persulphate in the presence and in the absence of sodium hydrogen sulphate, of sulphate, of nitrate, of hydroxide, of phosphates. Potassium persulphate decomposes more slowly than sodium persulphate.—**R. Weiss** and **S. Kratz**: The action of *o*-tolyl-magnesium-bromide on the dilacton of benzophenon-*o*-dicarboxylic acid.—**C. A. Bobies**: Geological studies in the Tertiary of Triesting- and Piesting-bay.—**O. Koller**: The geographical distribution of fresh-water fishes in southern Europe.—**H. Priesner**: Australian Thysanoptera.—**W. Frenzel**: Nutrition and colour formation in *Chlorosplenium acruginosum*. This fungus, which causes the green rot of wood, may be grown in pure culture, starting from the ascospores, from infected wood, or from fragments of the fruit body. Growth is slow; it attacks pith and rays, it penetrates vessels, it is ærobic, and has a wide range on the acid side of neutrality. Colour formation increases up to about 26° C. The colouring matter is dissolved by phenol and slowly precipitated by alcohol; it is easily reduced to red or yellow products, easily reoxidised to green; it is an indicator for alkalies.—**M. Gleispach**: The influence of vapours and gases on the fall of leaves and removal of other organs.—**A. Paltauf**: The staining of living cell nuclei. Erythrosin, eosin, and dahlia-violet gave clear positive results. The nuclear staining was favoured by addition of nitrates, also by alcohol and by ether. Cells with coloured nuclei can still be plasmolysed or deplasmolysed. Rise of temperature promotes staining.—**G. Koller** and **H. Ruppersberg**: An unusual mode of preparing 2-amino-pyridine. By heating 2-chloro-pyridine with pure pyridine.—**F. Wessely** and **J. Mayer**: Carbonyl-bisamino acids and their transformation products. Stereometric considerations are involved.—**R. Dworzak** and **A. Enenkel**: The bromination of valeraldehyde.—**R. Dworzak** and **W. Prodinger**: Studies on bromo- and oxy-aldehydes. (3) Preparation of crystallised lactic acid aldehyde and its behaviour towards dilute aqueous alkalies.—**H. Mache**: Rutherford's alternating field method for determining the velocity of gaseous ions.—**A. Skrabal** and **M. Rückert**: The velocity of saponification of mono- and di-chloracetic-acid ester.—**F. Hölzl**: The alkylisation of octocyano-tungstic acid.—**O. Dischendorfer** and **O. Polak**: Researches in the field of phyto-chemistry. (5) Allobetulin.—**S. Meyer**: Communication of the Radium Institute (No. 226). Comment on the relations between the atomic weights of uranium, radium, radium-G, and helium.

Oct. 25.—**T. Schmid**: The coincidence problem in the descriptive geometry of four-dimensioned space.

Official Publications Received.

BRITISH.

Journal of the Chemical Society: containing Papers communicated to the Society. November. Pp. iv+2827-3093+x. (London: Gurney and Jackson.)

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1927. Pp. vi+123. (London: H.M. Stationery Office.) 4s. net.

The Indian Lac Association for Research. Bulletin No. 1: Physical Properties of Shellac Solutions, Part 1. By M. Rangaswami and M. Venugopalan. Pp. 14. (Nankum.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 39, Part 3. Pp. 223-368+plates 13-23. (London: Edward Stanford, Ltd.) 7s.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 37: Paper-Pulp and Cellulose from the Eucalypts by the Sulphite Process. By L. R. Benjamin and J. L. Somerville. Pp. 84. Pamphlet No. 9: A Forest Products Laboratory for Australia; Justification for its Creation, Outline of its Organisation and Rough Estimate of Cost. By A. J. Gibson. Pp. 28. (Melbourne: H. J. Green.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 15, No. 3, November. Pp. 735-879 (Plymouth.) 5s. net

FOREIGN.

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 44: On the Interference of Wind Tunnel Walls of Rectangular Cross-Section on the Aerodynamical Characteristics of a Wing. By Kwan-ichi Terazawa. Pp. 69-81. (Tōkyō: Koseikai Publishing House.) 0.17 yen.

University of California Publications in Zoology. Vol. 30, No. 13: The Molts of the Loggerhead Shrike, *Lanius ludovicianus* Linnæus. By Alden H. Miller. Pp. 393-417. 30 cents. Vol. 32, No. 1: A Distributional Summation of the Ornithology of Lower California. By Joseph Grinnell. Pp. 300. 3.75 dollars. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

Bergens Museum. Årsberetning, 1927-1928. Pp. 112. Bergens Museums Årbok 1928. Naturvidenskapelig rekke. Hefte 2. Pp. 52+49. (Bergen: A/S John Greigs Boktrykkeri.)

Diary of Societies.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (II.): Signalling in Air and Water.

MONDAY, DECEMBER 31.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Madame Gabrielle M. Vassal: A Journey through French Indo-China (Christmas Lectures to Young People) (I.).

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (in Botanical Theatre, University College), at 5.30.—Dr. P. B. Ballard: The Psychological Basis of the Break at Eleven Years of Age.

TUESDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (III.): Notes and Noises.

TELEVISION SOCIETY (at Engineers' Club, Coventry Street), at 8.—J. C. Rennie: Scanning Methods used in Television.

WEDNESDAY, JANUARY 2.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Capt. P. P. Eckersley, T. L. Eckersley, and H. L. Kirke: The Design of Transmitting Aerials for Broadcasting Stations.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—G. Wilkinson: Economic Application of Electricity to Low Temperature Heating Purposes.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, JANUARY 3.

ROYAL SOCIETY OF ARTS, at 3.—Capt. Sir Arthur Clarke: Ships and Lighthouses (Dr. Mann Juvenile Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (IV.): How Sounds are Analysed.

LINNEAN SOCIETY OF LONDON, at 5.—C. E. Moss: A New Genus of the Hydrocharitaceæ from the Zambesi.—G. S. Carter and L. C. Beadle: (*a*) The Fauna of the Swamps of the Paraguayan Chaco in Relation to its Environment. I. Physico-chemical Conditions of the Environment; (*b*) Notes on the Habits and Development of *Lepidosiren Paradoxa*.—W. A. Cunnington: The Argulidæ of the Expedition to Brazil and Paraguay.—R. Gurney: The Branchiopoda of the Expedition to Brazil and Paraguay.—E. Meyrick: The Microlepidoptera of the Expedition to Brazil and Paraguay.—J. Stephenson: The Oligochæta of the Expedition to Brazil and Paraguay.—H. W. Parker: The Amphibia and Reptilia of the Expedition to Brazil and Paraguay.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Society) (in Chemical Department, Bristol University), at 7.30.—Prof. W. E. Garner: Some Properties of Flame and Combustion.

FRIDAY, JANUARY 4.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Dr. H. R. Mill: Capt. Cook and the Great Southern Continent (Christmas Lectures to Young People) (II.).

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—W. H. Lawes and others: Discussion on Precautions in the Use of Standard Instruments.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Major A. W. Farrer: The Engineer Salesman Abroad.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.—Discussion on the Prints in the Holcroft Collection.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—K. W. Willans: The Geared Steam Locomotive.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. K. W. Earle: Previous Land Connexions in the Lesser Antilles (Lecture).

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea).—A. Grounds: Preparation of Coal for the Market.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (V.): The Ear and What it Does.

PUBLIC LECTURES.

FRIDAY, JANUARY 4.

IMPERIAL COLLEGE OF SCIENCE, at 5.30.—Dr. R. Campbell: Mountains and their Origin (Swiney Lectures). (Succeeding Lectures on Jan. 7, 9, 11, 14, 16, 18, 21, 23, 25, 28, and 30.)

SATURDAY, JANUARY 5.

NEW EDUCATION FELLOWSHIP (English Section) (in Library, Central Hall, Westminster), at 5.30.—Sir Michael Sadler: Examinations.

CONGRESSES.

DECEMBER 31 TO JANUARY 5.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Monday, Dec. 31, at 3.—Earl of Lytton: Some Aspects of the Problem of Education in India (Presidential Address).

At 5.30.—British Psychological Society (Education Section).—Dr. P. B. Ballard: The Psychological Aspect of the New School Organisation.

Tuesday, Jan. 1, at 2.30.—Society for Experiment and Research in Education.—J. H. Whitehouse and others: Ruskin and Education.

At 3.—School Nature Study Union.—Dr. C. Tierney: Nature's Architecture.

Wednesday, Jan. 2, at 2.30.—Royal Drawing Society.—Rev. S. A. McDowall and others: The Value of Drawing to the Study of Science.

At 5.—Prof. H. G. Fleure, Miss M. D. Brock, E. R. Thomas, A. Saywell, and others: Joint Conference on The Influence of Examinations on Education.

Friday, Jan. 4, at 11 A.M.—British Broadcasting Corporation.—Demonstration of Educational Broadcasting.

At 2.30.—Medical Officers of Schools Association.—Dr. A. A. Mumford: Physical Activity and Physical Training in Relation to Scholastic and University Progress.

JANUARY 2 TO 5.

SCIENCE MASTERS' ASSOCIATION (at Cambridge).—Prof. A. C. Seward: Presidential Address.—Prof. A. S. Eddington: The Interior of a Star.—Prof. T. M. Lowry: The Arrest and Promotion of Chemical Change.—J. T. Saunders: Raising Animals in Cultures and their Use.—Prof. E. V. Appleton: Large Scale Optical Experiments.—Sir William Pope: Colour Photography.—Prof. J. Barcroft: Hæmoglobin.

JANUARY 3 TO 5.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Thursday, Jan. 3, at 11.30 A.M.—Prof. J. Sölch: Geomorphological Problems of the Eastern Alps.

At 5.—Dr. P. W. Bryan: Natural Environment related to Human Activity in the Corn Belt of N. America.

At 6.15.—W. Clayton and others: Discussion on Rural School Work: Geography in the Rural School.—Miss E. N. Broom and others: Discussion on Preparatory School Work: Outdoor Geography.—Miss E. G. R. Taylor and others: Discussion on Senior and Central School Work: Sketch Maps: the Shorthand of Geography.

Friday, Jan. 4, at 10 A.M.—E. J. Orford and others: Discussion on Educational Re-organisation and the Teaching of Geography.

At 11.45 A.M.—Sir H. G. Lyons: The Geographer and his Material (Presidential Address).

At 2.30.—Prof. C. B. Fawcett: The Balance of Urban and Rural Populations.

Saturday, Jan. 5, at 10.30 A.M.—Dr. Vaughan Cornish: On Linguistic Frontiers in Central Europe dating from Heathen Times.

At 11.45 A.M.—Hon. Secretary: Summary of the Results of Discussions held on the previous days.

JANUARY 3, 4, AND 5.

NORTH OF ENGLAND EDUCATION CONFERENCE (at Heaton Secondary Schools, Newcastle-upon-Tyne).

Thursday, Jan. 3, at 11.15 A.M.—The Marquess of Londonderry: Presidential Address.

At 2.45.—Miss E. R. Conway and others: School Books.

Friday, Jan. 4, at 10 A.M.—A. R. Pickles and others: Fireplace Examinations.

At 11.15 A.M.—Miss L. Jowitt and others: Social Activities in Education

At 2.45.—A. Watson and others: Education in Relation to Industry and Commerce.

Saturday, Jan. 5, at 10 A.M.—F. A. Hoare and others: League of Nations and the Schools.