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CONTENTS

Industrial Research

PARTICULAR attention is given to the work and position of industrial research associations in the annual report of the Department of Scientific and Industrial Research issued a few days ago. The reason for this is that the fund of one million pounds granted by Parliament nearly sixteen years ago for the promotion of industrial research in Great Britain, through research associations, has now been exhausted, and the time has come for the whole subject to be surveyed, as well as for the consideration of a policy for the future. When an industry is protected by a tariff, the State should demand in return that the industry is maintained in a condition of progressive efficiency ; and this can only be achieved through continued developments of methods and processes. Some large industrial concerns are in the position to maintain extensive research departments themselves ; but if the existence of these establishments means that the co-operative work of the industrial research associations is left to smaller firms, and that some of the associations have to close down for lack of adequate financial support, the result, from a national point of view, will be unfortunate—to say the least.

The Department of Scientific and Industrial Research was formed during the War as the result of a memorial from the Royal Society and other scientific and technical societies to the Government in May 1915 urging that assistance should be afforded "for scientific research for industrial purposes". In response to this appeal, a Committee of Council, presided over by the Lord President of Council, was constituted, with an Advisory Council of scientific men and industrialists. The functions of this Council were : (1) To act as scientific advisers to all Government departments concerned with, or interested in, scientific research. (2) With the co-operation of scientific societies, to consider the application of science to industry and enlist the interest of manufacturers. (3) To advise the Board of Education as to steps which should be taken to increase the supply of workers competent to undertake scientific research.

In the year 1917 Parliament placed a sum of one million pounds sterling at the disposal of the Committee of Council for the promotion of industrial research ; and a scheme was drawn up for the establishment of research associations connected with various industries, each of which

was to receive for five years a grant on a fifty-fifty basis in aid of its expenses. From the first, the guiding principle of the Department of Scientific and Industrial Research has been to induce the industries to do things for themselves rather than to attempt to do scientific work for them. In the fifteen years during which the million pound fund was available, five thousand or so firms contributed £1,750,000 to the support of their industrial research associations, and there are nineteen such associations now in existence. At present Parliament provides £65,000 a year and industry £170,000 towards the support of these associations. Most of the associations have established their own research laboratories, but others have their investigations carried out at the National Physical Laboratory and in universities and similar institutions.

The industrial research associations represent, however, only one side of the activities of the Department, which has also established a number of special stations on a large scale for building research, chemical research, food investigation, forest products research, fuel research, radio research, and water pollution research. During the past year, seventy-six per cent of the expenditure of the Department has been used for these stations and thirteen per cent in support of industrial research associations.

Although the Department has done a great deal to encourage fundamental scientific research in universities and other institutions, and is in close co-operation with the Royal Society, which receives an annual grant from the State in aid of purely scientific investigations, quite properly there has been no attempt to organise such research. Such a proceeding would be repugnant to the best research workers. At the same time no expenditure has ever earned such big dividends for industry and for the community as the money spent on pure research. One has only to think of such things as the modern electric lamp, the wireless valve and the photoelectric cell—products of pure research on atomic physics—to realise this. Although the majority of new knowledge which springs from fundamental research undoubtedly finds its application in industry, nevertheless the lag between scientific discovery and its use in industry has in the past been far too long.

Leaders of industry are finding that the methods followed by the men of science in approaching their problems can be followed with advantage in tackling many of the problems confronting modern industry. The result of this during the last few years has been the organisation of research sections in many of the larger industrial concerns, and the formation of the industrial research associations to serve the interest of industries where the units of production are similar.

One of the best illustrations of the way that science is strengthening the chains of production is that of one of our oldest industries, the wool trade. In the first place, wool is not a standardised raw material; many factors such as soil, climate, disease, gland secretions, food and management affect the quality of the wool. The influence of all these factors on fibre qualities such as strength, diameter, elasticity and so on, which play an important part in manufacture, are being scientifically investigated. Methods of controlling them are being sought with the view of reducing variations in the quality of the raw material. In the second place, the older methods of processing the wool, have, in the case of nearly all our older industries, been worked out without conscious planning. The methods of science are therefore being applied in the technical improvement of these processes, and ways are being sought through the application of science for cutting costs and increasing efficiency.

The first of these two aspects of wool research concerns the big wool-growing countries, Australia and South Africa, and the work on these aspects is being carried out in Australia, for example, under the Commonwealth Department of Scientific and Industrial Research. The link, however, between that work and inquiries seeking to discover how wool qualities are affected by feeding and by the soil, is the Wool Industries Research Association. The Association has suggested that elasticity is directly connected with the sulphur content of the wool fibre. It has been found that sheep obtain sulphur in the form of a protein called 'cystine', and accordingly experiments are in progress overseas on the effect of extra cystine with the object of raising the sulphur content of the wool. Similarly fineness in the wool may be due to deficiency in phosphorus.

The same kind of link between the Empire grower and the manufacturer is maintained by the Shirley Institute, which is the Research Laboratory of the British Cotton Industry Research Association, where there is a staff of more than 200, of whom about 70 are fully qualified scientific investigators. The income of the Association is well over £50,000 a year, four-fifths of which is

subscribed by the trade and the remainder by the Department of Scientific and Industrial Research. Eighty per cent of the cotton firms in the country engaged in all parts of the industry from spinning to finishing are members of the Association. The work of the Association has resulted in producing a large number of small improvements which altogether reach a substantial total. It has been calculated that a saving of something like £300,000 a year is being effected in Lancashire by the research carried out by the Research Association. This gives a return of about 500 per cent on the money invested in research.

One of the most productive researches ever carried out under the auspices of the Department depended mainly on the measurement of the conductivity of heat of soils and insulating materials. Cables distributing electric power in populated areas are, of course, put underground. The electric currents naturally heat them, and the amount of current they can carry depends on the rate at which this heat is conducted away. Accurate measurements on this point, carried out on behalf of the Electrical and Allied Industries Research Association, indicated that the heat conducted away was in most cases greater than had been supposed. It was therefore shown that existing cables could be further loaded with safety to an extent representing a capital value in cables of £4,000,000.

Related to this subject are investigations into the deterioration of lead sheath cables arranged by the Non-Ferrous Metals Research Association and carried out at the Research Department, Woolwich. Lead sheath cables, though generally excellent in service, were found to suffer failures on board ship, in submarine and aerial cables where movements by tide or wind could occur, in railway service of bridges, in tunnels and, in fact, in all positions where they suffer exceptional vibration. The breakdowns were very troublesome as the failure started from the inner part of the sheath and could not be seen until a complete breakdown of the sheath took place. The cause was investigated by the Research Association, which was able to produce two new ternary alloys of lead containing lead-cadmium-antimony and lead-cadmium-tin which have a fatigue resistance three and a half times as great as the ordinary pure lead. These alloys have solved the problem with regard to the deterioration of lead cable sheathing. It may be remarked that 80,000 tons per annum are used in Great Britain for this purpose and in the United States one company alone uses 75,000 tons of lead for the sheathing of telephone cables. The new alloy is used on the new Post Office submarine telephone cable to France. In addition to this better fatigue resistance, the new alloy is also at least fifty per cent stronger than pure lead in other respects, and it is therefore likely that it will have a great future for improved water pipes.

These examples selected from recent reports illustrate the bearing of scientific research upon industrial progress and commercial profits. It would be easy to advance many others to show that scientific research should be looked upon not as a last resource but as an essential part in the business of production. It is now generally recognised that the initial advantages which Great Britain secured through her island position, her natural resources, and the technical skill of her workers, are no longer sufficient in themselves to enable our manufacturers to withstand the organised and scientific rivalry of competing countries. The full utilisation of the results of scientific research, and the substitution of scientific for empirical methods can, however, only be secured as a result of confidence in the scientific workers engaged in the study of the problems concerned and of acquaintance with the existence and value of this large body of scientific knowledge and research.

Although scientific methods are much more widely used in almost all our industries than even a few years ago, there is not yet a general disposition to accept an adequate and sustained programme of research as a fixed charge, comparable with insurance, depreciation, obsolescence, etc., without which no industry can progress, if indeed it can survive. Science, whether in its broadest aspect or its narrow technical sense, will not occupy its proper place in industry until the industrialist is prepared not merely to admit its possibilities and accept its occasional assistance but also to incorporate it as part of his industrial practice. Such incorporation involves not merely the support of research work, whether conducted in his own laboratories or outside, or in co-operation with other firms, but also continuous contact with research in matters of interest to his industry, wherever that research is prosecuted.

With such convincing records as those mentioned in the report of the Department, of the financial advantage and public benefit derived from scientific research, particularly in the province of electrical engineering, it would seem to be unnecessary to urge that electrical manufacturers

and supply companies might reasonably be expected to devote a fraction of one per cent of their profits to research, whether in university laboratories or by co-operative effort. Leaving purely scientific investigations out of consideration, there are many technical problems awaiting solution, and great savings and economies may be confidently anticipated from systematic research into them, yet the funds provided to the British Electrical and Allied Industries Research Association for such work are a very poor return for benefits received or belief in favours to come. The annual revenue of the electric supply authorities in Great Britain is about £45,000,000, and so far their annual contribution to the funds of the Association has only reached about £5,000, though they are benefiting by research done or nearing completion to the extent of a sum approaching £1,000,000 per annum. If the public attention given to the recent report of the Department of Scientific and Industrial Research should lead to a wider understanding and more generous recognition of both scientific and industrial research from manufacturers and corporations who profit by the results, it will have achieved a most useful national purpose.

Numbers and Numerology

Numerology. By Prof. E. T. Bell. Pp. vii+187. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 11*s*. 6*d*.

"EVERYTHING is Number!" Thus spake the son of Mnesarchus. Ever since these words were uttered, not only have philosophers vied with each other to find a correct interpretation of them, but also the world has turned its back to the fact-finding approach to human affairs and still enjoys the rhetorical approach of numerology. Pythagoras was thus the founder of esoterism and arithmosophy as well as of science and philosophy. If the number of followers of any particular doctrine are to be taken as a criterion of its value, then esoterism and arithmosophy may well be given the palm.

The predominance of number in the world of appearance is obvious. Ancient religions and ancient philosophies recognise a quantitative order in the universe, whatever be their conceptions about its origin. The rhythm of life, the rhythm of Nature and the rhythm of the heavens have always appealed to the imagination of man. Number and proportion, its subtler aspect, dominate the practical arts of man. Without number, there would be no commerce, no architecture, no medicine, no religious cults, and none of the crafts appearing between these landmarks of human interests. This profound truth must have been revealed to Pythagoras by the sages of the East with whom he came into contact, and was probed by his own observations and meditations. For example, his exaltation in submitting the imponderable vibrations of sound to the law of number, inspired him with his famous doctrine of the harmony of the spheres, when he dogmatically imposed certain numerical proportions between the celestial bodies and their movements. It is this Pythagorean spirit which Plato inherited, as is shown in the "Timæus", where he builds up the universe by means of numerical proportions and geometrical figures, a process which culminates in the construction of the five regular solids. Moreover, we believe it is not far from the truth to assume that Euclid himself had a Pythagorean vision before him when he wrote his everlasting "Elements". It is significant to observe that his thirteen books end with the construction of the regular solids, as if their author were not interested in the other types of curves and solids already known in his time, once he had given to the world the rational steps leading to the understanding of the wonderful figures with which Plato had created the soul and the universe.

This spirit, dormant during the Middle Ages, which were more interested in ethical numerology, becomes supreme again during the Renaissance. The mathematisation of astronomy by Copernicus and Kepler, and the foundation of modern mechanics by Galileo on the firm ground of number, were in the best Pythagorean tradition. So also was the establishment of analytical geometry by Descartes, a new science which may be considered as a refined form of the arithmetical geometry of Pythagoras. Again, the invention of the calculus by Newton and Leibniz gave the man of science new tools for combining his mathematical picture of the universe. Ever since, not only have astronomy, physics and chemistry come more and more under the influence of the law of number, but also biology, psychology and sociology. Indeed, the most comprehensive thought ever conceived by man is short: the cosmos is isomorphic with pure mathematics; an obvious generalisation of the old Pythagorean saying that everything is number. At present,

we do not know whether it is a great though simple truth or whether it is just nonsense. But we cannot turn our backs on it, though theories are brought forward and discarded with disconcerting speed. In this respect, one may quote the case of Lord Kelvin, who endeavoured to paint one grand inclusive picture of the physical universe which would tell the whole story for ever; the only occasion when he shocked his followers was towards the end of his life, when he summed up his long search by describing it as a failure. Yet the same spirit pervades the younger generation, with the difference that instead of trying to construct dynamical models of the universe, they content themselves with purely mathematical maps. If a set of differential equations correctly describes the electromagnetic field, why look further? So we are told by Sir James Jeans that God himself is a pure mathematician.

If men of science profess such a divine consideration for mathematics, why not allow other types of number-worshippers to discover some numerical relations in the world of ethics and religion? The Pythagoreans maintained that virtue, as well as health, is a harmony obeying certain numerical proportions. Justice is also a reciprocal proportion; and friendship is a relation of equality, a belief illustrated by the 'amiable numbers' which are such that each is equal to the sum of the aliquot parts of the other. It is considerations of this kind which inspired the systematic researches of cabbalism, occultism and onomantic astrology. We ought not to laugh at such beliefs: even to-day, more people believe in lucky and unlucky numbers than in the mathematical expression of the external world.

The belief that mathematics can explain everything seems to be due to the fact that it has always been considered as the simplest and strongest manifestation of reason. So that, if the world is rational, then by studying mathematics in itself, the intellect penetrates more and more into the essence of things. This faith in the power of mathematics has been increased of late, with the growing assimilation of mathematics to logic. But then, how can one explain the reason of so many failures in science and of the general inconclusiveness of numerology? The difficulties in both cases are similar to those which account for the failure of primitive Pythagorism. In the simple figure of a square, the Master himself could not find a common measure, a number, between its side and its diagonal. If everything is number, how then can we explain the impossibility of finding a number expressing the relation between these two lines? No wonder the discovery of these 'irrationals' was kept secret in the inner ring of the Italic school, and their revelation cast doubts on the leadership of the Master. Thus number which caused the greatness of the Pythagorean order, also caused its breakdown. The efforts of the later mathematicians, and of Plato himself, tended to integrate the 'irrationals' into a comprehensive system of thought. Thus we soon had a theory of the 'irrational quantities' established by Theodorus of Cyrene, a theory of 'negative quantities' added by the Renaissance, and the 'infinitesimal quantities' invented by the seventeenth century in its endeavour to follow Nature as closely as possible. Still unable to exhaust Nature numerically, the nineteenth century thought of 'imaginary quantities', and we have had since such extraordinary conceptions as the 'ideal numbers' and the 'transfinite numbers', to which even mathematicians take exception. Whence Kronecker's aphorism: "God has created the integers, and everything else is human."

In this race towards the understanding of Nature, of man, of the universe as a whole, can we hope that number will overtake all the difficulties lying on its path? We doubt it; for numbers cannot identify themselves with human thought and human will, which give them meaning and practical application. On the other hand, however true may be Leibniz's aphorism "Dum Deus calculat fit mundus", we cannot be so vain as to pretend that the mathematical mind of God and the mathematical mind of man are identical. That is why one is forced to admit, in the universe, the existence of an irrational element, the existence of pure qualities, which are as yet beyond any mathematical expression, not to mention, of course, the impossibility of expressing mathematically existence itself.

Such and similar thoughts are suggested by the reading of Prof. Bell's interesting monograph on "Numerology", in which, without apparently taking sides, he is rather sceptical as to the value of the real claims of numerologists. The amusing stories and examples he quotes, as for example, the 'beasting' of people through the correspondence of their names with numbers, would naturally appear, to an orthodox mathematician, as added arguments in favour of that scepticism.

THOMAS GREENWOOD.

Physiological Balance in the Body

The Wisdom of the Body. By Prof. Walter B. Cannon. Pp. 312. (London: Kegan Paul and Co., Ltd., 1932.) 12*s.* 6*d.* net.

BOTH because of the vivid interest of its subject matter and also the simple and clear way in which it is written, this recent book of Prof. Cannon should make a ready appeal to a wide circle of the general public as well as to students of the biological sciences. It is the fourth of a series of volumes giving the conclusions of the researches he and his colleagues have been carrying out over a period of more than thirty years. The first of these, published in 1911, was concerned with the mechanical factors of digestion; but it included also chapters on the nervous control of the digestive process, and the effect of emotional states upon it. The second work (1915) was his well-known "Bodily Changes in Pain, Hunger, Fear, and Rage", which stressed the importance of adrenal secretion in connexion with the many somatic changes that occur in emotional excitement. The third, "Traumatic Shock" (1923), dealt with the general functions of the autonomic nervous system, and was mainly a war-case study. The present volume carries the same general line of study a step further, treating, as it does, of the relation of the autonomic system to the balance (or, as he terms it, homeostasis) of physiological processes.

The main part of the book is devoted to showing how, in the blood, the safeguarding of homeostasis in respect of water, salt, sugar, proteins, fat and calcium is brought about, how an adequate oxygen supply is maintained during states of relative passivity and active endeavour, how acid-alkali neutrality is secured, and how body temperature is kept within normal limits. All this may sound technical and uninteresting; in point of fact it makes fascinating reading. When one realises that the elements of the human body live in an internal environment the character of which must be maintained in order that they, and it, may live, not only are the mechanisms which secure the constancy of that environment, the 'fluid matrix', of supreme importance, but also our knowledge concerning them is of supreme interest. Chapters follow on the natural defences of the organism, the margin of safety in bodily structure and function, the divisions of the nervous system, and the part that the sympathetic-adrenal system has to play in homeostasis.

Prof. Cannon is careful to show where he is stating ascertained fact and where making use of conjecture, thus at once attracting the layman by the candour of his science and suggesting fresh fields of experiment to the biological worker.

The volume ends with a summary of the general features of bodily stabilisation, and an epilogue dealing with the relations of biological and social homeostasis. The title of the book, borrowed from the late Prof. Starling's Harveian oration of 1923, aptly and picturesquely describes its content. It is science; but it reads like a poem.

Tables of the Planets

Planetary Co-ordinates for the Years 1800–1940 referred to the Equinox of 1950·0. Prepared by H.M. Nautical Almanac Office. Pp. xviii+156. (London: H.M. Stationery Office, 1933.) 12*s.* 6*d.* net.

IT is not too much to say that the appearance of this volume will be joyfully welcomed by all astronomers who devote their attention to the calculation of planetary and cometary orbits, taking account of the perturbations by the major planets. Of late years the advantage of using rectangular co-ordinates, as in the methods of Encke and Cowell, has been more and more appreciated, first because of their greater simplicity, and secondly because of their adaptability to machine-calculations. A further advance towards simplicity and economy in arithmetical work consists in the choice of a standard equinox to which the co-ordinates of planets, etc., are referred so as to cover the needs of two or three decades. In this volume, the mean equinox for 1950·0 has been selected. The advantages of using a standard equinox had been pointed out by Dr. L. J. Comrie some years ago, and it is satisfactory that a proposal of this kind has now been translated into an accomplished fact.

The tables of the planets give the heliocentric longitude and latitude, the radius vector (with its logarithm), the heliocentric rectangular equatorial co-ordinates and the rectangular components of the attraction on the sun, all at intervals of 10 days from 1920 until 1940 and referred to the equinox of 1950·0. In addition, these quantities for Jupiter and Saturn are extended backwards to 1900 and the co-ordinates of Uranus and Neptune to 1903. The ecliptic co-ordinates for Jupiter and Saturn are also given at intervals of

100 days from 1800 to 1900. The latter data will enable computers to connect up earlier apparitions of comets or oppositions of minor planets. An innovation, which will commend itself to workers in this field of astronomy, is the expression of angular co-ordinates in the decimal division of the degree.

There are fifteen subsidiary tables dealing, *inter alia*, with the mean obliquity, ecliptic and equatorial precessional elements, the reduction of equatorial rectangular co-ordinates from one equinox to another, the reduction of star positions, interpolation coefficients and the general formulæ on which the computation of orbits is based.

A fully worked out example—the work of Miss Julie Vinter Hansen of Copenhagen Observatory and Mr. D. H. Sadler of the Nautical Almanac Office—in computing perturbations is given in the introduction. In addition to illustrating the methods of computation, it affords a practical comparison of the relative merits of the methods of Encke and Cowell.

It should be added that the tables have been prepared under the direction of Dr. L. J. Comrie, superintendent of H.M. Nautical Almanac Office, who must be congratulated on producing a work of such importance to dynamical astronomers.

Meteorological Science and Art

The Drama of Weather. By Sir Napier Shaw. Pp. xiv+269. (Cambridge: At the University Press, 1933.) 7*s*. 6*d*. net.

SIR NAPIER SHAW begins this book with a prologue on "Pageantry in the Sky" in which a vivid idea is given of the beauty and wonder of the pictures formed by clouds. The pairs of stereoscopic pictures are particularly to be commended in that the distance separating them is small enough to permit of their enjoyment without the need of optical equipment.

We next have the "Ideas of the Drama Ancient and Modern" and trace the gradual advance through magic, witchcraft and astrology. The development has closely resembled that of medicine, with which meteorology was formerly united under the care of the 'medicine man'. The two sciences have much in common; the principles of diagnosis and prognosis are alike and, as the author remarks, in weather "the processes of digestion have their counterpart, but here the analogy becomes a little too intimate". When dealing with the demand for forecasts, which has become far more insistent with the spread of wireless telegraphy, Sir Napier Shaw considers that in forcing the meteorologist to pronounce an opinion which cannot always be correct "the stress of service has hampered the progress of science". But he seems to overlook the enormous stimulus to investigation and the increase of financial provision that are the direct outcome of the demand.

In Chap. ii we read of "The Watchers: What They See and What They Say". The watchers are the meteorological factors—winds, pressure, etc.; some too little known weather toys fascinate us for a time and we learn something of the enormous bulk of the collections of data which form "the book of the play".

The chapter devoted to "The Score" shows how observation can be used to provide "a summary of the action of the play and to suggest leading motives for the sequence of events in the weather's arena". There is an admirable collection of diagrams showing different ways of exhibiting variations both in time and in geographical position. Effort is undeniably well spent in effecting pictorial representations which will cause to leap to the eye features which would escape notice when buried in masses of numbers: and the author's ingenuity in this respect is well known. As an example may be taken the method of showing the amounts of seasonal transfer of air over the earth, there being ten million million tons less over the northern hemisphere in July than in January.

Chap. iv is headed "The Chorus. Rhythmic Aspects of the Records", and contains an interesting series of contrasts between the periodic variations of the elements and the occasional freaks produced by external, and apparently capricious, interference. Sir Napier rightly points out that most periods have such small amplitudes as to exercise but trivial influences on the rainfall of any particular season: but this remark is not applicable to all seasonal relationships, and it seems unduly pessimistic to observe that it may "be best to regard our . . . coefficients as poetic illustrations of the meaning of our facts and not as substitutes for them".

The last chapter and the epilogue deal with the weather map and the history of daily forecasting. We read of the disappointment that followed the introduction of Abercromby's ideas, and of the success of Norwegian methods; perhaps the size of the book explains the absence of allusion to

Austrian methods of explaining the associated variations in the upper air in terms of its northern or southern origin.

Those who know Sir Napier Shaw's other writings will find fulfilment of their expectations of wealth of imagination, crispness of style, love of paradox and freshness of outlook. He has played a big part in the creation of the international organisations on which meteorology largely depends for its practical efficiency, and he has always been a fighter, with much disinclination to sit on the fence; so that he takes pleasure in vigorous strokes rather than in delicate expression of slight differences.

The advance of science is in some respects like that of a vessel in misty weather. The landmarks are hard to make out until somebody has picked them up, and after this they are obvious: accordingly there is great value in a book which stimulates thought. Although the present work will be intelligible as well as attractive to the layman with some slight knowledge of physics, its suggestiveness and its style alike recommend it to the specialist as worthy of careful perusal. G. T. W.

Short Reviews

Handbuch der Geophysik. Herausgegeben von Prof. Dr. B. Gutenberg. Band 2, Lief. 3: *Die Erdoberfläche*, von Erwin Kossinna; *Petrographischer Aufbau der Erdkruste*, von Dr. S. Rösch; *Chemie der Meteoriten*, von Prof. G. von Hevesy. Pp. 869–1119+xv. 42 gold marks. Band 4, Lief. 4: *Die zeitliche Folge der Erdbeben und bebenauslösende Ursachen.* Von Prof. Dr. V. Conrad. Pp. 1007–1202+xii. 39 gold marks. Band 7, Lief. 1: *Das Eis der Erde*, von Prof. Dr. H. Hess; *Seen*, von Prof. Dr. W. Halbfass; *Das unterirdische Wasser*, von Prof. Dr. W. Koehne. Pp. v+252. 42 gold marks. (Berlin: Gebrüder Borntraeger, 1932.)

Few readers, and even few authors, of papers on periodicities in the occurrence of earthquakes have taken the trouble to compare the amplitudes they obtain with those that would be expected to arise from the harmonic analysis of a purely random set of observations. Prof. Conrad has done a great service in collecting the results and testing them in all cases by means of the Schuster criterion. Most of the suggested periodicities turn out to be probably not significant, on the ground that they would be just as striking if the observations were arranged in any other order in time instead of the actual one; Turner's 21-minute period is among these. The possible survivors are the diurnal and annual periods, and perhaps a 14-monthly one. The curious thing about the first two is that they are conspicuous in felt shocks, but not in instrumental ones. This suggests that they may be the result of differences between the conditions of observing by day and by night; but then why should the phase vary conspicuously from place to place? Why should it be opposite in some parts of Japan from others?

There is a regularity in the frequency of aftershocks from a great earthquake, the number per unit time falling off according to a hyperbolic law. This suggests a relation with the mechanism of elastic afterworking.

The price of 42 gold marks for an unbound part of 252 pages is a poor service both for the authors and the reader. H. J.

British Wild Flowers. By Louis Johnstone. First Series. 16 plates+16 diagrams. Second Series. 16 plates+16 diagrams. *British Trees.* By Barbara Briggs. Second Series. 16 plates+16 diagrams. (London: The Lutterworth Press, 1933.) 3*s.* 6*d.* net each set.

The biologist always looks askance at "beautiful coloured plates" of biological material, for, unlike the hand paintings of flowers housed at Kew, scientific accuracy is almost invariably either disregarded or masked in the striving for artistic effect. None of these series of coloured plates, however, should be placed in the usual category of coloured diagrams of plant and animal subjects. In general, they are very accurate, and though they show little but the identity and general structure of the plants they portray, they are to be highly commended, since all the plants are pictured on a background representing their normal habitat. There is little fault to find with accuracy in this connexion, except that few botanists would agree that the usual habitat of the white deadnettle is "ruins and rocks".

In each of the two series of wild flowers, 135 species are represented. In the series of trees, each tree occupies one plate. The usefulness of all three series is enhanced by a collection of line diagrams accompanying each plate, where details of such diagnostic features as flower, fruit, leaf, winter bud, etc., are given.

The plates can be highly recommended, for reference purposes, to teachers of elementary nature study and botany; also, they are so attractively done that they would decorate the classroom, laboratory or museum wall.

Mathematical Facts and Formulæ. By A. S. Percival. Pp. v+125. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1933.) 4*s.* 6*d.* net.

To fill a notebook with the formulæ that happen to have been of most use to himself and the comments that he has found most illuminating is a pleasant and profitable task to anyone who performs it, but the result cannot have value of a

comparable kind to any reader. To say that it is hard to know to whom to recommend Mr. Percival's discursive jottings, which range from the multiplication of polynomials to the solution of partial differential equations, is not to deny that some of his remarks were worth making. On the other hand, the teacher who expects a protest against the prevalent inaccuracy in presenting the integral of $1/x$ will be disappointed to find only the usual formula, and inverse circular functions are said to be essentially acute angles.

The one surprising feature of the book is a six-figure table of log $\Gamma(x)$, from 1 to 2 at interval 0·001. There are only two substantial mistakes, and these would be patent in use: against 1·255, for 6854 read 6834, and against 1·529, for 8274 read 8174. Perhaps, however, the first row would puzzle an inexperienced user, and when the seventh digit of the Smithsonian table from which he was extracting was a 5, Mr. Percival adopted some rule of thumb instead of looking elsewhere for a closer approximation, and fifty entries are at fault by a unit in the last place for this reason.

E. H. N.

Men without Money: the Challenge of Barter and Scrip. By Wayne Weishaar and Wayne W. Parrish. Pp. x+111. (New York and London: G. P. Putnam's Sons, 1933.) 5*s.* net.

THE severity of the economic depression in the United States has led to the introduction of barter on a considerable scale, and this book provides a vivid record of a remarkable movement in which about a million persons are participating. The simplest form described is that in which commodities or services are directly exchanged against each other by farmers, dentists, barbers, shopkeepers, doctors, artisans and labourers. Direct barter, however, is limited, since a double coincidence of wants may be lacking. To meet this difficulty, exchanges have been inaugurated to act as clearing houses. One such exchange, for example, found a farmer in Syracuse who was willing to take shirts and shoes for his grain. This was exchanged with a poultryman for eggs and fowls which in turn were traded with restaurants to provide meals for workers engaged in making shirts for the farmer.

Many of the exchanges issue 'scrip' or tokens which circulate as a kind of local money. Certain municipalities have also issued 'scrip' to the unemployed in return for work on the roads. To prevent debasement, this scrip has to be stamped at every transaction, thus building up a fund for its eventual redemption by the municipality.

Sacraments of Simple Folk. By R. R. Marett. Pp. vii+230. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 10*s.* net.

IN the second series of his lectures on the Gifford foundation delivered in 1932–33, Dr. Marett studies the function of the sacrament in natural religion, that is, as he understands it, in the religion of primitive peoples. A sacrament is defined as "any rite which by way of sanction or positive blessing invests a natural function with a supernatural authority of its own". This definition is tested in the course of the lectures by the study of particular instances among the diverse activities of savage life. Ritual, instead of a deadening, is shown to be a vitalising force, bringing emotion to the support of reason in promoting right action, these terms in this context, naturally, being used in a relative sense.

It will be seen that Dr. Marett's point of view in his analysis of primitive institutions and their ritualistic accompaniments is both psychological and sociological, while he applies a formula to the behaviour of primitive peoples which is equally applicable to that of more advanced civilisations. This, however, is an aspect of his inquiry to which Dr. Marett makes only incidental reference. It should not, however, be overlooked, lest the broader view of anthropological studies be forgotten.

The Progress of Man: a Short Survey of his Evolution, his Customs and his Works. By A. M. Hocart. Pp. xvi+316. (London: Methuen and Co., Ltd., 1933.) 7*s.* 6*d.* net.

"LIVE man," Mr. Hocart says, "wants to know about his past as a key to his present. The man who does not is dead." He has written what is virtually a survey of the material of anthropological science to satisfy that desire. An enormous amount of ground is covered in a small compass; for he has traced the growth and achievement of man "from the time he can be reckoned as man" down to the present day. Mr. Hocart will have none of the arbitrary divisions between prehistory and history, and between savage and civilised. His treatment of the subject is individual in style and original in method; and be it added, at times provocative. It is not possible to comment here in detail upon the many points upon which his views stimulate thought; but attention must be directed to the emphasis he lays on the psychological and ritualistic element in mechanical invention. His protest against the misuse of 'evolutionary' in the study of technical development is salutary.

Network Synthesis: Synthesis of a Finite Four-Terminal Network from its Prescribed Driving-Point Functions and Transfer Function. By Dr. Charles Mason Gewertz. Pp. vi+257. (London: Baillière, Tindall and Cox, 1933.) 23*s.*

THIS work is an interesting exercise, and its subtitle is accurate. The main title alone, however, is quite misleading, for the reader who goes to this book for a general and comprehensive treatment will find that he must first go elsewhere for the foundations on which the author builds, and in the end he will probably conclude that empiricism is sometimes cheaper than pure reason.

The John Murray Expedition to the Arabian Sea

By LIEUT-COL. R. B. SEYMOUR SEWELL, C.I.E.

THE John Murray Expedition has now completed its first three months' work, during which time the H.E.M.S. *Mabahiss* has made four cruises, each of approximately three weeks' duration, namely, (1) down the Red Sea and round the head of the Gulf of Aden between Perim and Aden; (2) around the Gulf of Aden and out into the Indian Ocean to the south-east of Socotra; (3) along the southern and south-eastern coast of Arabia; and (4) up the Gulf of Oman. We have thus completed our programme of work across the northern part of the Arabian Sea and have carried out observations at 90 stations, of which 18 were in the Red Sea and the Straits of Bab el Mandeb, 20 in the Gulf of Aden or to the south-east of Socotra, 27 along the coast of Arabia, and 25 in the Gulf of Oman and its approaches. Of these stations, 15 have been 'complete' ones, including both physico-chemical and biological observations; at 41, physico-chemical observations only have been made; trawls or dredges have been carried out at 37; and at 8, observations have been made with the Priestman grab.

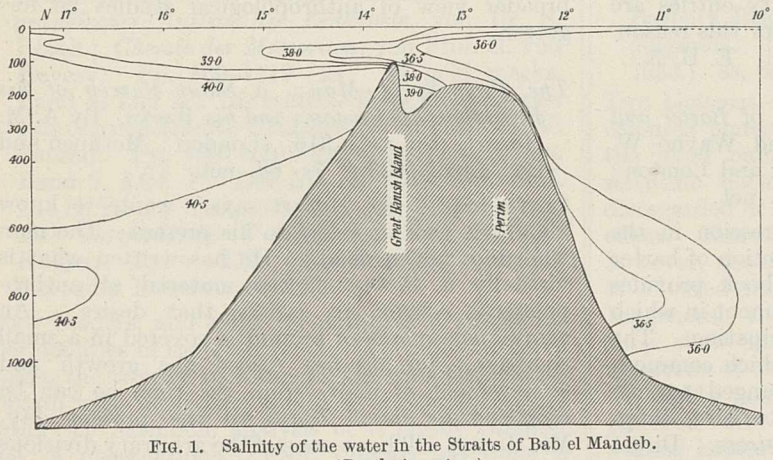

FIG. 1. Salinity of the water in the Straits of Bab el Mandeb. (*Depths in metres.*)

TOPOGRAPHY AND BOTTOM DEPOSITS

Thanks to the installation of the echo-sounding machine, we have been able to carry on an almost continuous survey of the bottom during our four cruises. In the Red Sea we were able to confirm the presence of a deep area having a depth of 2,204 metres (1,205 fathoms) in lat. 25° 24′ 12″ N., long. 36° 12′ 12″ E. The bottom in the deeper levels consists largely of a rock, or coarse gravel, containing a high percentage of calcium carbonate, that appears to be forming *in situ*.

We have three times traversed the Gulf of Aden along its whole length and have been able to detect the presence of no less than ten definite ridges that run obliquely across the northern and central parts of the Gulf in a north-east to south-west direction, the more westerly ridges showing a tendency to curve westwards. We have not yet been able to define the most southerly limits of these ridges, but we hope to do so during our return journey in April next.

Along the Arabian coast, throughout the area that we have investigated and extending from Ras Nus, the western headland of Khorya Morya Bay, to Ras al Hadd at the eastern extremity, the coast line is for the most part composed of high vertical, or in some places even overhanging, cliffs, some of which rise to a height of 600–800 ft. and are composed of a stratified sandstone alternating with horizontal bands of a harder material or limestone. A similar formation is also to be found on the Khorya Morya islands, though some of the steep hills are composed of granite. To seaward there is a broad, gently-sloping shelf; but at or near the 50 fathoms level the sea-floor drops with great rapidity and is very irregular, running out in a complicated series of submarine promontories, between which are deep gullies. Much of this bottom consists of rock that played havoc with our nets. On one occasion we brought up in the dredge from a depth of 1,416 metres (774 fathoms) a half to three quarters of a ton of angular granite blocks of various sizes, without any trace of associated sand or mud, constituting a definite scree slope, and there can be little doubt that the whole coast-line is part of a large geological fault.

Where not composed of rock, the bottom consists of a brown or green mud, and towards the eastern end in the neighbourhood of Ras al Hadd this green mud smells very strongly of sulphuretted hydrogen. Six observations showed that this is present between the depths of 95 metres and 1,253 metres, though most strongly marked at 421–457 metres, the occluded water from a bottom-sample at 421 metres containing as much as 29·39 milligrams of sulphuretted hydrogen per litre. This occurrence of sulphuretted hydrogen in the bottom deposit affords a parallel to the condition found in the Black Sea and in some of the enclosed fjords, but its presence along an open sea-coast was scarcely to be expected and its cause must at present remain unsolved. A very similar mud bottom, composed of green mud, or in the deepest depths of a grey clay, but not impregnated with sulphuretted hydrogen, is found throughout the whole of the Gulf of Oman and along the coast of Makran and Baluchistan below a depth of about 250 metres.

Between Ras al Hadd and the Indian coast in the neighbourhood of Karachi the echo-sounder has clearly revealed the presence of a submarine ridge that runs westward towards the entrance to the Gulf of Oman more or less parallel to the hill ranges of Baluchistan and Makran. To the south of this ridge and separated from it by a level plain with a fairly constant depth of 1,850 fathoms (3,383 metres) lies a second ridge that runs towards the south-west, and immediately to the south-east of this is a deep gully, bounded in its turn by the edge of a plateau that slopes gradually downwards towards the south-east. The bottom of this gully lies 2,000 fathoms below the sea surface and its general character reminds one strongly of a river bed. Have we here the now submerged bed of the Indus, where it flowed out into the Arabian Sea at a point more to the north of its present mouth or, possibly, the mouth of the great Indo-brahm river, the existence of which was postulated by Pascoe and Pilgrim ?

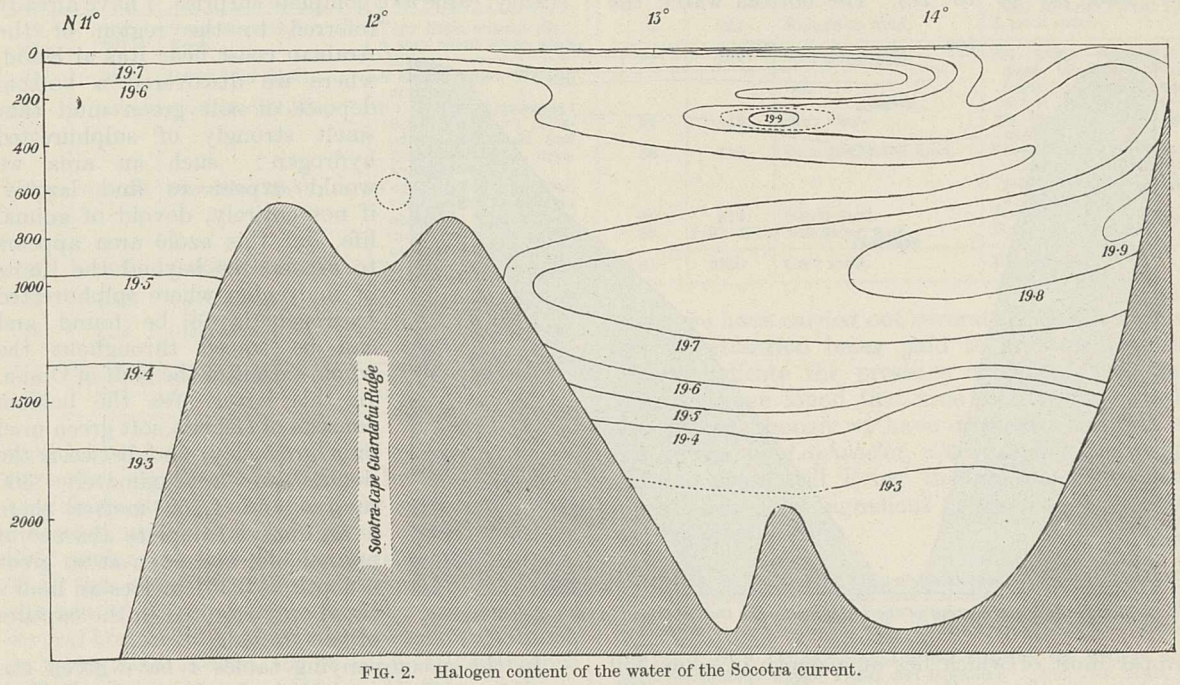

FIG. 2. Halogen content of the water of the Socotra current.

PHYSICO-CHEMICAL RESULTS

The physico-chemical examination of the sea-water of the Red Sea at all depths between the surface and the bottom indicates that there is in all probability a vertical circulation going on between a depth of 200–300 metres and the bottom, for at a depth of about 400–500 metres the temperature and both the halogen- and oxygen-content of the water are at a minimum and exhibit a clear increase in passing either upwards towards the surface or downwards to the bottom. We hope to carry out further observations on this point during our return journey.

On our way through the Straits of Bab el Mandeb a series of observations was made on the character of the sea-water and the fauna of the shallow channel that connects the Red Sea with the Gulf of Aden. There were indications of at least three different strata of water in the Straits, of which the uppermost was flowing out of the Red Sea, while the second and by far the largest of these water masses was flowing into the basin between the depths of 70 metres and 160 metres. The lowest stratum, namely, that of the bottom water of the Red Sea, was extremely small or even non-existent and scarcely passes over the sill near Great Hanish Island (Fig. 1). This condition of the water movements affords a marked contrast to the results obtained by the *Magnaghi* (1924) and the *Ormonde* (1927) in the months of April and May (*vide* Schott[1]). At this latter season of the year it is the outflowing bottom current and not the inflowing current that is the chief characteristic.

A number of serial observations on the sea-water in the Gulf of Aden have shown that there is in the Gulf a very complicated system of deep currents, and this is especially the case at the eastern end, where the "Socotra" current, to which Matthews has directed attention[2], sweeps northwards, partly through the gap between Cape Guardafui and Socotra and partly to the east of the island. A series of five stations running from south to north were made across this part of the Gulf and the results obtained indicate a deep and complicated vertical rotation of the water masses (Fig. 2).

At three places along the Arabian coast, lines of stations were run in order to detect, if possible, any upwelling of cold antarctic bottom-water ; but so far as our observations go, there was no

sign of any such phenomenon. On two occasions, off Ras Sukra and Ras Madraka, at the two ends respectively of Sukra Bay, there was a definite fall in the temperature of the surface water by as much as 2·5° ; this apparently was not due to the upwelling of deep water ; but was probably caused by water upwelling from only moderate depths under the influence of the tidal currents.

In the Gulf of Oman (Fig. 3), our observations indicate that whereas there is an outflowing current that extends from the surface down to some 30–70 metres and a second similar current extending from 125 metres down to 350 metres on the northern and 500 metres on the southern side of the Gulf; between these two layers there is a stratum of inflowing water that can be traced up the Gulf as far north as Station 71 (lat. 25° 35′ 00″ N., long. 56° 42′ 18″ E.). The bottom water, the

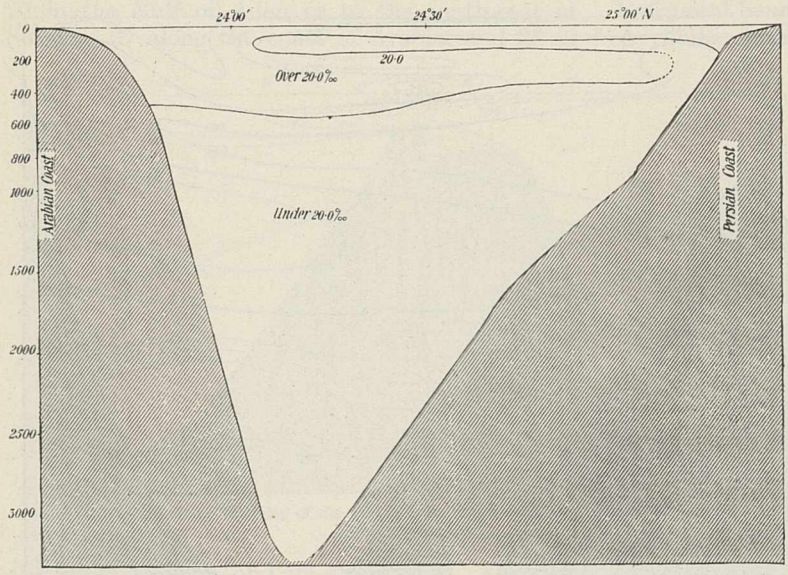

FIG. 3. Halogen content of the water across the Gulf of Oman in the region of Muscat.

upper limit of which lies at a depth of some 350 metres on the northern side and at about 500 metres on the southern side in the vicinity of Muscat, appears to be an offshoot of deep Indian Ocean water that is moving northwards into the Gulf through the gap between Arabia and the Karachi plateau, to which I have already directed attention.

BIOLOGICAL OBSERVATIONS

On the biological side, two areas have proved to be extremely interesting—not because of the richness of their fauna, but, on the contrary, because of its paucity or even complete absence. The first is the deep part of the Red Sea. During our cruise down this region in September, we carried out several trawls and dredges in depths ranging from 55 metres to 1,167 metres, and in four hauls in depths below 260 metres we were unable to detect any sign of living organisms on the bottom, which, as already mentioned, consists of a calcareous rock that appears to be in process of formation *in situ*. In view of the enclosed character of the basin, the depth of the entrance channel at Great Hanish Island just to the north of the Straits of Bab el Mandeb being only some 160 metres, the water of the Red Sea below this depth, as is well known, has a very high salinity (40 per mille and above) and a high temperature (22°–23° C.), though the oxygen content of the bottom water is higher than we expected to find and ranges from 1·32 to 1·65 c.c. per litre at depths between 800 metres and 1,500 metres in the northern part, sinking to less than 1·0 on the bottom in the southern area ; but such conditions are of themselves scarcely sufficient to account for the complete absence of life.

The discovery of the second area, in which all life is either completely absent or is extraordinarily scanty, came as a complete surprise. I have already referred to the region of the Arabian coast near Ras al Hadd, where we discovered a bottom deposit of soft green mud that smelt strongly of sulphuretted hydrogen ; such an area we would expect to find largely, if not entirely, devoid of animal life, but this azoic area appears to extend far beyond the limits of the region where sulphuretted hydrogen is to be found and can be traced throughout the whole extent of the Gulf of Oman. In this latter area the bottom consists of either a soft green mud or a grey clay, and between the depths of approximately 300 metres and 1,750 metres there is an almost complete absence of animal life, and even at so great a depth as 3,351 metres an hour's trawl only resulted in the capture of two starfish.

In the accompanying tables I have given the various stations and their depths in the Gulf of Oman and off the Arabian coast, and it seems clear that this azoic area not only lies at a deeper general level in the Gulf of Oman than on the Arabian coast but also that there is a difference of level on the two sides of the Gulf of Oman. The upper limit of the azoic area on the Arabian coast near Ras al Hadd lies somewhere between 83 metres and 102 metres and the lower limit between 1,253 metres and 1,536 metres. The depth of the lower limit, however, probably increases as we pass towards the north-east, where we found prolific life at a depth of 952 metres, the trawl bringing up a number of fish and crustacea and thousands of Ophiuroids ; in 1906 the R.I.M.S. *Investigator*, when trawling in the near vicinity, also secured a good catch, though the net was badly torn (*vide* Lloyd, 1907, p. 2[3]). There can thus be little doubt that this area is a fertile one ; but a little to the east at a depth of 1,253 metres we were within the zone of sulphuretted hydrogen and the catch after

an hour's haul consisted of a single crab, *Paralomis* sp.

In the Gulf of Oman, the upper limit of the dead area appears to lie at a slightly different level on the two sides. On the southern side in the vicinity of Muscat the great bulk of the fauna disappears between 210 and 269 metres, though a few live animals were obtained at a depth of 610 metres; off the coast of Persian Makran no life

ARABIAN COAST

Station No.	Depth in metres.	Character of bottom	Results.
53	13	Rock : *Lithothamnioneæ*.	A good and varied catch.
80	16–22	Sand and Shells.	A good catch.
45	40	*Lithothamnioneæ*, etc.	A good and very interesting catch.
43	83	? No sample obtained.	A small but interesting catch.
79	102	Green Mud (H_2S).	Very little animal life.
48	201	Rock.	A very small catch. Net torn.
77	350	Green Mud (H_2S).	A single crab ; *Paralia alcocki*.
56	457	Green Mud (H_2S).	No living organisms ; dead shells of *Rostellaria delicatula* and *Encephaloides armstrongi*.
57	428–750	Green Mud (H_2S).	Very little life ; one dead shell of *Rostellaria delicatula* and a few moribund *Encephaloides armstrongi*.
55	802	Stratified green mud.	No sign of living organisms.
54	952	Green mud and soft rock.	A good catch; thousands of Ophiuroids.
58	1253	Green mud (H_2S).	A single crab : *Paralomis* sp.
50	1536–1737	Brown mud.	Catch very small.
59	1977	Soft Green mud.	Catch very small.

was detected at a depth of 448 metres and it is somewhat significant that these levels correspond very fairly closely with the upper level of the deep inflowing mass of water that is running up the Gulf under the out-flowing Persian Gulf water. That this water is not *per se* responsible for the absence of life is clearly shown by the results of several horizontal hauls at depths down to as much as 1,500–2,000 metres, for at all depths numerous red deep-sea prawns and small fish, such as *Bregmaceros* sp. and Scopelids, were obtained. It would appear, therefore, that the sterility of the area must be attributed either to some harmful character of the bottom deposit or else to some seasonal change in the general conditions of the deep water.

The surface waters and the inshore areas in both regions, in marked contradistinction, appear to be particularly fertile. Along the Arabian

GULF OF OMAN

Station No.	Depth in metres.	Character of bottom.	Results.
72	75	Grey clay and shells.	A good and varied catch.
71	106	Grey-green mud and sand.	A moderate catch.
70	109	Soft green mud.	Moderately good catch ; 213 living examples of *Rostellaria delicatula* and several *Pirula* sp.
75	201	Soft green mud.	A good catch.
67	269	Soft green mud.	No living organisms ; dead shells of *Rostellaria delicatula* and a few Serpulid tubes.
64	448	Grey clay.	No signs of living organisms.
66	610	Brownish-green mud.	Several dead shells of *Rostellaria delicatula* and 3 living examples; a few Serpulids.
65	912	Green mud.	No living organisms.
68	1491–1518	Soft green mud.	No living organisms.
81	3350	Grey mud.	Two starfish.

coast we have carried out several successful trawls, special attention being paid to areas where the charts indicate the presence of coral; in every case we have found that true reef-forming corals are absent, though we have dredged a number of specimens of *Lophohelia*, *Caryophyllia* and *Flabellum*, some still living though many of them dead. The chief ingredient of the reef appears to be *Lithothamnioneæ*.

[1] Schott, G., "Uber die Wasserbewegungen im Bab el Mandeb". *Ann. der Hydrographie und maritime Meteorologie*, January 1929.
[2] Matthews, D. J., "The Percy Sladen Trust Expedition to the Indian Ocean in 1905 : No. VII. Physical Oceanography". *Trans. Linn. Soc. London*, **19**, Part 1, 1926.
[3] Lloyd, R. E., "Contributions to the Fauna of the Arabian Sea, with descriptions of new Fishes and Crustacea". *Rec. Ind. Mus.*, **1**, Part 1, Calcutta, 1907.

Recent Discoveries at Choukoutien*

By PROF. DAVIDSON BLACK, F.R.S., Honorary Director, Cenozoic Research Laboratory, Geological Survey of China

UPPER PALÆOLITHIC CULTURE IN "UPPER CAVE" SEDIMENTS

A DETAILED account of the results of the Choukoutien excavations up to May 1933 has already been presented in our memoir "Fossil Man in China" (Mem. Geol. Surv. China, Series A, No. 11). In that report it was noted that above the *Sinanthropus* deposits there occurred towards the top of the hill a pocket of grey sediments of apparently modern facies, the site being described as the "Upper Cave". During the past season, Mr. W. C. Pei has systematically investigated the deposits of the latter site, ably assisted by Mr. M. N. Pien. Their efforts have been rewarded by the discovery of much additional material of unexpected archæological significance.

(1) *Sedimentary and lithological characters of Upper Cave deposits.* The "Upper Cave" was a true cave but became completely filled with a mixture of grey cave loam and angular flat limestone fragments, the latter being derived from the collapsed portion of its roof. The roof is preserved over a quite large recess of the cave

* Report of excavations during the field season 1933, presented at the annual meeting of the Geological Society of China on November 11.

which extends to a smaller lower chamber not yet completely excavated. Where exposed, the cave walls are covered with stalactites and stalagmites. The grey Upper Cave sediments are largely unconsolidated and are in contact only over a few square metres with the hard red beds and stalagmitic floors capping the *Sinanthropus* strata of Locality 1. Elsewhere the Upper Cave appears to be developed as an independent system.

(2) *Fauna of the Upper Cave.* Though not very abundant, the Upper Cave fauna is remarkably rich in types and includes a puzzlingly large number of almost complete skeletons, the bones of which lie in correct association and are but slightly fossilised. The most interesting forms are as follows:—*Hyæna* (an extinct species very different from that found in the *Sinanthropus* beds but similar to that of Sjara-osso-Gol); *Felis tigris* (entire skeleton); *Cynailurus*, which is now restricted to India (an entire skeleton); *Viverra* (no longer found in North China); the wild ass; *Equus hemionus*; and the deer, *Cervus elaphus* (an entire skeleton), having antlers curiously similar to the special form from Sjara-osso-Gol.

(3) *Human and cultural remains.* In association with this fauna there occur both human skeletal remains and traces of industry. The skeletal remains are of modern type (*Homo sapiens*) and so far comprise two almost complete but somewhat crushed skulls, other skull fragments and teeth, fragmentary lower jaws, bones of the upper extremity (including one clavicle displaying a healed fracture), vertebræ, leg and foot bones. Traces of fire (charcoal and ash) are abundant.

There are three stone implements in a beautiful black chert, a well-made scratcher in vein quartz and several flakes and nuclei in vein quartz, and also a needle (eye broken), a deer canon bone worked at both ends, some thirty or more fox canine teeth perforated for necklace, an ornamental cylindrical piece made from a long bone of a bird, and a considerable quantity of oolitic hæmatite probably imported from a considerable distance. So far, no trace of pottery, polished stone or microlithic industry has been encountered.

Conclusions. The material recovered will shortly be made the subject of a full report and the conclusions here offered are wholly tentative. (*a*) The Upper Cave deposits appear to be decidedly younger than the *Sinanthropus* layers of Locality 1, from which they are separated by stratigraphic and lithological disconformity and by a faunistic interval (absence of thick-jawed deer, occurrence of a special *Hyæna*, presence of *C. elaphus*, *E. hemionus*, etc.). (*b*) The Upper Cave deposit is, however, probably also Pleistocene in age (collapsed cave, loess-like sediments, presence of Hyæna; cf. *spelæa*, *Cynailurus*, *Viverra*, *E. hemionus*, special deer, etc.). (*c*) In these circumstances, we are inclined provisionally to attribute the associated human remains to a Late Pleistocene, Palæolithic culture. The latter would seem to correspond approximately to the same stage as the Upper Palæolithic of Siberia and Europe. It appears, however, to be somewhat more advanced than the Ordos industries (Shui-tung-ko and Sjara-osso-Gol) in which no typically worked bones have thus far been found in certain association.

Cynocephalus Remains

In a cylindrical solution cavity about a metre in diameter in the limestone to the south of Locality 1, Mr. M. N. Pien discovered this season a considerable number of fossil bones imbedded in a peculiar red deposit containing a large proportion of small well-rounded pebbles. These bones are remarkably fossilised and heavy, many of them being water-worn and rounded. A few, however, are well preserved, among the latter being several teeth and limb bones of a large baboon, probably *Cynocephalus wimani*, Schlosser. Strikingly similar deposits containing the same type of heavy rolled bone fossils have already been encountered at the very base of the *Sinanthropus* deposits of Locality 1 (Lower Cave). At the present stage of excavation it remains an open question whether or not these beds represent a pre-Choukoutien stage or merely correspond to an early phase in the last filling of the clefts.

In any case it would seem that one must conclude from this latest discovery that the Choukoutien fissures have been successively inhabited by baboons, by *Sinanthropus* and by a modern type of *Homo*. However, such a coincidence appears less extraordinary when it is recalled that though Ordovician limestone is widely distributed along the Western Hills, at Choukoutien, on account of its low anticlinal structure at the borders of the plain, it is exceptionally well situated for dissection into fissures and caves.

Obituary

Prof. J. Joly, F.R.S.

JOHN JOLY came of a remarkable lineage. His father's grandfather was a member of a French noble family. His mother, a German countess, whose family had been ennobled by Frederick the Great, was descended from Greek, Italian, and English ancestors. This mixture of blood, perhaps, may explain his ready sympathy with the most diverse personalities, his princely generosity which often gave to others what he denied to himself, and his versatility which enabled him to prosecute research in so many fields of knowledge, and to obtain æsthetic pleasure in the realms of art, literature, music and science.

Joly's earliest papers were mostly occupied with mineralogy. The beauty of the colour and form of minerals had a marvellous attraction for him. In this period he wrote on the ash of Krakatoa, beryl, iolite and harmotome. Investigation on these minerals led him to devise the meldometer and

apophorometer, by means of which he determined the melting points of minerals with the greatest accuracy, and was able by volatilisation to reveal their constituents in a much more elegant and delicate way than by the blowpipe. About this time also he devoted some attention to the problem of accurate photometry and devised the well-known diffusion photometer. Next followed the invention of the steam-calorimeter, which not only enabled him to determine with greater accuracy than ever before the specific heats of minerals, but also put into the grasp of his imaginative mind the power of determining directly the specific heats of gases at constant volume. In this way he solved an experimental problem which had the highest importance in molecular theory. In 1892, doubtless in recognition of this achievement, he was elected to the Royal Society.

By a beautiful novel method Joly obtained the volume change of rocks and minerals on fusion, and so contributed accurate and important data to geophysics. His experiments with electrically heated furnaces enabled him at a very early period to isolate aluminium from aluminium silicates, but unfortunately a discouraging word from a senior deterred him from publishing the result, and so others obtained the credit for this method of reducing the element. During this period, photographic work became absorbingly interesting to him, and he investigated the relation of the sensitivity of the photographic film to temperature, and suggested the electronic theory of the latent image. He invented shutters for use in stellar photography and a photographic method for the detection of variable stars. But in this field his most arresting invention was the method of colour photography by which he rendered it possible for the first time to reproduce with accuracy on a single transparent plate the colours of Nature. At about the same time, his attention was directed to Lowell's observations on the canals of Mars. Contrary to the received statements that these markings on the surface of the planet were all portions of great circles, Joly perceived that this was not the case, and he showed that all could be traced by moons rotating near the surface of the primary, and so propounded a rational physical theory. Another essay of astronomical bearing, startling alike in its imagination and literary style, is his "Theory of the Prematerial Condition of the Universe."

Biological speculations frequently kindled Joly's imagination, and in essays on the bright colours of Alpine plants, and on the abundance of life, he made contributions to biological philosophy which are too often neglected. In collaboration with one of the writers of this notice, he formulated the cohesion theory of the ascent of sap, and devised and carried out several novel and beautiful experiments with plants. Here also should be mentioned his speculations on the connexion between cosmic rays and cellular evolution, morbid and normal.

Time and again Joly returned to his first love of mineralogy and geology, and his work on the thermal expansion of the diamond, the action of the ions of sea-water in sedimentation, and the influence of pressure on the order of formation of minerals in igneous rocks, ingeniously made use of physical principles for the solution of long-standing problems. Experiments on solvent denudation led him to formulate his method of determining the geological age of the earth by the sodium content of the ocean. The period yielded by this method in its early stages is now generally considered to be an under-estimate, but it must be remembered that, at the time, it materially and rationally extended the much more crippling estimate of the earlier physicists. In this connexion may be mentioned the attractive spell the sea exercised on his mind, and while he sailed in small boats or in large ships, geological problems were not the only ones which occupied his thoughts. In these surroundings he devised a method of observing the altitude of a celestial object at sea during night-time, or when the horizon is obscured ; he devised the collision predictor and synchronous signalling, an explosive sounder, two types of borers for obtaining samples of sediments and rock from the sea bottom, and floating breakwaters whereby the energy of the breaking waves is transformed into turbulent movements round the keel of a floating vessel.

It is, however, in the field of the application of the heat-producing properties of the radioactive elements to geophysical problems that Joly did some of his best-known work. So early as 1903, when Pierre Curie and Laborde first definitely established the continuous heat-production of radium, he pointed out the importance of this fact in geological science and its bearing on Lord Kelvin's view of the age of the earth, which was based on thermal considerations. The first actual detection of the wide distribution of the radioactive elements in terrestrial surface materials was due to the present Lord Rayleigh in 1906, but afterwards Joly and his pupils devoted much attention to this problem, and measurements on materials from most parts of the globe have been made in his laboratory. In 1909 he devised his method for the measurement of thorium in a rock, a problem previously unattacked, and in 1911 his well-known furnace method of determining the radium content of a rock.

Joly's early views on the effect of radioactivity on earth history are contained in his book, "Radioactivity and Geology" (London : Constable and Co., 1909). His theory of the production of pleochroic halos by α-ray disintegration also dates from about this period. In conjunction with Lord Rutherford he devised a new method of deducing the age of the mineral containing the halo, which gave results for geological ages more in accordance with the other radioactive methods than his previous method based on solvent denudation. In subsequent years he expended much time in further investigation of these halos, obtaining many interesting results, among which may be mentioned his discovery of an unknown radio-

active element, which he provisionally named hibernium. During the past year, this element has been shown by G. Hevesy and M. Pahl to be samarium.

Joly's general interest in all radioactive problems, and his great sympathy with human suffering, led to the foundation of the Irish Radium Institute by the Royal Dublin Society in 1914. He was both the originator and strong advocate of this Institute, and its present highly satisfactory condition is largely due to him. Among those to whom Joly was personally known, it would, we think, be unanimously agreed that, of all his many activities, this was the one nearest his heart, and for which he would best like to be remembered. The so-called Dublin method of using radon in fine capillary glass tubes, which can be placed inside hollow metal needles, was first developed by him, and his life-long friend, the late Dr. Walter Stevenson. This method of using radon and not the actual radium salt has always been employed at the Irish Institute, and has also been adopted at many other centres. To the end, his interest in radium therapy never failed ; some of his most recent papers, read before the Royal Dublin Society, deal with improvements in its technique. These include the use of native radioactive powders and a mechanical means of focusing γ-rays on deep-seated tumours.

During the War, Joly devoted his attention to various technical problems. At its conclusion, he returned to the study of radioactivity, and was among the first to attempt the separation of the lead isotopes by physical methods. Later he became interested in the problem of vision, and developed a theory of colour vision based on the quantum theory of photoelectric emission and the physiological structure of the retina. In 1923 he was asked to determine the radioactive contents of some South African rocks, and this led him to a reconsideration of the effect of radioactivity in geological history. From this sprang his theory of thermal cycles, which he has so brilliantly presented in his book on the surface history of the earth. The publication of this work is a landmark in the advance of geological science, focusing, as it does, the attention of geologists on the enormous importance of radioactivity in earth history, and giving a rational explanation of the succession of revolutions and geological strata. His subsequent work, mostly carried out in conjunction with one of the present writers, was largely devoted to further radioactive measurements, in the course of which the very low radium content of the eclogites was established, a fact of great interest in geological theory.

John Joly was born in Hollywood, King's County, in 1857. His early education was obtained in Rathmines School. In his school-days, which for various reasons were short, apparently he attracted no special attention in the usual educational tests, but won great popularity among his fellows by his powers of narration and the original tales which he contributed to the school magazine. While at Hyères, where he went for his health, he constituted himself 'foreign correspondent' and published many notes on the natural history of the south of France. Owing to these activities, he acquired among his school-fellows the title of 'the Professor', a title by which he was always known among his oldest friends.

In college Joly was omnivorous in his reading, but always refused to be limited by examination courses, and so it happened that while he studied physics, chemistry, mineralogy and modern literature with zeal, his only academic distinction was first honours in English literature. In the engineering school, however, his soundness and originality were recognised and he was placed at the top of the list in all subjects at the B.A.I. examinations. After his degree he held minor posts in the engineering school and in the school of physics, and while still FitzGerald's assistant, he had already attracted attention by his early inventions and researches in mineralogy and calorimetry. In 1897 he became professor of geology at Trinity College, Dublin, and though he received many offers of more lucrative posts, he remained until his death on December 7 last a Trinity man. Throughout his career, he kept in close contact with the students, and formed and accomplished many schemes for increasing undergraduate amenities. He was keenly interested in the scientific development of T.C.D., and was the originator and secretary of the science fund whereby T.C.D. acquired the present schools of physics and botany, with their equipment and most of their endowment. The special research endowment of the school of geology by the late Earl of Iveagh was a recognition of his personality and distinction as an investigator. He acted for many years as secretary to the Academic Council and was a member of the Board of T.C.D. In 1919 he was elected to a fellowship in the College.

Outside his College also Joly had many activities. He was successively member of council, secretary, vice-president and president of the Royal Dublin Society. He contributed many papers to its *Transactions* and *Proceedings*, and interested himself in every way in its welfare, and in forwarding its aims. He was warden of the Alexandra College and was one of the delegates of the Balfour Educational Mission to America in 1918. On the Board of Irish Lights he was one of the most active commissioners, and delighted to put his scientific knowledge and inventive mind at its service. He was also a governor of two Dublin hospitals. In his earlier days he was a keen Alpine climber, and yachtsman, and many of his researches were planned and his philosophical and speculative writings discussed with his companions on these expeditions. His fundamental method of treatment, his extraordinary originality and intellectual fertility, and his æsthetic appreciation of Nature made these conversations unforgettable by those who had the good fortune to be with him.

HENRY H. DIXON.
J. H. J. POOLE.

MR. H. F. BIGGS

WE regret to record the death at Oxford on January 9 after a short illness of Mr. Henry Francis Biggs, whose place in the University as a tutor in physics will be difficult to fill. In spite of severe calls on his time and energy in the fulfilment of his academic work, he took a keen interest in the latest developments of physics, and contributed to the columns of this journal and to other scientific journals. His main published works are an "Introductory Sketch on Wave Mechanics" and a monograph on "The Electromagnetic Field", the latter of which appeared only a few days before his death.

Mr. Biggs went to Oxford in 1919 as a demonstrator in the Electrical Laboratory under Prof. J. S. E. Townsend, and took an active part in the teaching of physics in the University. He had a varied experience of academic life, having studied at Trinity College, Dublin, and at Cambridge, and having held a lectureship at the South African College (now the University of Cape Town), and later a lectureship at the University of Manchester. During the War he was attached to a sound ranging unit, where his theoretical knowledge, his practical skill and inventive ability found abundant scope.

Mr. Biggs will be greatly missed by his pupils and colleagues, who will long cherish the memory of a cultured, courteous and interesting personality.

WE regret to announce the following deaths :

Sir William Lawrence, treasurer of the Royal Horticultural Society, 1924–29, formerly lecturer in organic chemistry in the University of Manchester, on January 4, aged sixty-three years.

Sir Donald MacAlister, K.C.B., Chancellor of the University of Glasgow since 1929, and president of the General Medical Council in 1904–31, on January 15, aged seventy-nine years.

News and Views

Dr. Harlow Shapley

THE Gold Medal of the Royal Astronomical Society has been awarded to Dr. Harlow Shapley for his studies of the structure and dimensions of the galactic system. Dr. Shapley, who was born on November 2, 1885, has been director of Harvard College Observatory and Paine professor of astronomy at Harvard since 1921, succeeding E. C. Pickering. He is known particularly for his development of the period-luminosity law of the relation between the period of variation and the absolute magnitude of Cepheid variable stars. The apparent magnitude of the Cepheid variables in a globular cluster is measured and compared with the known absolute magnitude of a Cepheid of the same period, and from this the distance of the cluster is obtained immediately, provided absorption of light in interstellar space is negligible. In 1915–18 he published a noteworthy series of papers on researches on the globular clusters which brought these objects prominently before astronomers. His principal results were brought together in 1930 in his "Star Clusters". Dr. Shapley's investigations have been applied at Mount Wilson by Dr. E. P. Hubble to measure the distances of the spiral nebulæ. Recent papers from the Harvard College Observatory have discussed the distribution of the galaxies and the uniformity of distribution of matter in space. Dr. Shapley is a member of the United States National Academy of Sciences and an associate of the Royal Astronomical Society.

Colwyn Gold Medal of the Institution of the Rubber Industry

THE Colwyn Gold Medal of the Institution of the Rubber Industry has been awarded to Dr. O. de Vries, until 1930, director of the Rubber Station, Buitenzorg, for scientific work in connexion with the production of raw rubber. The medal was presented to Dr. de Vries by Sir George Beharrell, president of the Institution, on the occasion of the twelfth annual general meeting of the Institution held on January 12. Dr. O. de Vries has devoted the best part of two decades to the investigation of plantation rubber problems. His work at the Buitenzorg Testing Station in Java brought world wide fame not only to the Testing Station but also to himself. It covered a large number of problems of various types which arise between the growing of the tree and the eventual vulcanisation of the rubber in the distant factories. He cleared up many obscure plantation practices, indicating the reason, if any, for their existence. Dr. de Vries overhauled and set new standards in methods for testing plantation rubber. His investigations contributed to the further standardisation of plantation rubber and its characteristics in respect to vulcanisation and mechanical qualities. The principal aspect of Dr. de Vries's work has been his desire to ensure its availability throughout the world. The result of his investigations were published in Dutch, but with a generous disregard for the labour entailed, the publication of each investigation was accompanied by a version in English. Similarly in 1920 he produced an English translation of his well-known book on "Estate Rubber", the original Dutch version of which appeared in the following year. This book is a lasting monument to his activities.

Early Man in China

FURTHER exploration at Choukoutien has resulted in discoveries which, if less sensational than that of Peking man, are none the less of considerable importance as additions to our knowledge of the distribution of palæolithic industries and of 'modern man' in late pleistocene times. According to Prof. Davidson Black's report on field-work at Choukoutien in 1933, which was presented at the annual meeting of the Geological Society of China on November 11, and appears in this issue of NATURE (p. 89), Dr. W. C.

Pei and Mr. M. N. Pien, in excavating the grey sedimentary deposits of what is known as the "Upper Cave", have discovered human skeletal remains in association with a fauna, in part extinct, implements of stone and bone and abundant traces of fire and charcoal. These sedimentary deposits were largely unconsolidated and in contact only over a few square metres with the hard red beds and stalagmite floor capping the strata in which the relics of *Sinanthropus* were discovered. The human skeletal remains include two skulls, which fortunately are complete, though said to be "somewhat crushed"; so that there should be no question of the correctness of their attribution to *Homo sapiens*. Full description of their specific characters will be awaited with the greatest of interest, as the first specimens of 'modern man' of palæolithic age to be found in China. In view of the character and associations of the discovery, subsequent consideration should confirm rather than controvert Prof. Black's tentative conclusion as to the late pleistocene dating of the find and the correspondence of the industry with the Upper Palæolithic of Siberia and Europe. The further discovery of fossilised bones of baboon, upon which Prof. Black bases a sequence of baboon-*Sinanthropus-Homo sapiens*, points to conditions at Choukoutien which will repay exhaustive study of the site.

Indian Earthquake of January 15

AN earthquake of considerable strength and of much interest occurred in Northern India at about 2.40 p.m. on January 15. The loss of life was larger than at first appeared, 61 deaths being officially reported in the Patna district, 1,000 unofficially reported at Muzaffarhur, and smaller numbers in other districts. In its long duration and immense disturbed area, the earthquake possesses two features of a great destructive shock. An interesting point in the recent earthquake is its probable connexion with the great earthquake of June 12, 1897, described by Mr. R. D. Oldham in a report which is one of the most valuable that we possess on any earthquake. The places that suffered serious damage are (from east to west) Jamalpur, Darjeeling, Patna, Gaya (Bihar), Benares and Cawnpore. Jamalpur lies within the epicentral area of 1897. All the others are included within an area about 600 miles long from east to west. The epicentre thus seems to lie about 350 miles to the west of that of 1897. At Calcutta, about 300 miles south-east of the epicentre, the shock was so strong that the seismograph at Alipore was put out of action. The shock there is said to have lasted 8 min., the violent motion in the middle continuing for 1½ min. Durations of 5 min. at Cawnpore and 3 min. at Delhi are also reported, but strong after-shocks may be included in such estimates. At Jubbulpore (about 350 miles from the epicentre) houses were shaken so strongly that people hurried into the streets. Even at Bombay (more than 800 miles), a mild shock was felt.

THE area disturbed by the earthquake may thus amount to as much as two million square miles, or about the same as that over which the Assam earthquake of 1897 and the Kangra earthquake of 1905 were felt. The whole Himalayan arc is bounded by four great seismic regions, namely (from east to west), Assam, Nepal, the Punjab and Cashmere. Denoting these regions by the letters *A*, *B*, *C*, *D*, and confining ourselves (with one exception) to great destructive shocks, we have the following succession of areas disturbed: *D* 1828, *C* 1832, *B* 1833, *A* 1869, *B* 1869, *C* 1875 (semi-destructive), *D* 1885, *A* 1897, *C* 1905, *B* 1934, a continuous migration from *D* to *A* and back again to *D*, followed by an oscillation to the east in 1897, back to the north-west in 1905, and ending in the intermediate region in the present year.

Wave-length Changes of European Broadcasting Stations

ABOUT an hour before midnight last Sunday, January 14, a large proportion of the broadcasting stations in Europe adjusted their wave-lengths to conform with the provisions of a scheme evolved at a conference of the International Broadcasting Union held at Lucerne in May and June 1933. The object of this Lucerne Plan was to effect such a distribution of wave-lengths from a geographical point of view that the amount of interference caused to the service of any broadcasting station should be reduced to a minimum. To assist in the matter, the Plan also provides for certain maximum power limitations which differ according to the wave-length range. Unfortunately, the operation of the scheme at the present time is not completely successful because several countries declined to sign the agreement, while a few individual stations are also not abiding by the terms applicable to their country. During the first portion of the change-over programme, each broadcasting station adjusted its wave-length with the aid of its own national calibrating station. Then at about 2.30 a.m. on Monday morning the Brussels Checking Station of the International Broadcasting Union began to check the wave-lengths of the stations at the rate of twenty-four an hour, this procedure continuing until about 7.30 a.m. This checking process was resumed during Monday night after the cessation of the normal programmes.

ON the medium wave-lengths band, the changes were carried out without much difficulty and when the final adjustments have been made at certain stations, it is expected that European reception of broadcasting in general will have been appreciably improved. On the long-wave band, however, certain difficulties have resulted from the non-compliance of some countries and stations with the provisions of the scheme, but it is hoped that a convenient compromise will be reached in the near future. Listeners to British stations will not experience much difficulty in finding their new tuning adjustments, for except in the case of Bournemouth, the change was fairly small. A useful pamphlet, entitled "The Lucerne Plan", explaining the wave-length changes has been published by the B.B.C., and some of technical periodicals such as the *Wireless World* and *World Radio* have provided useful charts by means of which the new position of any European station on the wave-length scale can be ascertained.

New Chemistry Building at University of Leeds

SIR FREDERICK GOWLAND HOPKINS, president of the Royal Society, formally opened the new chemistry building at the University of Leeds, on January 12, in the presence of the Pro-Chancellor of the University, Col. C. H. Tetley, the Vice-Chancellor, Sir James Baillie, and a representative gathering of past and present members of the University and of visitors from other universities. Sir Frederick Hopkins, in an address entitled "Modes of Thought in Chemistry", stressed the importance of chemical knowledge for national progress and emphasised the importance of experimental inquiry in pure chemistry, one of the fundamental sciences. In a critical and stimulating discussion of the differences in the habits of thought of workers in the several sections of pure chemistry, he dwelt on the great results which have been achieved especially in organic chemistry by the use of a mode of thought essentially pictorial and non-mathematical, which is as necessary as the more quantitative methods of the physical chemist. After the ceremony in the large lecture theatre, an inspection was made of the new laboratories. The rapid growth of the Department under Prof. Arthur Smithells, who succeeded Sir Edward Thorpe and by whose efforts the chairs of organic and physical chemistry were instituted, called for an extension of space but for many years the only quarters available were buildings of a temporary nature and geographically separated. Now, thanks to the generous response of the public and the policy of the University Council, all the various sections of pure chemistry have been gathered together under one roof in a new building facing Woodhouse Lane, which forms the latest addition to the general scheme for the extension of the University of Leeds.

Ball Lightning

PROF. J. C. JENSEN, of Nebraska Wesleyan University, Washington, describes in *Physics*, vol. 4, October, 1933, how he was fortunate enough to photograph ball lightning when he was taking photographs of ordinary lightning in an August thunderstorm. The display of lightning was taking place in the region of the outrushing cold squall in advance of the main mass of the storm, and this squall was carrying with it great quantities of dust. In the wake of one of the flashes came the globular lightning, apparently floating slowly downwards. Two or three brilliant globular structures of the kind known as ball lightning appeared to travel along a pair of high-voltage power lines for a considerable distance, eventually falling to the ground and disappearing with a loud report. Two are clearly visible on one of the photographs, and, as their distance was known, it was an easy matter to determine their diameters, which were found to be very much larger than numerous observations of the phenomenon made elsewhere would have led one to expect, namely, 28 ft. and 42 ft. Unfortunately, ball lightning is so rare compared with ordinary lightning that the much desired confirmatory evidence of the occurrence of such large globular structures that might result from further photographs may be a long time in coming. There seems no doubt from the repeated observations of ball lightning made inside houses, and from the size of holes made by it through window-panes, that it is generally much smaller.

Mind, Brain and Survival

DR. WILLIAM BROWN, lecturing on "Modern Science and the Possibility of Survival", at the Survival League at Caxton Hall on January 11, discussed the various theories of relation of mind to brain, and expressed the view that nothing firmly established in modern science makes personal survival after bodily death intellectually inconceivable. But the task of obtaining reliable evidence is beset with enormous difficulties. The results and messages in mediumistic trance should be closely scrutinised in the light of modern knowledge of the psychology of the unconscious, and sifted with due regard to the statistical laws of chance coincidence. Spontaneous psychic experiences on the part of private individuals, though more reliable in other respects, are specially difficult to assess statistically. There is little doubt that a large proportion of the apparent evidence for survival has to be rejected by strict science ; but when all the sifting has been done there remains a small residuum very difficult to explain. Phenomena can only be fitted into a scientific system if their conditions of causation are known, and this is far from being the case with psychic phenomena, although some of the more general conditions are being gradually revealed. Very thoroughgoing psychological analysis of selected mediums will advance our knowledge considerably in this dim borderland of science, and may indicate further lines of investigation.

Administration and Management in Industry

THE number of societies and institutions dealing with the administrative or managerial side of industry is now very considerable and covers a wide and varied field in works management, costing, salesmanship, advertising, research, etc. That there is plenty of work and scope for organisations of this sort is evident enough, but there is certainly some ground for supposing that their number may soon become excessive, and some at least may be unable to obtain sufficient financial support to keep going, especially since the subscription rates are necessarily rather high and correspondingly onerous to manufacturers and their executives in these difficult times. From its name, the Institute of Industrial Administration should be capable of covering the whole territory, but it has many rivals. It is to be hoped there is room for all, and that there will be no desperate struggle for survival. The Institute held its annual general meeting on December 12, and an increase in the subscription of corporate members from 3 guineas to 5 guineas was recommended. This is to be interpreted, we hope, as a measure of increased usefulness to members rather than as an expiring clutch for more funds. The papers presented at the 1932–33 session have just been published, on

'Roneod' sheets bound in paper covers (London: Institute of Industrial Administration, 1933. 5*s*.). They are none the worse for this, and two of them deal in an effective manner with difficult problems of distribution, and another is on research in industry, by Mr. A. P. M. Fleming.

IN few branches of social study, however, is there a greater tendency to discursiveness and mere talk than in these various divisions of industrial administration, especially in salesmanship and advertising; and in fewer still is there a greater misuse of the term 'science'. In the papers here published it must be admitted that this tendency is little in evidence. They are indeed bright, brief and stimulating. The discursive tendency is perhaps exhibited most in the first paper on personal and impersonal management, by H. N. Munro, although his theme, so far as it can be definitely apprehended, seems sound enough. The next two papers, on distribution, are well worth reading and serious reflection, not only because this subject is one of the most important and difficult in the present age, but also because the authors strongly condemn that 'production complex' which is still too much in evidence in industrial management. One of them, based largely on personal experience, has an air of convincing reality and logic which is very attractive. It is scarcely necessary to say that Mr. Fleming's paper on research is characterised by his usual methodical and orderly presentation, and overwhelming arguments in support of far-sighted research policies and carefully thought-out research programmes. Other papers deal with finance and secretarial duties.

Flood and Erosion Control

AMONG the various expedients put forward for dealing with the problem of unemployment in the United States, one of considerable interest from a scientific point of view is that of Dr. L. E. Freudenthal, chairman of the Institute of Irrigation Agriculture, American Farm Bureau Federation, Las Cruces, N.M. In an address to the South-Western Division of the American Association for the Advancement of Science, which appears in *Science* of November 17, 1933, he points out that flood and erosion control are matters of national importance in America in that they are beyond the capacities of individual States to deal with. He instances the huge sums of money which have been beneficially expended on water supply, irrigation, water power and waterway undertakings and the equally enormous losses of life and property due to floods and erosion. The Mississippi flood of 1927, which inundated 18,000 square miles, drove 750,000 persons from their homes, did some 300,000,000 dollars worth of damage and took 246 lives, is, he states, an example of what is happening annually on a smaller scale in nearly every State. For the last twenty years, flood damage in South Carolina and Tennessee has averaged nearly one million dollars per annum.

THE attendant erosion of fertile lands is stated by Dr. Freudenthal to be a national menace and he quotes a report of the U.S. Bureau of Soils to the effect that not less than 126 billion pounds of plant food material is removed from the fields and pastures of the United States every year, the value of the plant food elements in the waste being 2½ billion dollars annually. Erosion, adds Dr. Freudenthal, has been the principal cause for abandoning millions of acres of cleared land, and he goes on to suggest various directions in which Government assistance might be rendered in the matter of flood control measures with the object of providing relief for unemployment, including stream regulation, tree and brush planting, contour furrowing, protective fencing and seeding. He believes that flood and erosion control work are ideally suited for unemployment relief, not only for the reasonably effective results which could be obtained, but also because of the possible excellent effect upon the unemployed themselves.

Darwin's Parish

SIR BUCKSTON BROWN'S generous gift to the British Association, in trust as a national possession, of Down House, Charles Darwin's home for forty years, and his further benefaction of the Research Farm of the Royal College of Surgeons at Downe, have revived the association with science of a secluded Kentish village which has retained much of its rural character, although within twelve miles of Charing Cross. It is sometimes forgotten that Downe was the residence of the Lubbocks and that it was here that John Lubbock, afterwards the first Lord Avebury, entered into the close and lifelong friendship with Darwin which exercised so great an influence on his scientific work. It is only reasonable to expect that those who visit Down House, now that it has become a place of scientific pilgrimage, should wish to know more of the history of its village. This need has been met in a little book ("A History of Darwin's Parish: Downe, Kent", Russell and Co., Southern Counties Ltd., Southampton, pp. viii + 88. 1*s*. 6*d*.) written by Dr. O. J. R. Howarth, secretary of the British Association, and Mrs. Howarth, with a foreword by Sir Arthur Keith, now also a resident of Downe. The parish history has nothing sensational to relate; but apart from the association with Darwin, it is interesting as a record of the life of a typical secluded English village—a life, which as the authors allow us to see by their skilful selection from humdrum records, was not without its humours and its tragedies. The evidence, which, so far as written documents are concerned, begins about A.D. 1100, is fragmentary at the best; but the authors have made the most of their material and have produced a really informative and interesting account of the parish.

Psychology in Germany

THE German Psychological Association's proceedings at its thirteenth congress, held at Leipzig on October 15–19, are reviewed in a thoughtful article, "Psychology under Hitler" by Goodwin Watson of Columbia University, in *School and Society* of

December 2. In that assembly of more than six hundred, Jewish members of the Association, among whom are many who have been leaders of psychological thought, were conspicuous by their absence—and an opening address emphasised the demand for a psychology which expresses the genuine German spirit. *Gestalt* concepts were much in evidence and underlying all discussion was the assumption that parts are influenced by their membership character in larger wholes. It seems clear that "German psychology is developing a special concern for the type of *Gestalt* which is not limited to the perceptual field, but gives us the essential way of life of a whole personality". Of great practical significance was the address of Poppelreuter on political psychology. This directs attention to an increasing preoccupation with character and life as against intellect and theories and to the change of attitude brought about by the Hitler revolution, a change from an attitude of helplessness to one of determination to create, from disunity in economic ideas, political programmes, morality and world views to a sense of a common purpose. In the new whole of German culture, psychology no less than the other sciences must contribute to the realisation of the common purpose. "American psychologists," says Dr. Watson, "surveying the scene as spectators, may well wonder how long they can retain their own very considerable isolation from the major tasks of our generation." Coming as it does from the most influential focus of psychological doctrine in the United States, the comment is not without a certain piquancy.

History of the Parsons Steam Turbine

THE first issues for 1934 of the *Engineer* contain two instalments of a series of articles to be devoted to the development of the Parsons steam turbine. It is just fifty years since Sir Charles Parsons took out his patents for improvements in electric generators and improvements in rotary motors actuated by elastic fluid pressure, and constructed his first turbo-generator. This machine developed about 7·5 kw. To-day single turbo-generators of 100,000 kw. capacity are in use, and the present estimated value of Parsons turbines alone is £152,000,000, the figures for marine and land turbines being £92,000,000 and £60,000,000 respectively. Nothing to equal that rapid extension of value and dimensions has ever happened before. The publication of the series of articles will take many weeks and will appropriately mark the jubilee of this great invention. The first article contains a detailed description of the original turbo-generator, while the second, after referring to the early development of the parallel-flow turbines, deals with the radial-flow turbines of 1889–91.

Automatic Voltage Control of Electrical Systems

THE problems which arise in connexion with maintaining the voltage of supply constant in electrical distributing systems have been closely studied by electrical engineers during recent years. The permissible variation allowed by the regulations is plus or minus four per cent of the 'declared' voltage, but the average regulation is much closer; the houses near the supply station at times of maximum load are supplied at a voltage above the declared pressure and the few near the ends of the distributing mains at a voltage below the normal. The lamps near the supply station therefore give a better light and have a shorter life than the distant lamps. In a paper read by W. Kidd and J. L. Carr to the Institution of Electrical Engineers on December 7, methods of automatic voltage regulation and switch control were described. The city of Manchester is the first area to have complete automatic voltage regulation and it also has supervisory control for its main sub-stations. By a careful application of automatically controlled regulators it is shown that the voltage on distribution networks can easily be maintained within the permissible limits. Manual control of voltage is never quite satisfactory and necessitates the uneconomic employment of additional labour. The installation of the regulating equipment gives better service to the public and removes a possible cause of complaint. It has to be remembered that a rise or fall in the voltage of one per cent increases or diminishes the light emitted by the lamp by about three per cent. Several diagrams are given showing methods of adapting existing transformers by means of automatically controlled tap-changing devices so that the voltage of supply can be kept constant at all loads.

Organisation of a Social Centre

IN a recently issued publication entitled "The Centre" (London: P. S. King and Son, Ltd. 3*d*.) various problems confronting the organisers of social centres for the unemployed are discussed by five contributors, who have had experience in the running of such centres. Special emphasis is laid on the importance of not losing sight of the individual in the mass, and of adapting the facilities provided to the needs of the individual. To prevent employables from becoming unemployable, though most desirable, is but a small part of a centre's activity. The way social centres can help best is to aid the individual to discover new powers, since this is the key to re-creation and progress. One person may need opportunities for thinking (study, reading, talks or discussions); another may wish to make something; another may prefer some form of amusement (a game, dancing, gymnastics); others again may want advice as to cooking food, mending boots, making clothes or keeping well. It is no part of the purpose of a centre to compete with or undercut existing employment. It is conceivable that certain articles such as handwoven scarves might find a ready market, but the repeated manufacture of products of the same kind is not the aim of a social centre. The work there should be undertaken for the sake of the effect which the making has upon the maker. Its purpose is to perfect the individuals and this will not be obtained by encouraging them to do the same thing over and over again.

Non-Reflecting Windows

IN connexion with the note under this title in NATURE of January 13, p. 59, a correspondent points out that the principle can be applied to the glazing of pictures and of museum cases, both of which applications were explained and discussed, with illustrations, in the *Museums Journal* of November 1932 (pp. 305–308).

The Zoological Station, Naples

THE attention of British zoologists, botanists and physiologists is directed to the facilities for research available in the Zoological Station, Naples. A Committee of Section D (Zoology) of the British Association is empowered to nominate competent research workers to a table in the Naples Station which has been maintained by the British Association since 1876. Workers so nominated are provided, without charge, with material and ordinary chemicals and apparatus. The Station possesses a considerable range of apparatus for physiological and biochemical investigations. Applications for the use of the table should be sent to the Chairman and Secretary of the Committee, Prof. J. H. Ashworth, Department of Zoology, The University, Edinburgh, and should specify the nature of the research proposed and the period for which the table is desired.

Geological Society Awards

THE following awards of the Geological Society of London have been made for this year : The Wollaston medal to Sir Henry Miers, honorary professor of crystallography in the University of Manchester, for his researches on the mineral structure of the earth, and especially in the realms of crystallography and mineralogy ; the Murchison medal to Prof. George Hickling, professor of geology in Armstrong College, Newcastle-on-Tyne, for his contributions to geological science in many branches, but especially in the stratigraphy of the Coal Measures and the structure of coal ; a Lyell medal to Dr. Finlay Lorimer Kitchin, of H.M. Geological Survey, in recognition of the value of his contributions to palæontological science ; another Lyell medal to Prof. Walter Howchin, emeritus professor of geology and palæontology in the University of Adelaide, South Australia, for his geological and palæontological researches in Australia and particularly for his investigations of ancient glacial deposits ; Wollaston fund to Dr. William Richard Jones, of the Royal School of Mines, in recognition of the value of his work in economic geology and his recent investigations in silicosis ; Murchison fund to Dr. Wilfrid Jackson, assistant keeper in the Manchester Museum, for his contributions to Pleistocene geology and palæontology and to malacology ; Lyell fund to Mr. Frederick William Shotton, in recognition of the value of his work on the Upper Palæozoic and Quaternary rocks of the Midlands.

Announcements

DR. W. CAWOOD has been appointed to a Moseley research studentship of the Royal Society, for work on the accurate determination of molecular weights of gases.

UPON the retirement from the public service of Dame Janet Campbell, as from December 31 and of Sir George Buchanan, as from February 18, Dr. Jane H. Turnbull will be in charge of the Maternity and Child Welfare Division of the Medical Staff of the Ministry of Health and Dr. J. M. Hamill will act as senior medical officer in charge of the Foods Division of the Ministry.

AT the annual general meeting of the British Ecological Society held at Cambridge on January 2–4, the following officers were elected : *President*, Prof. J. R. Matthews ; *Vice-President*, C. Oldham ; Hon. Editor of the *Journal of Ecology*, Prof. A. G. Tansley ; Hon. Editor of the *Journal of Animal Ecology*, C. S. Elton ; Hon. Secretary, Dr. H. Godwin. The Council unanimously approved the nomination of Prof. H. C. Cowles and Prof. L. Cockayne for honorary life membership of the Society.

THE twentieth International Congress on Alcoholism will be held at the Imperial Institute, South Kensington on July 30–August 3 under the presidency of Lord Astor. The aim of the Congress is to secure a comprehensive world picture of the present position concerning alcoholism in its various ramifications in social life. The mornings will be devoted to the consideration of national surveys, and the afternoons to papers on education, the influence of legislation on the consumption of alcoholic beverages, alcohol in the treatment of disease, the causes and treatment of inebriety, alcohol and eugenics, alcohol and heredity and the organisation of press work. All communications concerning the Congress should be made to the convener, Dr. C. C. Weeks, 33 Bedford Place, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Examiners for the Aeronautical Inspection Directorate of the Air Ministry—The Secretary (S.2), Air Ministry, Adastral House, Kingsway, London, W.C.2 (Jan. 26). A lecturer in pharmaceutical chemistry in the Department of Pharmacy in the Birmingham Central College—The Principal, Central Technical College, Suffolk Street, Birmingham, 1 (Jan. 31). An assistant chemist in the Royal Naval Cordite Factory, Holton Heath, Dorset—The Secretary to the Admiralty (C.E. Branch) (Feb. 3). A chief veterinary inspector for the Leicestershire County Council—The Clerk of the County Council, 10 New Street, Leicester (Feb. 3). A public analysist for the Metropolitan Borough of Fulham—The Town Clerk, Fulham, London, S.W.6 (Feb. 7). A teacher of domestic science at the National Training College of Domestic Subjects, 72, Buckingham Palace Road, London, S.W.1. A veterinary officer for the County Borough of Wallasey—The Town Clerk, Town Hall, Wallasey.

ERRATUM. In the table on p. 3 of NATURE of January 6, the heading of the third column should be "Manual workers per 100 acres" and not "Manual workers per acre".

Letters to the Editor

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

A Suggested Explanation of β-Ray Activity

IN continuation of our letter on the above subject which was published in NATURE of November 11, 1933, p. 747, we wish to add the following remarks :—

We have changed the term 'electrodivision of quantum' used in that letter to 'electrofission of quantum'. Under the intense electrical field of the nucleus, a quantum of sufficient energy undergoes *fission* into an electron and a positron, the energy being distributed between them in varying proportions, but the law of conservation of energy continues to hold good.

Our interpretation offers an unforced solution of Bohr's paradox that though the nucleus contains no electrons, free or bound, but only positive particles (α-rays, protons) and neutrons—a view which is now universally held—a β-ray can be created inside it and ejected with high speeds. It has further been established that radioactivity, whether marked by an α-ray or a β-ray disintegration, is mainly due to the leakage of loosely bound α-particles through the potential barrier. The β-ray is only a by-product, when the α-particle cannot escape, but on leaking to the second crater falls into a lower level, and gives rise to a γ-ray which undergoes fission into an electron and a positron.

We should further add that the phenomenon of 'electrofission' is different from the reverse process of annihilation of charges or conversion of radiant energy into mass postulated by many astrophysicists. For when a positron and an electron combine to form one or two γ-ray quanta, the charges do not neutralise but form a dipole which can be again disrupted into its constituents. This does not bring us nearer to the problem of the total conversion of mass to radiation, for the main amount of mass resides in the neutron, which according to one of us (Kothari) is a dipole formed of two Dirac magnetic poles of opposite sign, separated by a distance of e^2/Mc^2. The neutron evidently cannot be disrupted by the nucleus ; the binding is too strong. It may be disrupted, however, by the electromagnetic action of cosmic rays, giving rise to free magnetic poles. Such phenomena, to our knowledge, have not yet been observed.

Much other evidence, physical as well as astrophysical, in favour of these views has been obtained.

M. N. SAHA.
D. S. KOTHARI.

Allahabad.
Dec. 5.

Activities of Life and the Second Law of Thermodynamics

IN "The New Background of Science" Sir James Jeans, in discussing the activities of life in relation to the second law of thermodynamics, states that living organisms must possess some method of evading this law. He points out, for example, that a visitor to this planet from some other universe would observe various curious and highly improbable arrangements of matter, such as collections of gold in various places, numerous collections of ice in hot climates, etc. These improbable arrangements or organisations imply presumably a decrease of entropy, that is, a violation of the second law. Surely, however, these actions are functionally inter-related with other simultaneous actions ; namely, the metabolism and oxidation of food by the human organisms and the oxidation of fuel in such engines as they employ, and these causally inter-related actions involve an increase of randomness, that is, disorganisation and consequent increase of entropy. I presume that Sir James Jeans would agree that the total effect will be a net increase of entropy.

An essential feature of the second law is that a finite amount of organisation may be purchased at the expense of a greater amount of disorganisation in a series of inter-related spontaneous actions. If for a single moment the blood sugar circulating through the brains of Sir James Jeans's humans should cease to be oxidised, they would fall down unconscious and cease to be able to collect gold or ice. Is it good logic to pick out a series of actions which imply an increase of organisation and therefore a decrease of entropy, whilst neglecting simultaneous interlocked actions in the same system which involve a greater increase of entropy ; and then to announce as a mysterious result that the former actions evade the second law ? Could one not reason in a similar manner that a crystal evades the second law when we watch a crystal growing in a supersaturated solution ? No doubt the growth of the crystal involves *per se* an increase of organisation, but this increase is purchased at the expense of a greater decrease of organisation in the inter-related actions, as may very readily be demonstrated. Such examples in inorganic Nature can be multiplied almost *ad infinitum*.

I do not wish to assume the rôle of a die-hard *fidei defensor* of the science of the nineteenth century, or to assert or even suggest that the present known principles of science suffice to offer an adequate description of the phenomena of life. Indeed, in various publications I have striven to show that such an opinion or assertion would be quite unjustified. Nevertheless, I would humbly suggest that eminent physicists must not ignore the known and relevant facts of biochemistry, and that a knowledge of these facts may serve to remove a certain amount of mystery from their minds.

F. G. DONNAN.

Sir William Ramsay Laboratories of
Physical and Inorganic Chemistry,
University College,
London, W.C.1.

Artificial Production of the Blue Fluorescence of Fluorite

CATHODO-LUMINESCENCE, thermo-luminescence and phosphorescence of fluorite show the well-known rare earth lines. These are, as a rule, not conspicuous in the *fluorescence* excited by filtered ultra-violet light, except in certain cases, especially when the concentration of the rare earths is high, as in yttrofluorite and yttrocerite, but also in some ordinary fluorites, especially after suitable heat treatment.

Generally the fluorescence shows only three diffuse bands in the red, green and blue-violet, differing also in their behaviour towards temperature. As has been

shown previously[1], the capacity to emit these bands, the well-known blue one included, can be destroyed by heating and regenerated by treatment with radium rays (radio-photofluorescence).

Systematic experiments with synthetic materials, kindly prepared for us by Miss E. Rona, have proved that the element responsible for the blue band is a rare earth, most probably europium. Pure CaF_2, and CaF_2 with additions of one per mille Ce, Pr, Nd or Sm, do not show, after heating and exposure to radium rays, the blue band when examined visually with ultra-violet light; CaF_2 with Sm containing traces of Eu show it distinctly, with pure Eu very strongly, with Gd weaker, with Tb, Dy, or Ho not perceptibly. With one per mille Eu and suitable heat-treatment, we obtained preparations that fluoresce, after radium treatment, with purple light; prolonged ultra-violet illumination destroys the red band and the preparation then emits a beautiful blue light, which, in intensity and colour, exactly matches the fluorescence of the best English fluorites. Spectrograms of the fluorescence of such a natural fluorite (Weardale) show, after sufficiently long exposure, amongst other lines, several coinciding with europium lines. Also when the preparations are diluted to one-tenth per mille the one containing Eu gives the greatest intensity of the blue band.

A more detailed report will be presented to the Vienna Academy of Sciences in due course, when the influence of the other rare earths and of their concentration have been examined.

H. HABERLANDT.
BERTA KARLIK.
K. PRZIBRAM.

Institut für Radiumforschung,
Vienna.
Dec. 9.

[1] H. Haberlandt and K. Przibram, *Mitt. Inst. Rad.-Forsch.*, No. 313, *Wien. Ber.*, IIa, **142**, 235; 1933.

Interpretation of the Benedicks Effect

ACCORDING to Benedicks[1], thermoelectric forces should exist even in a homogeneous substance, if only the gradient of temperature is asymmetrically distributed. For example, a potential difference should occur at the ends of a homogeneous wire when both are kept at the same temperature, if a point in between is heated in such a way that the decrease of temperature takes place in a much shorter interval at one side compared with the other. The ordinary theory of conduction leads to effects which depend on the total temperature difference only and not on the length of the interval. Considerable doubt[2] has been expressed, therefore, as to the reality of this Benedicks effect. By quite a simple macroscopic consideration, however, its existence can be demonstrated and also its maximum magnitude in a limiting case can be derived.

The conditions for the Benedicks effect must be such that the assumptions of the ordinary theory of conductivity cease to be valid. The only possibility for this, so far as I can see, consists in gradients of temperature so high that a considerable variation of temperature (compared with temperature itself) occurs in an interval short compared with the mean free path l of the electrons.

A general theory for this case seems to be extremely difficult, but one may hope for simplification in the limiting case of a sharp jump of temperature (with a breadth small compared with l). Even this offers still a rather complicated problem, as the distribution function for the electrons near the discontinuity is influenced by the neighbourhood of the material with a different temperature and is not simply the distribution calculated in the ordinary way for a homogeneous material. (In the case of a contact of two different materials at the same temperature, it can be easily shown that the distribution is not disturbed, the ordinary theory remaining valid therefore.) It is only if the 'back diffusion' of the electrons returning from the other side of the discontinuity can be neglected, that conditions become more simple, as the distribution remains the ordinary one up to the contact itself.

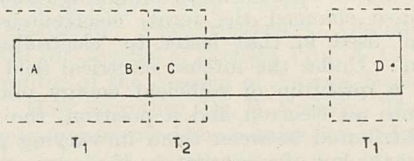

FIG. 1.

This can be arrived at in two ways. Either the dimensions of the contact are to be small compared with l (so that we have, say, a hole, as in the Knudsen effect), or an intermediate layer (for example, a potential barrier of some sort) is present, which reflects the greater part of the impinging electrons, transmitting a small fraction only. Such a hole conforms to a degree to the usual experimental conditions, as the cross-section of the contact is kept as small as possible to obtain a high gradient of temperature.

Consider, therefore, a 'Benedicks chain' as in Fig. 1, with a sharp jump of temperature and a suitable contact (hole or barrier) between the points B and C. The potential difference φ_B between the

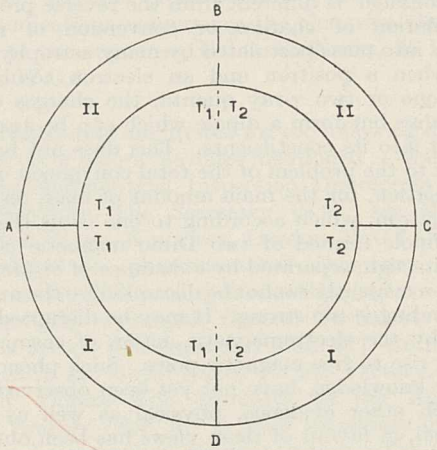

FIG. 2.

points A and D (kept at the same temperature, T_1) consists then of two parts:

$$\varphi_B = \varphi_D \left|\begin{matrix} T_1 \\ T_2 \end{matrix}\right. + \varphi_T \left|\begin{matrix} T_2 \\ T_1 \end{matrix}\right. = (\varphi_D - \varphi_T) \left|\begin{matrix} T_1 \\ T_2 \end{matrix}\right. ; \qquad (1)$$

φ_D at the discontinuity and φ_T of the slow gradient between C and D. The equilibrium condition (if one neglects the 'back diffusion') consists then simply in the equality of the numbers of electrons transmitted from both sides of the discontinuity. As the number of incident electrons on a surface increases with temperature, a potential difference must be built up, which retains the surplus from the hotter side. (It is assumed that the distribution function

is not changed appreciably by the space charge, which, for good conductors, certainly is justified.)

In order to calculate φ_B, consider a chain as in Fig. 2 with two opposite jumps of temperature in two different materials. This chain does not give rise to an E.M.F. As, with our assumption, simple differences of currents from both sides have to be considered at all contacts, one can remove intermediate links without disturbing the balance. At this point it is essential to neglect the back diffusion, as, otherwise, the numbers of electrons outgoing from both ends of the link A–B will not be the same. Furthermore, one has to assume that the number of electrons for unit surface, which are retained by a given potential difference, does not depend appreciably either on temperature or on the nature of the metal. This condition is fulfilled, if the electrons are in a state of high degeneration, that is for all ordinary metals.

If we transpose in the above sense the 'hole' at B to the contact at A, and D to C, a symmetrical arrangement remains (one metal at T_1, the other one at T_2, and at both contacts a sharp jump of temperature) and, therefore, neither chain (the transposed or the original one) can give rise to any current.

If we substitute in the original chain a slow transition of temperature in solid material for the sharp discontinuities at B and D, there remains simply an ordinary thermocouple with a corresponding E.M.F. $F_{\mathrm{I,II}}$. If we write down this balance we obtain the relation :

$$0 = F_{\mathrm{I,II}} + \left(\varphi_D \Big|_{T_2}^{T_1} - \varphi_T \Big|_{T_2}^{T_1}\right)_{\mathrm{II}} = \left(\varphi_D \Big|_{T_2}^{T_1} - \varphi_T \Big|_{T_2}^{T_1}\right)_{\mathrm{I}} \quad (2)$$

or with (1)

$$- F_{\mathrm{I,II}} = \varphi_{B\mathrm{II}} \Big|_{T_2}^{T_1} - \varphi_{B\mathrm{I}} \Big|_{T_2}^{T_1}. \quad (3)$$

Now, the E.M.F. of a chain can always be written as the difference of two functions characteristic for each of the two constituents.

$$F_{\mathrm{I,II}} = F_{\mathrm{I}} \Big|_{T_2}^{T_1} - F_{\mathrm{II}} \Big|_{T_2}^{T_1}; \quad (4)$$

and we obtain, therefore, by comparison with (3), the general result :

$$\varphi_B \Big|_{T_2}^{T_1} = F \Big|_{T_2}^{T_1}; \quad (5)$$

that is, the potential of our special Benedicks chain is a magnitude which can be described as an absolute thermoelectric potential for a single material. It is, therefore, of the same order of magnitude as ordinary thermoelectric potentials.

It is to be noticed that the above result, though independent of any special model, is only valid for a suitable contact and a sharp discontinuity of temperature. It represents clearly the maximum effect possible. But as, according to our present picture, the free path comes out rather large, especially for low temperatures, where it reaches macroscopic dimensions, it should not be impossible to measure this effect.

A more complete discussion, together with a kinetic derivation and a treatment of related subjects, will shortly appear in the reports of the Réunion Int. de Chimie-Physique, Paris, 1933 ("Act. Sci. et Ind.", Paris, Hermann) and the *Nachr. Goett. Ak. Wiss.*

Institut Henri Poincaré, Paris.
Nov. 12.

LOTHAR NORDHEIM.

[1] Benedicks, *Ergebn. d Exakt. Natw.*, 8, 25 ; 1929.
[2] "Handb. Phys.", vol., 13, p. 200.

Chemistry of Cheddar Cheese-making

SINCE its introduction by Lloyd in 1895 in the south-western counties of England, the determination of the acidity of the whey exuding from the curd has been regularly used by cheese-makers as a means of timing the manufacturing operations. The acidities are generally expressed as percentages of lactic acid in the whey. During the later stages of the process, it is found frequently that there is a fall in acidity in the whey, more especially after the salt has been added. No valid explanation has been put forward for this fall in acidity, apart from the obvious ones, namely, that the whey after salting is diluted with fat and salt, and the acidity might be expected to fall.

Determination of lactic acid in the wheys at various stages in the Cheddar cheese-making process have shown that there is a steady and continuous rise in the percentage present, even through the salting stage, despite the fact that the titratable acidity at this latter stage either falls or shows no appreciable rise. The rise in lactic acid content is accompanied by a very marked rise in calcium content (already noted by Lloyd) and the lactic acid is carried out in the whey as calcium lactate which does not exert any appreciable buffer action at hydrogen ion concentrations intermediate between the normal hydrogen ion concentration of wheys and the phenolphthalein end point.

Determination of the lactose content of whey has shown that there is a sharp fall in the percentage of lactose in the water of the whey liberated by the addition of salt at the salting stage. This is due to a diffusion outwards of water from the curd, and probably to a liberation of bound water from the curd. The addition of salt to curd at any of the earlier stages of the cheese-making process produces a similar sharp fall in the lactose content of the whey, calculated on the basis of the water content ; whereas the whey from the unsalted curd shows a steady fall in lactose content. That rennet curd contains a considerable quantity of bound water is indicated by the fact that the proportion of lactose to water in the whey immediately after the curd is cut is greater than the proportion in the original milk, indicating that about 2 per cent of the water in milk is bound, that is, cheese curd will contain a quantity of bound water equal to about four fifths of its casein content.

An attempt to throw some light on the action of salt on cheese curd has yielded interesting results. Sodium sulphate was added to milk to give a concentration of 0·1 per cent SO_4 radicle. The proportion of SO_4 to water in the whey showed a slight fall until the salting stage was reached ; after which there was a sharp rise of about 50 per cent, despite the fact already referred to above, that there is a dilution of the whey either by osmosis or by the liberation of bound water. No well-founded explanation is submitted for this observation, but it is suggested that the curd may be acting as a membrane and that the rise in SO_4 content is a Donnan equilibrium effect.

These matters are receiving further attention at this Institute.

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Palmerston North,
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Nov. 2.

Condensation of Water in the Atmosphere

IN NATURE of December 16, p. 938, it is stated: "A number of workers, notably Defant, Köhler, Niederdorfer, claim to have shown that the volume of droplets in the atmosphere are most frequently integral multiples of some standard minimum size". The "law" claimed by Defant and Köhler is much more interesting than this statement implies.

In 1905 Defant measured raindrops: the smallest drops were less than 1/40th of a milligram in weight, while the largest were more than 100 milligrams.

The outstanding feature of the result which Defant claimed to have established was that the most frequent sizes (weights) of raindrops were in the ratio 1 : 2 : 4 : 8 : 16, etc. Defant found two such series. In the principal series the unit was 0·115 mgm., and in the secondary series it was 0·35 mgm. or three times as heavy. Thus the two series can be represented as $1x$, $2x$, $4x$, $8x$, etc. and $3x$, $6x$, $12x$, $24x$, etc. where x is 0·115 mgm. This immediately suggests three things:

(i) Primary drops tend to be of the same size.

(ii) Large drops tend to be formed by coalescence of drops rather than by continuous growth.

(iii) Gravity is an effective operating agent in the formation of compound drops.

If one had (i) and (ii) alone, then drops would tend to be 1, 2, 3, 4, etc., times the primal drop; that is, the integral multiple law would hold. The "law of 2" necessitates a sorting of the drops by the action of gravity. Such a sorting by gravity is indeed inescapable: rain does fall on places not themselves in cloud. I remember mentioning this twenty-five years ago in a letter to the late Prof. Poynting about his note on the rate of fall of cloud drops in the first edition of the volume on "Heat" in the Text Books of Physics series, and in later editions he referred to Defant's work.

These measurements by Defant were made with raindrops. Köhler, many years later, measured the sizes of drops in fogs and clouds, and came to the conclusion that for these drops, also, the same "law of 2" held. These drops have a diameter 100 times less than Defant's raindrops, and weights 1,000,000 times less[1]. At that time I wrote: "Independent testimony—dare one hope from Scotland—is required of the 'law of 2' before it can be included among the established facts of meteorology". It appears from the article in NATURE of December 16 that not only does Scotland stand where it did, but that the testimony is not yet complete.

E. GOLD.

8, Hurst Close, N.W.11.
Dec. 19.

[1] NATURE, **119**, 654, April 30, 1927.

Measurements of Submarine Daylight

IN the course of the last nine years Poole and Atkins[1] have developed a very ingenious method for measuring the intensity of the daylight penetrating into the sea by means of alkali-metal photo-cells, using a delicate balance method for measuring the very weak photo-currents. The many vagaries of the photo-cells make measurements with this contrivance rather difficult to any but trained experimenters. In order to find a simpler and less expensive method of measuring submarine daylight we have used the novel 'Sperrschicht' selenite photo-cells due to Dr. B. Lange. As these cells give a photo-current several hundred times more intense than the most sensitive of the alkali cells, it is possible to use an ordinary pointer galvanometer, or some similar instrument, for the observations, while at the same time they are simpler and more easily manipulated by relatively untrained observers. The instrument used for our measurements gave a deflection of one scale-unit for $3{\cdot}76 \times 10^{-7}$ amperes and could be read to within 0·1 scale-unit. Another advantage of the Lange cell is its broad maximum of sensibility between 4500 and 5500 A., that is, with its centre near the minimum of light-extinction found by Knudsen for coastal water at 5100 A. The narrow region of maximum sensibility characteristic of the potassium cell is situated much nearer the violet end of the spectrum.

We have been using the Lange cell, protected from the water by a thick disc of plate-glass, externally roughened, within a strong box of brass, into which a rubber-insulated cable holding two 0·75 mm.^{2} copper wires for the photo-current passes from below. Readings taken, first when the instrument was being lowered into the sea, then repeated at the same depths while it was being raised to the surface, agreed closely *inter se* and showed characteristic variations in the transparency, apparently due to plankton or to detritus suspended in the water. On a clear day in August the submarine daylight in the central Baltic Sea could be measured by this simple contrivance down to a depth of 50 metres. With the cell inverted, its sensitive surface facing downwards, the light scattered upwards could be measured down to 25 metres.

Two similar instruments combined with a registering galvanometer have for the last three months been used for recording continuously the variations in submarine daylight in the Gullmar Fjord, here suspended from our observation pier, one in 15 metres depth and the other cell one metre below the surface. We believe the instrument will become useful to oceanographers for making rapid surveys of the transparency of the water at different depths and also for studying the relationship between the light-factor and the flowering of the phyto-plankton. A more detailed report is being published in *Meddelanden från Göteborgs Högskolas Oceanografiska Institution*.

HANS PETTERSSON.
SVANTE LANDBERG.

Bornö Station.
Nov.

[1] *J. Marine Biol. Assoc.*, **14**, 177; 1926; **15**, 485; 1928; **16**, 297; 1929. Also *Biol. Bulletin*, **65**, 317; 1933.

Structure of Collagen Fibres and the Point of Attack by Proteolytic Enzymes

SOME recent work by Bergmann and his colleagues has shown that the action of trypsin on gelatin gels is limited to the surface of the gel[1] and that the action on fresh collagen fibres is limited to the cut ends of the fibres[2], the enzymes having apparently no power to attack the fibres from their sides. Some observations made here on the penetration of bacteria into putrefying hide suggest that the same generalisation can be applied to the bacterial proteases.

It has been observed that the organisms penetrate the experimental pieces most readily from their cut edges and from the inner or 'flesh' surface, penetration from the outer or hair surface being very slow. According to Kaye[3], the reticular fibres of skin, which hold the collagen fibres and fibre bundles together,

are readily attacked by bacteria. Bacterial penetration between the collagen fibres can occur therefore through the hydrolysis of the reticular fibres.

A microscopical study of the penetration of bacteria suggests, however, that the sides of the collagen fibres have considerable resistance to the action of the proteolytic enzymes of bacteria. It is well recognised that keratins are resistant to proteolytic enzymes and the resistance of the hides to penetration of bacteria from the hair surface is doubtless due to the keratinous outer layers of the epidermis. It was recently observed, in examining a consignment of hides from Kenya, that putrefaction commonly occurred along brand marks and cuts on the flesh surface caused by bad flaying, even when the rest of the hide was free from any sign of taint. The putrefactive bacteria evidently gained access into the hides at the cut ends of the fibres on the flesh side and through the epidermis where it had been thinned and changed in character as in the regeneration that follows after burning, that is, in the condition found in a brand mark. The fact that the brand marks had been denuded of their protecting hair may also play some part in the greater tendency of these parts to putrefy—more organisms having possibly been deposited on them during the curing process. These hides were a consignment cured under experimental conditions through the co-operation of the Government of Kenya and the Imperial Institute, by the courtesy of which we were able to examine them.

The suggestion that proteolytic enzymes can attack collagen fibres with ease at their cut ends, but only with difficulty at their sides, is in accord with the molecular structure of collagen fibres recently suggested by one of us[3]. It is also in accord with the demonstration made by Marriott[4] that the shearing strain of the cutting tool alters the character of the collagen, making it take on the properties of gelatin. This change can now be interpreted as due to a change in molecular structure rather than chemical nature.

D. JORDAN LLOYD.
M. E. ROBERTSON.
British Leather Manufacturers' Research Association,
20, St. Thomas St.,
London, S.E.1.

[1] M. Bergmann and F. Töhr, *Biochem. Z.*, **264**, 246; 1933.
[2] M. Bergmann, G. Pojarlieff, H. Thiele, *Collegium*, 582; 1933.
[3] D. Jordan Lloyd, R. H. Marriott, W. B. Pleass, *Trans. Faraday Soc.*, **29**, 554; 1933.
[4] R. H. Marriott, *J. Internat. Soc. Leather Trade Chem.*, 1932.

Mr. H. R. A. Mallock, F.R.S.

THE obituary notice of the late Mr. Mallock in NATURE of January 6 refers to his experiments on the trajectories and extreme range of rifle bullets. It was in 1896 that I began an association with Mr. Arnulph Mallock which continued actively until his health failed a few years ago. He was always interested in rifle matters as well as in big guns, and first came to me at the suggestion of the late Sir Henry Halford, whom he knew through Mr. W. E. Metford, to consult me as to an optical rifle sight which he had devised. Together we made at various times many experiments, such as one on the rate of increase of the velocity of a bullet when fired; a ballistic pendulum was used and the barrel was cut down by stages. In connexion with questions of air resistance, he also carried out trials with bullets having a velocity as high as 4,000 ft. per sec., using for this purpose a special cordite and a bullet of spherical shape.

The notice in NATURE mentions Mallock's work in ascertaining the extreme range reached by rifle bullets, about which no great certainty existed, by a new and successful method. It was in 1910 and 1911 that, by the kindness of Sir Andrew Noble, we were enabled to fire into the water parallel to a long stretch of shore on Loch Fyne, Mallock with other observers taking up positions approximately opposite the point at which the bullets fell into the water when fired with increasing angles of elevation. It had been thought that in calm conditions—for calm was in any case essential—the splash made by the bullet would be visible, but beyond 2,000 yards it could not be seen. However, the 'plop' of the bullet as it struck the water could be heard, and it was found by all who assisted that its direction could be located with unexpected accuracy and plotted in relation to the opposite shore half a mile away. In this way groups of shots were mapped. Shooting was done on five days in the very early mornings, and the 0·303 in. rifle was fired with different loads, and also the 0·280 rifle, up to extreme range. It was found that with the present pattern of 0·303 Service cartridge (Mark VII), then newly adopted, the extreme range was 3,400–3,500 yards, the height reached by the bullet being about 3,500 ft. and the time of flight about 28 seconds. The angle giving the maximum range was a little more than 30°; firing with angles of 35° and 40° showed the shortening of the range. The method of firing into water for long range trials has since come into use in Great Britain and elsewhere.

Mallock, in the years before his marriage, habitually worked through the night at his laboratory in Victoria Street, to avoid interruption. There were a surprising number of directions in which he applied his great knowledge, which was always at the service of others. It may be worth noting that he always firmly believed the helicopter to offer the final solution of the problem of safe and practical flying. He had great musical gifts, and an amazing memory, which made his conversation full of interest.

COTTESLOE.
Swanbourne,
Bletchley,
Bucks.
Jan. 6.

Leonids Observations from an Aeroplane

THE weather conditions in November 1933 being unfavourable, it was decided by the United Czechoslovak Observatories (National Observatory, University Observatory, Stefanik Observatory) to use an aeroplane for observations of the Leonids.

Opportunity was given by the Czechoslovak Government and the Public Airlines Company to provide a three-engined Fokker for meteor observations. According to C. C. Wylie, in *Popular Astronomy*, 41, p. 170, the maximum was to be expected in the night of November 16–17. On this date the night was thoroughly cloudy and all preparations for the flight being made, the Fokker left the airport of Prague at 1^h 30^m (M.E.T.). There were three observers: Dr. E. Buchar, Dr. V. Guth, Dr. H. Slouka, one assistant, Mr. Bláha, the pilot and the radio-operator. The first observations were made at a height of 1000 m. but growing clouds and mist forced the pilot to ascend to 3000 m. The view

of the observers was somewhat limited by the wings; Dr. Guth, who was at the rear window of the aeroplane, had the best view. The windows were open and the fields of view were estimated in square degrees.

The following observations were made:

Nov. 17. Time 1.30–2.30 (M.E.T.)

Observer	Field of view in square degrees	No. of meteors	No. of Leonids
Bláha ..	1000	2	2
Buchar ..	1200	5	5
Guth ..	2500	12	10
Slouka ..	1200	4	3

Contrary to expectation, this year's Leonids were decidedly few, or the maximum was shifted a few hours or days and was not observed because of bad weather.

The usefulness of aeroplanes for meteor observations was proved beyond a doubt, and preparations are being made for the modification of an aeroplane so that the observers will have an unlimited field of view.

HUBERT SLOUKA.

Astronomicky Ustav,
Karlovy University,
Prague.
Dec. 23.

External Leaf-Characters of the Cricket-Bat and other Willows

IN a recent paper, Dr. J. Burtt Davy gives photographs showing the size and spacing of 'surface dots' on the upper side of the leaves of *Salix alba* L., *S. fragilis* L. and × *S. viridis* var. *eleyensis*[1]. It has been suggested that these surface dots, which occur in willow leaves generally, may be of diagnostic value in determining the true cricket-bat willow, *S. alba* var. *cærulea*, Smith; and an investigation of this feature has accordingly been undertaken.

The 'surface dots' represent *stomata*, which in willow occur on the upper as well as on the lower surface of the leaves; and it must be fully recognised that the evidence of many independent workers indicates that there is no diagnostic value in the size of stomata, or in their number per unit area of the leaf[2]. Such, in general, after an examination of a large number of leaves, is my own conclusion with regard to the various species of willow.

It is, however, possible that if completely comparable mature material of different species and varieties, grown under exactly similar conditions of soil, water-supply and exposure to light and air, could be used, rough estimates of stomatal frequency might be made with the aid of a good lens, which might be of some help in diagnosis. From an examination of such comparable material, *S. alba*, for example, was found to have roughly twice as many surface dots as *S. fragilis*. Actual counts of the number of stomata per square millimetre were made by removing the epidermis from leaves by means of a weak macerating agent, and examining microscopically. The counts were most probably comparable, for the material was treated in the same way in the different cases, and was in the same condition before treatment; they gave an average of 114 per sq. mm. for *S. alba*, and of 50 for *S. fragilis*. It must not be concluded, however, that 114 and 50 represent the *actual* number of stomata per sq. mm. when the epidermis was in position on the leaf; for the area of a *detached* portion of epidermis is not necessarily the same as when held in position by the underlying leaf-tissues; epidermis may shrink or stretch when removed, according to the condition of the underlying tissues.

Unfortunately, surface dots did not provide a diagnostic difference between *S. alba* and var. *cærulea* in the comparable material examined, for the number was approximately the same in the two cases (113 per sq. mm. in var. *cærulea*). Dr. Burtt Davy notes that Dr. Floderus, of Stockholm, is unable to recognise var. *cærulea* as distinct from *S. alba*[3]; it was certainly not decisively differentiated by the frequency of the stomata in the leaves for which counts were made. Further, it must be noted that surface dots do not provide a reliable means of distinguishing × *S. viridis* var. *eleyensis* from *S. alba* in the field.

Mention may also be made of the hairiness of the surfaces of old leaves of *S. alba* and var. *cærulea*. It is frequently stated that such leaves of var. *cærulea* are glabrous on the lower side, and that they are thereby distinguishable from those of *S. alba*. They were, however, found not to be consistently glabrous; var. *cærulea* is thus not certainly distinct from *S. alba* in this character also; for, like the spacing of stomata, hairiness is a surface feature varying with external conditions.

These notes are contributed by way of warning field-workers on the bat-willow problem that external leaf-characters do not provide consistent and reliable diagnostic data unless used with extreme discretion.

H. BANCROFT.

Imperial Forestry Institute,
University of Oxford.
Dec. 20.

[1] "The Cricket-bat Willow Problem". Reprint from *Quart. J. Forestry*, 1932.
[2] See Odell, M. E., "The Determination of Fossil Angiosperms by the Characters of their Vegetative Organs". *Ann. Bot.*, **46**, 941. Note especially pp. 951–56 and references.
[3] *loc. cit.*, p. 7.

The Term 'Mesolithic'

I HOPE I may be allowed to call myself an archæologist, although a very humble one, yet I find myself in complete disagreement with my friend Mr. Reid Moir in NATURE of December 30, p. 1006. After C. J. Thomsen[1] had in 1836 revived the idea of Lucretius[2] and divided the past history of man into the three ages of stone, bronze and iron, there was one stone age, but when the discoveries of Boucher de Perthes had been recognised by English savants, Sir John Evans[3] in 1859 pointed out that this age must be divided into two, that in which the *fauna* was extinct and that in which it was recent. Later on, Sir John Lubbock[4] suggested that these two periods should be termed respectively the palæolithic and neolithic ages. It was soon noted, however, that these ages did not pass into one another, but that between them there was a great gulf fixed, and this became known as the great hiatus.

About the same time an opportunity occurred to bridge this gulf, for in 1860 Profs. Steenstrup, Forchhammer and Worsae were appointed a committee to investigate the shell-mounds that had recently been discovered on the shores of Jutland[5]. These savants differed as to where this culture was to be placed, for, whereas Worsae suggested that these remains should be relegated to a late phase of the Old Stone Age, Steenstrup allotted them to the true Neolithic Age. To effect a compromise, Lubbock suggested that these remains should be referred to an early Neolithic period[6], in which they remained for many years.

By degrees other industries were found which could neither be placed in the Old Stone Age or the

New, and matters came to a head with the discovery of the deposit in the cave of Mas d'Azil, first explored by Piette in 1887[7], and continued for several years. The study of these implements led him in 1895 to suggest that there was a transitional period between the Palæolithic and the Neolithic Ages[8]. He had, however, been anticipated in this, for on March 8, 1892, Mr. John Allen Brown read a paper before the Anthropological Institute, postulating the existence of a Mesolithic Age[9].

The paper by Piette, the remains from the cave of Mas d'Azil, the microlithic industry found by E. Vielle in 1879 in the park of the Chateau of Fère near Fère-en-Tardenois[10], and the early culture found in 1903 by Sarauw at Maglemose[11], persuaded the archæologists of France to insert a transitional phase between the Old and the New Stone Ages. This was clearly set out by Déchelette in 1908[12], though in deference to the views of the Danish archæologists he excluded from this phase the culture of the shell-mounds, which he left standing alone in an early Neolithic Age. This treatment was followed by Sollas[13] in 1911 and 1924, and by Burkitt[14] in 1921, but in the latter year Macalister[15] boldly included the shell-mound culture in a period that he called Mesolithic.

The advantages of this new arrangement seem obvious. Palæolithic remains are found associated with an extinct *fauna* and glacial or interglacial environments. True Neolithic remains are associated with agriculture, domesticated animals, pottery and ground or polished implements. There are, however, cultures that have neither kind of association and lie for the most part between the two others in time. What more natural than to treat them as a series apart and call them Mesolithic ?

At first some writers, notably Gordon Childe[16], feeling that these cultures were really rather an appendix to the Palæolithic Age than an entirely new phase, used for them the term Epipalæolithic, a name first introduced by Obermaier in a slightly different connotation. It is undoubtedly more logical, but Mesolithic has the advantage of being shorter and so has won the day. At last, after a struggle of nearly forty years a Mesolithic Age has been adopted by all archæologists except Mr. Reid Moir.

The Museum,
Newbury.
Jan. 1.

HAROLD J. E. PEAKE.

[1] Thomsen, C. J., "Ledetraad til Nordisk Old Kyndighed" (Copenhagen, 1836).
[2] Lucretius, "De Rerum Naturæ", **5**, 1282–96.
[3] Evans, J., in *Archæologia*, **38**, 293. cf. *Phil. Trans.*, 311 ; 1860.
[4] Lubbock, J., "On the evidence of the Antiquity of Man afforded by the Physical Structure of the Somme Valley", *Nat. Hist. Rev.*, 144–169 ; 1862. *Prehistoric Times* (London, 1865).
[5] "Undersögelser i geologisk-antiquarisk Retning af G. Forchhammer, J. Steenstrup, og J. Worsae. cf. also *Mem. Soc. Vaudois*, **6** ; 1860.
[6] Lubbock, J., "Prehistoric Times" (London, 1865), p. 196.
[7] Piette, E., *L'Anthropologie*, **5**, 129–146 ; **6**, 276–292 ; **7**, 1–17, 309, 385–427 ; **14**, 641–653 ; **16**, 1–11.
[8] Piette, E., " 'Hiatus et lacune', vestiges de la période de transition dans la grotte du Mas d'Azil." *Bull. Soc. d'anthrop. Paris*, Ser. iv. **6**, 235. cf. also *L'Anthropologie*, **6**, 276.
[9] Brown, John Allen, "On the continuity of the Palæolithic and Neolithic Periods", *J. Anthrop. Inst.*, **22**, 66–98 ; 1893.
[10] Vielle, E., "Pointes de flèches typiques de Fère-en-Tardenois", *Bull. Soc. d'anthrop. Paris*, Ser. iv, **1**, 959 ; 1890.
[11] Sarauw, G. F. L., "En Stenalders Boplads i Maglemose ved Mallerup", *Aarbøger for nordisk Oldkyndighad og historie*, Ser. ii, **18**, 148 ; 1903.
[12] Déchelette, J., "Manuel d'archeologie" (Paris, 1908), 1, ii, Ch. 1.
[13] Sollas, W. J., "Ancient Hunters" (London, 1911 and 1924), Ch. xiii.
[14] Burkitt, M. C., "Prehistory" (Cambridge, 1921), Ch. xii.
[15] Macalister, R. A. S., "A Text-book of European Archæology", Vol. 1 (Cambridge, 1921), 516–7.
[16] Childe, V. Gordon, "Dawn of European Civilisation" (London, 1925), Ch. i.

Influence of Pressure on the Spontaneous Inflammation of Hydrocarbons

NEARLY a year ago we investigated the conditions of spontaneous inflammation in mixtures of pentane and oxygen at pressures from 5 cm. to 140 cm. by admitting the gases into an evacuated metal vessel. We were not satisfied with the data obtained, since the experimental points showed considerable scattering, and the work was therefore not published.

The curves obtained by us for the mixture $C_5H_{12} + 8O_2$ in an iron bomb and in a bomb the inner surface of which was covered with gold (Fig. 1) have sharp kinks in the region of 60 cm. We were, therefore, able to draw the conclusion that there are two different ways in which the oxidation may

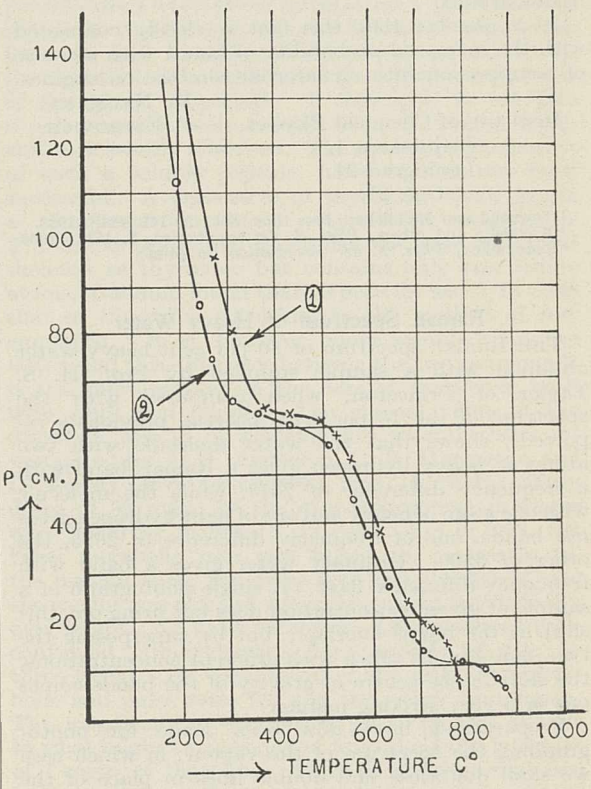

FIG. 1. Pressure-temperature curves for spontaneous inflammation of the mixture $C_5H_{12} + 8O_2$ in (1) iron vessels, (2) gilded vessels.

proceed, each of which prevails in a definite region of pressure.

Townend and Mandlekar[1] have recently investigated the inflammation of butane-air mixtures and have found that the curves have distinct breaks in the pressure region between $1\frac{3}{4}$ and 3 atmospheres. They explain this fact on Bone's hydroxylation theory :

$$\begin{array}{ccccccc} R.CH_3 & \rightarrow & R.CH_2OH & \rightarrow & R.CHO & \rightarrow & R.COOH \rightarrow \text{etc.} \\ & & \downarrow & & \downarrow & & \downarrow \\ & & \overbrace{RH + CO + H_2} & & \overbrace{RH + CO} & & \overbrace{R.OH + CO}. \end{array}$$

At high pressures, ignition probably arises as the result of the rapid oxidation of an aldehyde or other intermediate oxygenated product which may occur at temperatures of about 300° C. ; at low pressures, conditions are more favourable to the thermal decomposition of these bodies into hydrogen, carbon

monoxide, methane, etc., the ignition of which does not occur until much higher temperatures have been attained.

This hypothesis finds support in work carried out at the Leningrad Institute of Chemical Physics. Thus Kovalsky[2] has found that at low pressures the oxidation of methane is accompanied by the formation of carbon monoxide in large quantities. Sadovnikov[3] has recently shown that at low pressures, during the inflammation of ethane-oxygen mixtures, carbon monoxide accumulates and then explodes.

From our own experimental results, we are able to apply the above hypothesis, used for butane mixtures, to pentane mixtures. The existence of a sudden lowering of the inflammation temperature at any critical pressure may therefore be considered to be quite general for the inflammation of complex hydrocarbons.

It is possible that this fact is closely connected with the increased probability of knock with increase of compression ratio in internal combustion engines.

M. NEUMANN.
Institute of Chemical Physics, V. ESTROVICH.
Prijutskaja 1,
Leningrad 21.
Oct. 27.

[1] Townend and Mandlekar, *Proc. Roy. Soc.*, A, **141**, 484; 1933.
[2] Kovalsky and others, *Phys. Z. der Sowjetunion*, **1**, 451; 1932.
[3] Sadovnikov, *Phys. Z. der Sowjetunion* (in print).

Raman Spectrum of Heavy Water

THE Raman spectrum of 80 per cent heavy water obtained with a sample supplied by Prof. H. S. Taylor of Princeton, when compared with the spectrum of the 18 per cent material previously reported[1], shows that the water molecule with two atoms of heavy hydrogen gives a Raman band with a frequency difference of 2517, while the molecule with one atom of heavy and one of light hydrogen gives *two* bands, one of frequency difference of 2623, the other of 3500. Ordinary water gives a band with frequency difference 3445. A single photograph of a sample of given concentration does not bring out this shift as the bands overlap; but by superposing the two photographs taken with different concentrations, the shift in the centre of gravity of the bands comes out in a very striking manner.

Preparations have now been made for photographing the spectrum of the vapour, in which case we shall doubtless find double lines in place of the superposed and slightly shifted bands.

Johns Hopkins University, R. W. WOOD.
Baltimore.
Jan. 2.

[1] NATURE, **132**, 970, Dec. 23, 1933.

Molecular Polarisations of Nitrobenzene in Various Solvents at 25° C.

A STUDY of the dielectric constants, densities and refractivities of dilute solutions of nitrobenzene in various solvents at 25° C. has been made in these laboratories with the following results:

Solvent	ε	$_{\infty}P_2$ c.c.	$_{\infty}P_{A+O}$ c.c.	μ
n-Hexane ..	1·887	372·5	339·9	$4{\cdot}049\times10^{-18}$ E.S.U.
cyclo-Hexane ..	2·016	360·0	327·4	3·974 ,,
Dekalin	2·162	352·9	320·3	3·930 ,,
Carbon tetrachloride	2·228	353·1	320·5	3·932 ,,
Benzene	2·273	353·8	321·2	3·936 ,,
Carbon disulphide..	2·633	310·0	277·4	3·658 ,,
Chloroform ..	4·722	241·2	208·6	3·172 ,,

$_{\infty}P_E = 32{\cdot}6$ c.c.

where: ε = dielectric constant of solvent, $_{\infty}P_2$ = total polarisation of nitrobenzene at infinite dilution, $_{\infty}P_{A+O}$ = atom + orientation polarisation, $_{\infty}P_E$ = electron polarisation, and μ = apparent electric moment calculated from the Debye equation neglecting the unknown atom polarisation. The error of measurement of the polarisations is probably $\pm$ 0·5 c.c.

If $_{\infty}P_2$ for all these solvents is plotted against ε, a reasonably straight line is obtained, the polarisation of the solute falling with increasing dielectric constant of the solvent. It is to be noticed that the table contains a polar solvent, chloroform. Non-polar solvents have dielectric constants between 1·8 and 2·6 approximately, and possibly polar solvents of higher dielectric constants may prove as serviceable for the measurement of apparent dipole moment as non-polar ones. The right conditions for the accurate determination of the dipole moment of a molecule in solution has yet to be found. In the past the Debye equation deduced for a gas has been slavishly applied. It may not be valid for a solution.

A more detailed account of this work will be published later.

H. O. JENKINS.
Dyson Perrins Laboratory,
South Parks Road,
Oxford.
Dec. 8.

Integral Right-angled Triangles

IN NATURE of September 9 and October 14 integral right-angled triangles have been discussed. It is of interest to note that in the general solution

$$2fg\,;\ f^2-g^2\,;\ f^2+g^2,$$

if we make f and g consecutive terms of the series

1, 2, 5, 12, 29, 70 . . .

where $U_n = 2U_{n-1} + U_{n-2}$

we get triangles whose sides about the right angle differ by unity.

The first five triangles are

4	3	5
20	21	29
120	119	169
696	697	985
4060	4059	5741

The first one is used extensively by surveyors and others when constructing a right angle either on the ground or on a plan. The second, however, is a better 'conditioned' triangle and would be used if it were more generally known.

The law of formation of the series given above is the same as the law for forming successive convergents of $\sqrt{2}$ from the continued fraction.

Successive approximations to $\sqrt{2}$ can be obtained by dividing the hypotenuse by the mean of the other two sides of the triangles given here. If we take the fifth triangle and divide 5741 by 4059·5, we get $\sqrt{2}$ correct to one part in a hundred million.

F. S. RICHARDS.
Survey of Egypt,
Giza (Mudiria),
Egypt.
Nov. 19.

Research Items

The Capsian Industry. A preliminary reconsideration of the Capsian phase of the Stone Age in North Africa is put forward by M. R. Vaufrey in *L'Anthropologie*, **43**, Nos. 5–6 in the light of the results of investigations in the shell-heaps of southern Tunisia in 1931–32. The evidence then collected gives an entirely different view of the Capsian industry from that generally accepted, according to which the Capsian is regarded as the ancestor of the Upper Palæolithic and the Mesolithic of Europe, and an upper and lower Capsian are distinguished, microliths being rare in the latter, the older culture. These investigations, which have been conducted in accordance with a more stringent method than that employed by previous investigators, show that the conception of an ancient Capsian composed almost exclusively of large implements is entirely due to an incomplete view of the evidence. More exacting methods of investigation show that the microlith is abundant in this early stage, and is already highly developed. The Capsian, it appears, is essentially one, but is divisible into three chronological stages—a homogeneous body in which the microlith forms the binding material. The three stages are : typical Capsian in which points, burins and scrapers occur with a typical microlithic industry ; (2) interogetulian neolithic or upper Capsian, in which the burin becomes exceptional, though scrapers are more or less numerous, while among the microliths, triangles and scalene points predominate, but true geometrical forms are rare, geometrical forms, however, characterising a divergent development in Algeria ; (3) neolithic of Capsian tradition, in which shell heaps are rare, the characteristic Capsian implement, the point *à dos rabattu* disappears, and evidence of Saharan influence appears. Typologically the Capsian is late Palæolithic or Mesolithic, and does not belong to geologically ancient deposits. Hence it could not be the ancestor of Aurignacian, nor does it lend support to the African origin of *Homo sapiens*.

Maya Archæology in South-West Guatemala. In 1932 Mr. and Mrs. S. K. Lothrop made a reconnaissance of some thirty sites containing ancient remains and excavated the ruins of Chukumuk and Chuitinamit on the shores of Lake Atitlan in south-west Guatemala, a region archæologically almost unknown. In a report on the excavations ("Atitlan". Pub. No. 444, Carnegie Institution, Washington) it is stated that the remains may be classified into several stylistic and chronological categories, and exhibit both strongly developed local characteristics and connexion with other areas. Thus the most ancient types of pottery embrace non-Mayan elements which may have come from south and east ; but it is premature to decide whether it represents a transitional pre-Mayan population or a primitive Maya. The second pottery period shows connexion with 'early' Mexican culture as represented by Ticoman. It is related to late phases of Maya Old Empire as exemplified in Peten, western Salvador and western Honduras. At the same time it preserves non-Mayan elements of the previous schools. The last pottery period is typified by styles found at other highland sites such as Utatlan. As a whole, it has little resemblance to finds in other regions. It is believed to cover the period of the political ascendancy of the historic highland tribes and ended with the Spanish conquest. Architectural features do not accord with those of other Maya remains. Ruined residences are of two kinds, which, it is believed, are of different epochs. As a whole, the remains indicate the early period in which the inhabitants drew inspiration from western Salvador and to a less extent from Central Mexico. At a later period they were in contact with the Maya Old Empire, and in the centuries before the conquest developed a culture of strongly local type.

Di-iodothyronine in Myxœdema. Although dried thyroid gland is physiologically active by mouth, the pure active principle, thyroxine, only exerts a comparable effect when given by injection : it is generally supposed that this is due to failure of absorption from the gut, since thyroxine is very insoluble. In the digestion in the intestine of the iodothyreoglobulin of the gland, a peptide of thyroxine is set free which is much more soluble than thyroxine itself, and so is readily absorbed. The synthetic production of such a soluble peptide, however, has not been successful. A derivative of thyroxine which exerts a significant amount of thyroid-like activity is 3 : 5-di-iodothyronine, which has the same structural skeleton as thyroxine but contains only two iodine atoms. Gaddum found that its activity was 1/15–1/40 that of thyroxine according to the method of test employed. It is, however, more soluble than the latter, and this difference between the two compounds is still more marked in the case of their salts both with acids and alkalis. The clinical value of the disodium salt in myxœdema has recently been investigated by A. B. Anderson, C. R. Harington and D. Murray Lyon (*Lancet*, 1081, Nov. 11, 1933). Daily doses of 50 mgm. of the di-iodothyronine in water were given by mouth to six cases, and in each the basal metabolic rate was raised to, or nearly to, the normal level, the pulse rate was quickened and the weight was reduced when the patient was initially overweight. No toxic symptoms were observed with continued administration over periods of two to three weeks : on withdrawal of the drug, the metabolic and pulse rates fell and the weight rose again. The magnitude of the effects produced was similar to what might be anticipated from the daily injection of 1 mgm. of thyroxine. Since di-iodothyronine can be prepared in the pure condition and moreover appears to exert its physiological activity with a remarkable degree of constancy, it may prove to be a valuable substitute for thyroid gland in all cases in which administration of the latter is indicated.

Structure of Larvæ of Hispine Beetles. An interesting case in which a study of the larval morphology has made it possible to correct the systematic position of the adult insect is offered by a recent paper of S. Maulik (*Proc. Zool. Soc. London*, 1933, part 3). The beetle *Platyauchenia latreillei*, Cast. has been referred to the subfamily Cassidinæ, but its larva lacks the prolongations at the end of the body which are used for carrying on the back of a mass of excreta, and constitute a character peculiar to larvæ of the subfamily Cassidinæ. On the other hand, the structure of the partially fused eighth and ninth segments of the abdomen is such as is often observed amongst larvæ of Hispinæ. Other larval and adult characters of *Platyauchenia* are discussed at length and it is

concluded that the genus should be removed to Hispinæ. At the same time the larva shows some modifications in the position of spiracles not previously recorded amongst Hispinæ, while its head, though that of a true miner, shows a structure different from any so far observed in other leaf-mining larvæ.

Entry of Water into the Germinating Seed. A study of the brief communication on this subject by Alexander Nelson and Jas. C. Macsween (*Trans. and Proc. Bot. Soc. Edin.*, 31, Part 2) will dispel certain popular illusions. The least study of the broad bean would show that the micropyle is far from being a hole permitting access of water to the interior of the seed, and careful measurements with beans floating in a 'lifebelt' of paraffin wax show that intake of water is about the same whether the half immersed includes the micropyle or not. Reasons are given for concluding that two factors are at work in facilitating water entrance : (1) the hydration of the colloids of the testa, (2) an osmotic action through the semi-permeable coat due to the release of carbohydrates in the inner lining of the testa. Emphasis is laid in this paper upon the great variation in the behaviour of individual seeds.

Growth of Evergeens. According to the Science Service, Washington, D.C., Prof. Ansel F. Hemenway, of the University of Arizona, has recorded evidence concerning the growth of the great evergreen trees of the Pacific north-west. Prof. Hemenway points out that the cambium, and also certain elongated cells, the function of which is considered by botanists to be the transportation of dissolved food substances, appear to be in active condition from early autumn until the commencement of the summer drought of this region. In other words, that these species continue their growth throughout the winter. Similar structures in deciduous or broad-leaved species in the same region, and also in conifers and broad-leaved trees in Kentucky, do not appear to be functioning in specimens collected during the winter. The Oregon broad-leaved trees also appear to have a period of little or no growth during the midsummer drought of the region. It is thus apparent that there are two long periods in the year during which the broad-leaved trees do not grow ; whereas the evergreens are able to grow continuously through nine or ten months of the mild, moist autumn, winter and spring. The author holds that the broad-leaved species have lost the race for supremacy in the north-west coast region. For this reason the forest of this region now consists almost entirely of Douglas spruce, grand fir, coast cedar and yellow pine.

Geographical Distribution of Tea Cultivation. Tea cultivation has a peculiar geographical distribution, for apart from recent plantings in Africa and Russian Georgia, commercial tea-growing is practically limited to the south-east of Asia and the adjoining islands, none being as yet carried on in America or South Europe. The reasons for this have been recently discussed by H. H. Mann (*J. Exp. Agric.*, 1, 245). The centre from which the plant originated, coupled with the availability of cheap hand labour, have naturally played an important part in the distribution of the crop as a commercial proposition, but despite these factors, the areas in which tea is grown are curiously limited. In certain directions the plant is very tolerant of variations in soil or climate, for it is found in comparatively temperate regions where frost is common and also in the neighbourhood of the equator. In other respects, however, the crop are precise in its demands, certain conditions of soil and climate being essential for vigorous growth. Although most of the important tea estates lie on alluvial soils, the crop can be grown successfully on varied types provided certain physical and chemical conditions are satisfied. In the first place, the soil must be deep and well drained, with a porous lower layer into which the roots of the plant can easily penetrate, and secondly, an acid reaction is essential, commercial success being unlikely if the *p*H is higher than 6·0. As regards manurial requirements the position is less clear. Abundant available nitrogen is known to be important, but excessive quantities, particularly if not accompanied by adequate dressings of phosphoric acid and potash, prove harmful. Recent work has, further, shown that other nutrients such as sulphur may sometimes be important, the diseased condition known as 'tea yellows' being attributed to a deficiency of this element.

Long Beach Earthquake of March 10, 1933. The Californian earthquake of March 10, known as the Long Beach earthquake, is the subject of a valuable preliminary report by Mr. H. O. Wood (*Bull. Amer. Seis. Soc.*, 23, 43–56 ; 1933). Notwithstanding the great amount of damage caused in Long Beach and other towns, the shock does not belong to the class of great earthquakes, but was rather a fairly strong local shock originating near a thickly populated region. From the records obtained at seven stations in southern California, the epicentre was found to be in about lat. 33° 34·5′ N., long. 117° 59′ W., or 3½ miles south-west of Newport Beach and in the general course of the Inglewood fault continued towards the south-east. The shock was felt in the ten southern counties of California and in a few places beyond, but serious damage to badly constructed houses was confined to an area of about 450 square miles, and was greatest in and near Compton and Long Beach. No fault displacement was found at the surface. The earthquake was followed by many after-shocks, some thousands being recorded by seismographs, but none of them comparable in strength with the principal shock, though a few increased the damage in buildings already injured.

Acoustic Absorption. In two recent papers (*Rend. R. Ist. Lombardo Sci. Let.*, Parts 11–15, 1933), Dr. D. Faggiani discusses the question of acoustic absorption by porous materials. Previous theories which have been propounded lead to consequences which are not in agreement with the phenomena observed. The new theory advanced by Faggiani is based on a consideration of the conditions of resonance of the very small channels into which the porous absorbing strata may be regarded as subdivided, and on the hypothesis that, in such conditions, the coefficient of absorption has, within suitable limits, a single value. Application of these conceptions to the ideal case of a number of parallel channels of uniform radius and length leads to two conclusions which are in accord with certain of the empirical laws. Actually, in absorbent materials it may be assumed that the values for the lengths of the different channels are not constant, but are distributed about a certain most probable value. When such variation is taken into account, there emerge further conclusions, all of which receive confirmation from the experimental data obtained by various observers with the most diverse porous materials.

Infra-Red Emission from Heated Metals. C. Hurst has recently published some observations on the emission of infra-red radiation by surfaces of copper and nickel (*Proc. Roy. Soc.*, A, Nov.). The temperatures used were 700°–850° C. for copper and 850° and 1,000° C. for nickel, and the wave-length ranges lay between 1μ and 6·5μ. In the near infra-red region of the spectrum, the emissive properties change from 'optical' type to those characteristic of the electrical properties of the metal, and this change appears in the results of the present investigation. The experimental method adopted was to compare the radiation from the metal surface with the black-body radiation from a wedge-shaped cavity in the metal. The emitter was mounted in a vacuum chamber and heated by an internal tungsten spiral. The surface and the cavity were focused alternately on the slit of a rock-salt spectrometer, and the intensities compared by a thermopile and Paschen galvanometer. A rotating sector cut down the black radiation to a convenient value for comparison. The surface was prepared by grinding with emery paper and polishing with chamois leather, the metal was reduced with hydrogen to remove oxide films, and the values of the emissivity remained stable, in the case of copper, over weeks of work. The experiments, taken in conjunction with the reflectivity measurements of Hagen and Rubens, made at room temperature, show that while the emissivity at short wave-lengths is not much affected by temperature, the emissivity at the longer wave-lengths increases considerably with temperature as required by the classical electromagnetic theory. The results have been compared with the theory of Kronig, who attempted to calculate with appropriate simplifying assumptions the motion of electrons in the periodic field of a metal lattice. The Kronig theory agrees less well with the experimental results in this region than does the classical theory of Drude, and the author shows that no simple modification of Kronig's theory is likely to explain the observed temperature variation of emissivity.

Oscillations in an Ionised Gas. It has been known for some time that oscillations may exist in a mass of ionised gas. R. W. Revans has recently described experiments in which stationary waves were set up in a bulb containing a hot cathode arc in mercury vapour (*Phys. Rev.*, Nov. 15). In a 9 cm. spherical bulb the strongest oscillation was just within the upper audible range, and a long train of harmonics could be detected. The oscillations are apparently due to the vibrations of the glow as a whole comparably to those of the air in a Helmholtz resonator. Over wide ranges of the arc current the frequency would remain constant and then at a certain value of the current the frequency would drop or increase suddenly due to a change to a different mode of vibration. The 'temperature' of the electron velocity distribution increases greatly when the glow begins to oscillate. A positively charged probe moved across the discharge showed maxima and minima in the collected electron current, indicating the presence of stationary waves. The fundamental frequency agreed with that calculated from a formula of J. J. Thomson giving the velocity of waves travelling in an ionised gas. The author intends to apply the idea of transmission of waves to the ionised atmospheres of stars, and in particular to disturbed areas such as sunspots.

Carbon Dioxide to prevent Ignition of Firedamp by Sparks. The Safety in Mines Research Board has just issued Paper No. 81 on "The Prevention of Ignition of Firedamp by the Heat of Impact of Coal-Cutter Picks against Hard Rocks", written by Messrs. M. J. Burgess and R. V. Wheeler (H.M.S.O., 6*d.* net). It may be remembered that these same authors showed that firedamp could be ignited by the impact of coal-cutter picks against highly siliceous rocks. They now point out that it is possible to prevent such ignition by discharging carbon dioxide into the cut made by the coal-cutter jib. They arranged a flow of carbon dioxide by means of the solid form 'Drikold', manufactured for the market by Imperial Chemical Industries, Ltd., and usually in cylindrical blocks, 25 lb. in weight, used in a standard liquifier, from which the gas could be delivered at known rates. Their experiments are not very convincing, but their conclusions are that the possible ignition of firedamp when a coal-cutter pick strikes against a hard rock can be prevented by discharging carbon dioxide at the rate of at least 1½ cub. ft. per minute into the cut. Imperial Chemical Industries, Ltd., state that a continuous discharge of 1½ cub. ft. of carbon dioxide per minute would be obtained from 75 lb. of Drikold, costing about 15*s.* 6*d.* As in 34 tests there were only 22 ignitions without the use of carbon dioxide at all, it is doubtful whether the coal mining industry will pay the price for a probable insurance against a possible accident, but the fact that a fair proportion of carbon dioxide prevents any ignition is decidedly interesting.

The Gas Pressure Cable. Recent progress in electrical engineering has been in the direction of ever-increasing voltages, but until quite recently this has not been accompanied by any radical change in cable design. Up to 66 kilovolts, cables with solid insulating materials have proved satisfactory, but beyond this pressure new methods have to be devised. In the *Electrical Power Engineer* of November–December 1933 an interesting lecture on this subject by Dr. E. Bowden and F. W. Main, given to the London Section of the Electrical Power Engineers' Association, is given in full. The principle of the method used in the 'pressure cable' is to apply mechanical pressure radially to the insulation so that the vacuous spaces which tend to form in the material are either closed up or the pressure in them is raised to such an extent that no ionisation occurs. The main difficulty to be overcome was to separate the pressure medium from the dielectric by an impermeable membrane. This was done by means of a thin lead sheath. The gaseous pressure was applied from the outside, being confined in a pipe line. The effect of this pressure produced a very marked improvement in the ionisation curve of the cable. It was found that with nitrogen gas as the compressing medium, a pressure of eight atmospheres was sufficient to maintain the cable in a stable state. The first installation of pressure cable at 66 kilovolts on a commercial scale was completed about a year ago between Hackney and Walthamstow, the length of the line being about 2½ miles. The route went through a thickly populated suburban district and the pipes had to be threaded through gas and water mains, sewers, etc. The pipe is filled with nitrogen and a working pressure of 12 atmospheres is maintained. The current carrying capacity of this type of cable is about 30 per cent higher than that of the usual type and its cost is about 25 per cent lower.

International Mathematical Congress Medals

EVERY four years there is held an international gathering of mathematicians, known as the International Congress of Mathematicians. At the next meeting, to be held in Oslo in 1936, two gold medals will be awarded to mathematicians selected for their outstanding contributions to mathematics by an international committee appointed for the purpose. The foundation of these medals is due to the efforts of the late Dr. J. C. Fields, research professor of mathematics at the University of Toronto. Dr. Fields was responsible for assembling the Mathematical Congress in Toronto in 1924—the only meeting which has been held outside Europe—and was president of the Congress and the editor of its *Proceedings*, which constituted two large volumes, published by the University of Toronto Press. With funds remaining after the completion of the work, Dr. Fields suggested the foundation of these medals, as a Canadian contribution to the cause of international scientific co-operation, which he always had much at heart. Unfortunately, Dr. Fields did not live to see the realisation of his scheme, as he died in August 1932, a month before the meeting of the Congress in Zurich, which gave international approval to the foundation of the medals. The medals will be awarded at each International Congress of Mathematicians in future.

FIG. 1. Medal of the International Mathematical Congress.

In spite of the fact that the medals are of Canadian origin and are due to the personal efforts of Dr. Fields, it was his particular wish that in design and award they should be truly international in character, and should not be associated with any country or person. The task of designing a suitable medal was entrusted to the distinguished Canadian sculptor, Dr. R. Tait McKenzie, R.C.A., who has now completed his work (Fig. 1).

The medal is two and a half inches in diameter. The obverse shows the head of Archimedes facing right. As there are no authentic portraits of this perhaps greatest of all mathematicians, recourse was had to the fine collection of more than thirty pictures collected by Prof. David Eugene Smith, and placed by him in Columbia University. They show the idea of as many artists, ancient and modern, of what Archimedes may have appeared to be. They naturally vary greatly, so the sculptor followed his own impression from reading his life and works. He shows the sage as a man of mature age, vigorous, with curly hair and beard, straight Greek nose and prominent brow. In the field is the word "Archimedous" in Greek capitals, and the artist's monogram, "RTM" and "MCMXXXIII".

The inscription surrounding it is: "Transire suum pectus mundoque potiri", which may be freely translated: "To transcend one's human limitations and master the universe." This appropriate quotation from the Roman poet Manilius was supplied by Prof. Norwood of the University of Toronto.

The reverse has a label bearing the inscription: "Congregati ex toto orbe mathematici ob scripta insignia tribuere", which may be freely translated: "Mathematicians gathered together from the whole world honour noteworthy contributions to knowledge."

Behind the label is a laurel branch, and cut in the background can be made out the diagram of a sphere contained in a cylinder. The determination of the relation of these two was one of the outstanding achievements of Archimedes, and this diagram was engraved on his tomb. The name of the recipient will be cut on the edge of the medal and will not interfere with the design.

Narcosis and Mental Function

IN a paper read before Section J (Psychology) of the British Association at Leicester, Dr. J. H. Quastel, director of the Research Laboratory, Cardiff City Mental Hospital, gave an account of recent experiments with narcotics. The evidence points to narcotics acting primarily by producing a state equivalent to anoxæmia at the particular parts of the nervous system where they are absorbed. Also the psychological effects of narcosis and of oxygen want are very similar to each other.

The narcotic drugs tested have the common property of inhibiting, at low concentrations, the oxidation in the nervous system of substances important in carbohydrate metabolism, such as glucose and lactic acid, for which the effects are practically specific. If certain other substances are investigated which are freely oxidised by the brain, this inhibition of oxidation does not take place. The main effect of the narcotic appears to be at the nervous cells, where it interferes with the activation of the lactic acid molecule, a process which is necessary before its oxidation can take place. The narcotic and the lactic acid compete for the cell catalysts involved in the activation process.

The following picture may be given of the mechanism of narcosis. Absorption of the narcotic takes place from the blood stream at a nervous centre. There it competes with lactic acid for the

cell catalysts, hindering the access of lactic acid to these catalysts and lowering the effective concentration of lactic acid available for oxidation. Hence the supply of energy is diminished; this produces a decrease in functional activity of the nervous centres in question and narcosis may ensue. It is clear from experiments—although much has yet to be done—that any mechanism resulting in deficient carbohydrate or lactic acid oxidation in the nervous system may well play a part in causing disorders of the functional activity of the nervous system.

The interesting question of the possibility of certain psychotic disorders having their origin in a state equivalent to oxygen deficiency at certain parts of the nervous system is thus raised. Evidence in favour of this possibility would be forthcoming if it could be shown that the body itself can produce substances which behave in a manner similar to narcotics. This seems to have been accomplished by Quastel and other investigators at Cardiff. They have found that certain substances, mainly breakdown products of tyrosine and tryptophane, have precisely similar effects to those of the narcotics on the oxidation of glucose or of lactic acid in the brain at equivalent concentrations. Mescaline has a similar effect. Most of the substances in question—tyramine, indole, and so on—are normally detoxicated in the body (chiefly in the liver), so that not more than traces can normally circulate in a healthy individual.

A disturbance in hepatic functions, however, makes it not difficult to visualise the presence in the blood of more than ordinary amounts of these toxic substances, and their circulation over a long period would create a condition in the nervous system the psychological effects of which would be expected to resemble those found in anoxæmia or light narcosis. Experiment has yet to show such a disturbance in detoxicating processes among certain psychotic types and attention is being focused on this problem.

Prolonged narcosis as a therapeutic method, which seems to be satisfactory in certain cases in that it brings about an improvement in the mental condition, has been used in recent years. Many, however, have abandoned it because of the production of toxic symptoms from the administration of the drug, which necessitated the cessation of this method of treatment before recovery was assured. A modified treatment of giving the patient a dose of glucose and an injection of insulin at the same time as the administration of the drug has proved very successful. Ketonuria and other serious complications cleared up and the narcosis treatment became practically safe.

Constitution of the Alloys of Iron and Manganese

THE latest contribution to the really remarkable work on the alloys of iron which has been carried out now for many years at the National Physical Laboratory is a paper by Dr. M. L. V. Gayler on the manganese-iron alloys, which was read at the meeting of the Iron and Steel Institute in September.

Fundamental work of this category demands as a preliminary the preparation of the elements themselves in a state of high purity. The iron employed

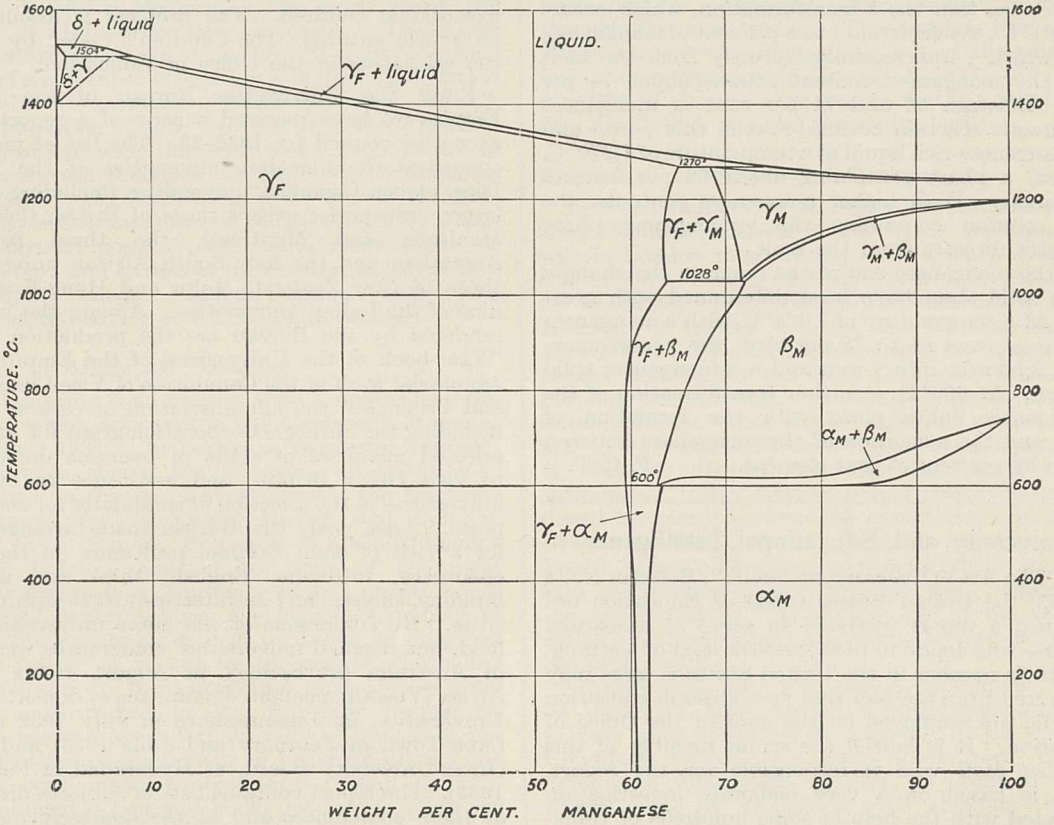

FIG. 1.

was prepared electrolytically, treated in hydrogen at a temperature of 900°–1,000° C. to remove oxygen, and then melted into ingot form in an induction furnace under hydrogen, being finally cooled *in vacuo*. The manganese was distilled from the thermit product. The metals were then remelted in magnesia crucibles in an electric induction furnace, being allowed to solidify three times with intermediate remeltings prior to the final solidification. To give an idea of the degree of purity of the final alloy the following composition of one with around 50 per cent of manganese may be cited: carbon, 0·007; silicon, 0·023; sulphur, 0·014; phosphorus, 0·0013; manganese, 47·88 per cent.

It is pointed out that the refractory materials available for the crucibles, thermo-couple sheaths, etc., has a profound effect upon the results in such work, and the analysis given above shows the extent to which the absorption of impurities by the metals from the refractories with which they have been in contact has been overcome. To all workers with metals at very high temperatures the observations made upon the refactory materials which were tried will be of the greatest value. The remainder of the experimental technique attains that high standard for which the work at the National Physical Laboratory in this field is famed.

The diagram proposed is shown in Fig. 1, reproduced from Dr. Gayler's paper by courtesy of the council of the Iron and Steel Institute, which does not, however, contain data concerning the constitution of the iron-rich alloys in the solid state. This part of the problem still requires further work. It will be seen that the δ transformation, which occurs at 1,504° C., extends from 1 to 8 per cent of manganese, after which γ-iron separates directly from the melt until the manganese content attains about 74 per cent. Between 65 and 74 per cent of manganese a peritectic reaction occurs between this γ-iron and the manganese-rich liquid at a temperature of 1,270° C. to form a phase containing about 68 per cent of manganese. With higher manganese contents, the solid solution containing the γ-manganese phase separates directly from the melt.

At the manganese end of the diagram the changes in the solid state have been determined with great care. At a temperature of 1,028° C. with a manganese content of from 64 to 72 per cent, the γ-manganese phase separates into γ-iron and a β-manganese solid solution. At 600° C. a further transformation of the β-manganese takes place with the formation of γ-iron and the α-solution of the manganese between 59 and 63 per cent of that element. F. C. T.

University and Educational Intelligence

IN "The Art of Teaching by Radio", Bulletin No. 4 of 1933, the United States Office of Education has published a report intended to serve as a manual for those who aspire to broadcast the seed of learning. That their number in the United States is large may be inferred from the fact that specialists in education by radio are employed on the staff of the Office of Education. It is indeed the senior member of this specialist staff who is responsible for the report, which is based on a very elaborate investigation conducted with the help of some hundreds of transmitting stations, the Association of College and University Stations, the National Association of Broadcasters, and other representatives of radio and educational interests. It expresses a consensus of opinion among experts as to the best technique for preparing, advertising and transmitting educational programmes and as to preparing the ground for their reception by providing supplementary aids for listeners. Appended to it is a bibliography comprising ninety-one items, about a third of which have a European (chiefly British) origin. It is a convenient summary, well adapted to serve its purpose. Special sections deal with music, the drama, debates and dialogues.

SCHOOL administrators and teachers in the United States are exhorted by the Commissioner of Education in the September issue of *School Life* to co-operate in President Roosevelt's great national recovery scheme, so as to make school work a fitting preparation for life in the new world. This formidable task is aggravated by the fact that the N.R.A. code prohibition of employment of children less than sixteen years of age in industry and commerce automatically increases the school population by about 100,000. A more serious difficulty than the finding of accommodation for these additional pupils is the organisation of curricula suitable to the requirements of pupils of types for which the schools have not been accustomed to provide, and especially of those who have already been employed in paid work and are now obliged to go back to school. This acute need for programmes of schoolwork appropriate to the requirements of 'working class' adolescents comes at a time when retrenchment policies have eliminated many of the courses in music, home economics, vocational guidance and the arts and crafts, and provisions for exceptional children. The problem is discussed in an article entitled "The Children's Code" by one of the specialists in the Office of Education.

FROM the Universities Bureau of the British Empire we have received a copy of a report of its executive council for 1932–33. The list of members comprises the nineteen universities of the British Isles, eleven Canadian universities (including all the larger universities except those of British Columbia, Manitoba and Montreal), the three principal Australian and the four South African universities, those of New Zealand, Malta and Hong-Kong and nine of the Indian universities. Among the services rendered by the Bureau are the production of the "Year-book of the Universities of the Empire", the secretarial work of the Committee of Vice-Chancellors and Principals, the administration of certain trusts, including the Carnegie Corporation grant for enabling selected members of staffs of overseas universities to visit Great Britain, and assistance to overseas universities in the selection of candidates for academic posts. Last year, the Bureau made arrangements for a visit of eight German professors (of theology, chemistry, medicine, English, ship- and airship-building, physics and architecture) to British universities. No conference of the home universities was held, but regional universities' conferences were held in Australia (at Sydney in August 1932), South Africa (Vice-Chancellors' Committee of South African Universities, at Johannesburg in July 1932 and at Cape Town in February and June 1933) and India (Inter-University Board, at Hyderabad in February 1933). The report contains lists of subjects discussed at these conferences and at the quarterly meetings of the home universities' Committee of Vice-Chancellors and Principals. Appended to the report are fully annotated accounts for the year.

Science News a Century Ago

Phenology

The study of plant geography initiated by Linnæus and carried on by Humboldt and others was well advanced in the early years of the eighteenth century, but the study of the influence of climate on the growth of plants in different parts of the world was of later date. On January 22, 1834, Mr. John Hogg addressed a letter to the *Philosophical Magazine* "On the Influence of the Climate of Naples upon the Periods of Vegetation as compared with that of some other Places in Europe" (vol. 4, 1834, p. 274), with the view of making the importance of this subject of study better known in England. Most of the observations quoted are extracted from an Italian work on Naples or from Gilbert White, but Hogg was one of the first authors to attempt actually to work out the average dates of germination, flowering, fruiting, etc., of a number of plants in different regions, and to interpret the results in terms of climate, so that he may be regarded as a pioneer of the science of phenology.

Foundation of Electrochemistry

On January 23, 1834, and at meetings in two subsequent weeks, Faraday read before the Royal Society his important Seventh Series of the "Experimental Researches in Electricity". It is particularly in this Series, the outcome of his experiments in the autumn of 1833, that he establishes the principles of definite electro-chemical action upon which the science of electro-chemistry is based. The paper contains his statement of the law "that the chemical power of a current of electricity is in direct proportion to the absolute quantity of electricity which passes", and a tabulation of 'ions' evolved on electro-chemical decomposition and the equivalent proportions in which they are produced, or their 'electro-chemical equivalents'. He describes in it his new instrument, "the only actual measurer of voltaic electricity which we at present possess", the 'volta-electrometer' or voltameter ; and he defines the new terms, 'electrode', 'electrolyte', 'anode', 'cathode', 'anion', 'cation', he coined on the advice of Whewell and others.

Magazine of Botany and Gardening

The following is an extract from a review by John Lindley, which appeared in the *Gardener's Magazine* of January 1834. "In Berrow's 'Worcester Journal', I have been shown the following advertisement : 'Published on the 1st of every month, the Magazine of Botany and Gardening, British and Foreign. Edited by J. Rennie, Professor of Zoology, King's College, London, assisted by some of the most eminent botanists in Europe ; sixteen quarto pages of *original matter*.'—From the ingenious manner in which this is worded, it must doubtless be imagined by the public, as it was by the person who called my attention to the paragraph, that this original matter is furnished to Mr. Professor Rennie by writers whose names include mine. But, as I am not ambitious of the honour of being considered one of this gentleman's contributors, I shall be very much obliged if you will be so good as to allow me to state, through the *Gardener's Magazine*, that no original matter whatever has been either supplied or promised to Mr. Professor Rennie by me. He has availed himself of some passages in works written by me, as he also has of others in the works of several of the writers mentioned in the advertisement ; and this is, I presume, what is meant by being assisted ; but, if so, the public should understand it rightly."

Fires in London

In a report on the fires in London in 1833 given in the *Mechanics Magazine* for January 25, 1834, it was stated that there were fifteen stations where men were on duty both day and night, four other stations were engines were kept, and at Kings' Stairs, Rotherhithe, there was a fire float. Although the steam fire engines patented by Braithwaite and Ericsson in 1829–30 had worked gratuitously at several fires in London with great success, there was prejudice against their use. All the engines belonging to the Fire-engine Establishment were hand-worked, and were of the type introduced a century before by Richard Newsham, who by his invention of his "engines for quenching fires" it was said had given "a nobler present to his country than if he had added provinces to Great Britain". In 1834 there was no means of signalling to the fire stations and the watchmen on the bridges were often the first to give the alarm from seeing a reflection in the sky. A shilling was usually given to the person who was the first to report a fire to a station, and by an Act of Parliament there were rewards respectively of 30*s*., 20*s*. and 10*s*. to the first, second and third engines arriving on the scene. The number of fires attended by the Fire-engine Establishment in the year was 458, while there were 59 false alarms and 75 alarms from fires in chimneys. The number of deaths through fire was twelve. The London Fire-engine Establishment was founded by ten of the principal insurance companies on January 1, 1833 ; the headquarters of this concern was in Watling Street and Mr. Braidwood was the superintendent.

Airy and Groombridge's Star Catalogue

Between January 11 and February 13, 1834, Airy, then Plumian professor of astronomy at Cambridge, was in London recuperating after a sharp attack of scarlet fever. During that time he drew up the papers for the Smith's prizes, which were awarded to Philip Kelland, of Queens' College, and Thomas Rawson Birks, of Trinity College, and began to examine the papers relating to the Star Catalogue formed by Stephen Groombridge. "I believe," he says, in his autobiography, "that it was while in London that I agreed with Mr. Baily on a Report condemnatory of H. Taylor's edition, and sent the Report to the Admiralty." Star catalogues had already been produced by many professional astronomers, including Bradley, Lacaille, Piazzi, Lalande, Argelander and Bessel. They all entailed enormous labour and Airy said of Groombridge's Catalogue that, considering the circumstances, "the work is one of the greatest which the long deferred leisure of a private individual has produced".

Groombridge, who was born at Goudhurst, Kent, on January 7, 1755, was first a linen draper and then a West India merchant in London. At his house in Goudhurst he set up a small observatory, but removing to Blackheath in 1802, he acquired a fine transit circle by Troughton with which in 1806 he began his catalogue. In about ten years he had accumulated some 50,000 observations, and he was engaged in reducing them when in 1827 he was attacked by paralysis. On his partial recovery he

applied to the Board of Longitude for assistance in preparing the catalogue for the press. It ultimately appeared in 1832, the year Groombridge died, but owing to errors was suppressed. Its revision was due to Airy. Elected fellow of the Royal Society in 1812, Groombridge was one of the founders of the Royal Astronomical Society. He died on March 30, 1832 and was buried at Goudhurst.

Societies and Academies

LONDON

Society of Public Analysts, December 6. C. H. CRIBB : A specific gravity apparatus. In order to avoid the necessity for a water-bath with thermostatic control, the bottle, which has a thermometer stopper, is provided with a glass bulb sufficiently heavy to sink in any ordinary fluid and having a diameter about twice that of the neck of the bottle. With this addition, the adjustment of temperature can be made to within a tenth of a degree in the course of a few minutes. G. F. HALL and W. M. KEIGHTLEY : The excretion of aloes. Applying their modification of the Schoutelen reaction, the authors have shown that it is possible in some cases to detect unhydrolysed aloin in the urine for periods up to 60 hours after the aloes have been taken. The unhydrolysed material can be detected at a later period than the hydrolysed drug, since the Schoutelen test is more sensitive than the Bornträger test (for the hydrolysed drug). H. E. COX : Chemical examination of furs in relation to dermatitis. (4). Chemical reactions of dyeing with *p*-phenylene diamine and *p*-amino phenol. A quantitative study of the oxidation of *p*-phenylenediamine by hydrogen peroxide in the presence of fur shows that the principal pigment formed is an azine combined with the fur proteins. Some Bandrowski's base is found on the surface of the fibres, and there exists in the solution in the dye-bath much free *p*-phenylenediamine unoxidised, together with some Bandrowski's base and traces of quinone and ammonia. Similar data are given in respect of *p*-aminophenol, which forms an oxazine in an analogous manner. The occurrence and properties of intermediate oxidation products in relation to dermatitis are discussed. JOHN GOLDING : Use of the air-damped balance for the determination of total solids in milk. Very rapid determinations of milk solids can be made by evaporating about 1 gm. of the milk in an aluminium cap (which cools very rapidly) and weighing the residue on an air-damped prismatic reflecting balance (Oertling). The influence of the time of drying on the results is shown in a series of tables. G. G. RAO and K. M. PANDALAI : Rapid method of determining minute quantities of nitrites. An iodimetric method has been devised in which the iodine liberated by the interaction of nitrous acid and hydrogen iodide is titrated in the presence of carbon dioxide evolved within the liquid itself. This prevents oxidation of the nitric oxide, also formed in the reaction, and expels it from the system, thereby eliminating the action of the resulting nitrogen peroxide on the iodide.

PARIS

Academy of Sciences, December 4 (*C.R.*, 197, 1369–1472). EMILE BOREL : The determination of the probability of series of rainy days and fine weather at the Parc Saint-Maur. HADAMARD : Observations on a recent note of Sixto Rios. Reply to a criticism by Sixto Rios of a result of Mandelbrojt. GABRIEL BERTRAND and MLLE. M. ANDREITCHEVA : The comparative proportions of zinc in green and etiolated leaves. There is a relation between the amount of zinc present in leaves and the coloration by chlorophyll. There is 2–3 times as much zinc in external green leaves as in the internal yellow leaves. Where the etiolation is artificial the difference is greater. LOUIS DE BROGLIE : The density of energy in the theory of light. RENÉ THIRY was elected *Correspondant* for the Section of Mechanics. E. J. GUMBEL : The limiting distribution of the greatest value amongst the smallest. RICHARD OBLÁTH : The theory of cubic constructions. H. AUERBACH : The number of generators of a limited linear group. RENÉ DUGAS : The establishment of Schrödinger's equation. BONNIER and MOYNOT : The possible consequences of the use, in internal combustion engines, of hydrocarbons with a high antidetonating value. The adoption of anti-knock has not the same effect in all engines. In an engine which is normally in detonation, as is the case for many aviation engines, the change of the fuel produces a rise in the temperature of the escaping gases. In engines less pushed, with little or no detonation, the variation of the escaping gas temperature is less marked. JEAN CHAZY : The uniform integrals of the problem of three bodies. JULES GÉHÉNIAU : The fundamental laws of the L. de Broglie wave in the gravific of Th. De Donder. PIERRE VERNOTTE : The absolute measurement of the coefficients of thermal conductivity of gases. The apparatus described avoids the complication due to convection. MICHEL ANASTASIADES : The mechanism of rectification in copper sulphide–magnesium rectifiers. According to the author's theory, cuprous sulphide is produced from the cupric sulphide, and the rectification is mainly due to the contact Mg/Cu_2S. E. THELLIER : The permanent magnetism of fired earths. A brick earth, heated uniformly in a magnetic field, is uniformly magnetised, this magnetisation depending on the conditions of time, temperature and atmosphere of the furnace. The magnetisation is permanent. J. GENARD : The magnetic extinction of the fluorescence of diatomic molecules of sulphur. The action of the magnetic field on the fluorescence of sulphur vapour is complex. Some lines are extinguished, others appear to be unaffected, whilst some are strongly enhanced. E. RINCK : Solidification diagrams of alloys formed by two alkali metals. The sodium-rubidium alloys. No evidence was obtained of the existence of the compound Na_2Rb corresponding to the compound Na_2K. PIERRE AUGER and G. MONOD-HERZEN : The presence of neutrons in cosmic radiation. MARCEL GODCHOT, ETIENNE CANALS and MLLE. GERMAINE CAUQUIL : The Raman spectrum of some substituted cyclenic hydrocarbons. JEAN COURNOT and HENRI FOURNIER : Comparative results of the measurement of corrosion. ALBERT SAINT-MAXEN and EMILE DUREUIL : The absorption spectrum of the diphenols in alkaline medium. The results confirm the hypothesis of Euler and van Bolin, relating to the existence of a compound of quinone structure in alkaline solutions of hydroquinol. AUGUSTIN BOUTARIC, MAURICE PIETTRE and MLLE. MADELEINE ROY : The physicochemical study of the flocculation of myxoprotein by resorcinol. PICON : The titanium sulphides. A description of the preparation and isolation of three new sulphides, Ti_3S_5, Ti_3S_4 and Ti_4S_5. B. BOGITCH : The preparation of ferrochrome in the electric furnace. Description of experiments on the semi-industrial scale on the

direct reduction of chromite by retort carbon. AUGUSTIN MACHE : Contribution to the study of hydraulic mortars. A. MAILLARD : The hydrogenation of naphthalene. A study of the causes of the anomalies found in the hydrogenation of naphthalene in the presence of catalysts. In the gas phase, there are two successive reactions producing the tetra and hexa hydrogen addition compounds. The reaction $C_{10}H_8 + 5H_2 = C_{10}H_{18}$ has not been observed. D. LIBERMANN : The preparation of the salts of trioxytriarylsulphonium derivatives of the para and ortho substituted phenols and on the arylsulphonium bases. PAUL CORDIER : The condensation of benzylpyruvic acid with benzyl cyanide. An acid nitrile is formed by this condensation : the corresponding dicarboxylic acid is unstable, it loses water and is converted by an isomeric change into the anhydride of an ethylene dicarboxylic acid. ANTOINE WILLEMART : Isomeric transformations of the hydrocarbons $C_{42}H_{30}$, isomers of 1, 3, 1′, 3′. tetraphenyl-1, 1′-dihydrorubene. GEORGES RICHARD : An oxido-reduction of 1-chloro-1, 2-diphenylethanal and on a supposed tolane oxide. MARCEL TUOT : Some ethylene and saturated hydrocarbons containing eight and eleven atoms of carbon. PAUL GAUBERT : Liquid crystals produced by the evaporation or cooling of an aqueous solution of tartrazine. ROBERT LAFFITTE : The tectonic of the south of the massif of Aurès. ALBERT DE LAPPARENT : The synclinal of Rians (Var). J. P. ROTHÉ : Morphological observations at Scoresby Sound. RAYMOND CIRY : The eastern termination of the primary Asturian massif and the structure of the Mesozoic region which envelopes it towards the east. G. DEDEBANT : The envelopes of isobars. F. M. BERGOUNIOUX : Remarks on the fossil Chelonians of the family of Amphichelydæ. W. C. DARRAH and P. BERTRAND : Observations on the flora of the Pennsylvanian coal measures (regions of Wilkes-Barre and Pittsburgh). MLLE. A. MICHAUX : The calcium contents of striated muscle and liver in normal guinea pigs and guinea pigs suffering from starvation, acute scurvy or chronic scurvy. RENÉ HAZARD : Potassium, an element producing adrenaline. The effects produced by the injection of solutions of potassium chloride resemble those produced by adrenaline. N. KOBOZIEFF : The diversity of the genotypical constitution on mice with a normal tail. ETIENNE WOLFF : The experimental production of otocephaly and the principal malformations of the face in the fowl. D. BACH and D. DESBORDES : The direct transformation of nitrates into ammonia by the mycelium of the lower fungi. A. and R. SARTORY and J. MEYER : The evolutive cycle of the Actinomyces in cultures after passage through a collodion ultra-filter. J. LAIGRET : The reproduction of murine leprosy in the guinea pig and rabbit, treated with an acetone extract of tubercle bacilli. VICTOR PAUCHET, PIERRE ROSENTHAL and HENRI BERTREUX : The treatment of surgical shock by fresh embryonic juices.

GENEVA

Society of Physics and Natural History, October 19. E. JOUKOWSKY and CHARREY : A levigator with immovable liquid medium. The authors have constructed an apparatus in which the precipitation takes place in a cylindrical tube. A sand can be separated into a very large number of sizes, up to complete precipitation, and a large number of points on the curve of precipitation can be determined. LÉON W. COLLET : The gneissic mylonites of the southern side of the Tour Sallières. The author describes four different outcrops of gneissic mylonites in the sedimentary substratum of the Morcles Nappe. Two of these lenticles are located on the thrust plane of the Nappe. The two others are situated at the base of slices of the autochtonous rock and are in relation with crystalline wedges of the Aiguilles Rouges massif. STUDER : Geological sketch of the neighbourhood of Renéville, French Congo.

ROME

Royal National Academy of the Lincei, June 18. A. BEMPORAD : Stellar currents about R.A. $13^h + 52°$ Decl. E. ALMANSI : Deformations of elastic strips (7). P. VINASSA DE REGNY : Age of the white chalk of Mount Casale, near Palermo. Fossil studies show that the Mount Casale deposits must be ascribed, not to the Lower Lias, but to the Trias. L. PETRI : Ionising action of fresh vegetable tissue pulp and mitogenetic radiations. In continuation of earlier work, it is found that, with potatoes, the emission of mitogenetic radiations ceases and oxidation processes are greatly enfeebled when the tubers are cooked, whereas in the live tubers oxidising enzymes are very active. A. DEL CHIARO : An inequality of Jensen. I. OPATOWSKI : Biharmonic functions as products analogous to Lamé's products, and the lines of force of Newtonian fields (1). J. C. VIGNAUX : A theorem on the double integrals of Abel and Laplace. G. KRALL : Motion of a planetary system of $(n + 1)$ rigid bodies ; its stationary limiting aspects. Proof is given of the statement made in an earlier communication : celestial bodies having the structure of a planetary system, subject to tides or any internal dissipative actions, tend to have their baricentres on a straight line revolving with uniform velocity round the common baricentre in a plane determined by the initial data. A. COLACEVICH : Excess of colour and the K calcium line in interstellar absorption. NELLA MORTARA : The use of liquid air for the purification of radium emanation. B. ROSSI : The disintegration of lead by the effect of penetrating radiation. G. A. BARBIERI : A new type of complex compounds of bivalent silver. The anhydrous salt, silver picolinate, $Ag(C_5H_4N.CO_2)_2$, is described. A. BARONI : Mixed sulphonic anhydrides (1) : Preparation of acetosulphonic anhydrides. Mixed anhydrides of acetic acid with methane-, ethane-, benzene- and *p*-toluene-sulphonic acids have been obtained by the action of the chlorides of the sulphonic acids on silver and sodium acetate. The mechanism of the decomposition of these anhydrides seems to be of the same type as that of mixed anhydrides of ordinary organic acids. F. P. MAZZA and A. CIMMINO : Dehydrogenase activity of *Bacillus coli communis* on higher fatty acids. Palmitic, oleic and, especially, stearic acid are dehydrogenated by this organism. The velocity of the action diminishes in the fatty acid series with increase of the molecular weight up to the C_6 or C_9 member and afterwards increases continuously. G. PICCARDI : Detection of europium, and three lines of extreme sensitivity. The flame spectra of certain mixtures of rare earth oxides revealed three intense europium lines of wave-lengths 4461, 4627 and 4594, which at low temperatures are highly sensitive. A. CHIARUGI : Development of the female gametophyte of *Weddellina squamulosa*, Tul. (Podostemonaceæ). PAOLA PARDI : Contribution to the cariology of the Asclepiadaceæ. B. DE LERMA : The pharyngeal bodies of the Orthoptera ; proof of the existence of endocrine glands in arthropods.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, January 22

UNIVERSITY COLLEGE, LONDON, at 5.30.—S. R. K. Glanville: "The Eastern Origin of Western Civilization".*

EAST LONDON COLLEGE, at 5.30.—Prof. J. T. MacGregor-Morris: "Cathode Rays and their Use in Electrical Engineering".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—R. Kaulback: "The Assam Border of Tibet".

Tuesday, January 23

EAST LONDON COLLEGE, at 5.30.—Prof. E. C. C. Baly: "The Photosynthesis of Carbohydrates from Carbonic Acid".*

Friday, January 26

GEOLOGICAL SOCIETY OF LONDON, at 4.30.—Joint meeting with the Royal Astronomical Society in the rooms of the Royal Astronomical Society, Burlington House, W.1. Discussion on the "Origin of the Earth's Major Surface Features".

ROYAL SOCIETY OF ARTS, at 8.—Hal Williams: "Modern International Practice in Factory Design".

Official Publications Received

GREAT BRITAIN AND IRELAND

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 2, 1933. Pp. iv+193. (London: Brompton Hospital.) 2*s*. 6*d*.

The Pharmaceutical Society of Great Britain: Codex Revision Committee. Report of Action and Uses Sub-Committee: Summary of Descriptions and Standards recommended by the Action and Uses Sub-Committee for Certain Substances to be included in the British Pharmaceutical Codex, 1934. Pp. 14. 1*s*. 6*d*. Report of Pharmacognosy Sub-Committee: Summary of the Principal Standards for Crude Vegetable Drugs recommended by the Pharmacognosy Sub-Committee and accepted, provisionally, for inclusion in the British Pharmaceutical Codex, 1934. Pp. 20. 2*s*. (London: Pharmaceutical Press.)

Old Ashmolean Postcards: Oxford Science Series. Men of Science of the 18th Century. 6 cards in Monochrome. (London: Oxford University Press.) 6*d*. net.

Electrical Equipment for London's Underground Railways. Pp. viii+83. (London: British Electrical and Allied Manufacturers' Association, Inc.)

Hull Museum Publications. No. 178: Record of Additions. By Thomas Sheppard. Pp. 32. No. 179: Fact and Fiction in Geology. By Thomas Sheppard. Pp. 20+2 plates. No. 180: Guide to the Museum of Commerce and Transport, High Street, Hull. Edited by Thomas Sheppard. Pp. 36. No. 181: Record of Additions. By Thomas Sheppard. Pp. 48. (Hull.)

The South-Eastern Naturalist and Antiquary: being the Thirty-eighth Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Thirty-eighth Annual Congress held at Norwich, 1933. Edited by Capt. T. Dannreuther. Pp. xlvi+119. (London.) 5*s*. net.

Proceedings of the Society for Psychical Research. Part 132, Vol. 41, December. Pp. iv+331–382. (London: Society for Psychical Research.) 4*s*.

Catalogue of the Twenty-fourth Annual Exhibition of Scientific Instruments and Apparatus, held at the Imperial College of Science and Technology, South Kensington, London, S.W.7, January 9, 10 and 11, 1934. Pp. 184+liv. (London: Physical Society.)

OTHER COUNTRIES

Cornell University: Agricultural Experiment Station. Bulletin 559: Social and Economic Areas of Broome County, New York, 1928. By Dwight Sanderson. Pp. 79. Bulletin 562: Economic Studies of Dairy Farming in New York, 11: Success in Management of Dairy Farms as affected by the Proportion of the Factors of Production. By P. H. Stephens. Pp. 45. Bulletin 574: A Test of Floats as Fertilizer and a Study of the Influence of Farm Manure on their Effectiveness. By T. L. Lyon. Pp. 18. Memoir 147: The Comparative Value of Different Colonies of Bees for Fruit Pollination. By A. W. Woodrow. Pp. 29. Memoir 148: The Occurrence of Azotobacter in Peat Soils of New York. By J. K. Wilson and B. D. Wilson. Pp. 15. Memoir 149: The Character of the Peat Deposits of New York. By B. D. Wilson and E. V. Staker. Pp. 20. (Ithaca, N.Y.)

U.S. Department of the Interior: Office of Education. Bulletin, 1933, No. 11: The Education of Spanish-Speaking Children in Five Southwestern States. By Annie Reynolds. Pp. vi+64. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the American Philosophical Society. Vol. 73, No. 2. Pp. 71–126+5 plates. (Philadelphia.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 11, No. 4, October, Research Papers Nos. 600–608. Pp. 441–566+30 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

Malta. Annual Report on the Working of the Museum Department during 1932–33. Pp. xv. (Malta: Government Printing Office.)

Ministry of the Interior: Public Health Department. Report on the Mission of the Research Institute, Public Health Department, and the Faculty of Medicine, Cairo, to Siwa Oasis, in January 1933, for the Study of Parasitic Infections, Malaria and Diphtheria. By Prof. M. Khalil Bey. Pp. 21+5 plates. (Cairo: Government Press.)

Smithsonian Miscellaneous Collections. Vol. 91, No. 1: Station Records of the First Johnson-Smithsonian Deep-Sea Expedition. By Paul Bartsch. (Publication 3224.) Pp. ii+31+1 plate. (Washington, D.C.: Smithsonian Institution.)

The Indian Forest Records. Vol. 18, Part 10: The Physical and Mechanical Properties of Woods grown in India; Third Interim Report on Project 1 (Tests on Small Clear Specimens, including Results of Work done up to the end of 1932). By V. D. Limaye, under the direction of L. N. Seaman. Pp. iv+70+13 plates. (Delhi: Manager of Publications.) 4.4 rupees; 7*s*.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 28, 1932, No. 1. Pp. 377+23 plates. 17.10 rupees. New Series, Vol. 28, 1932, No. 2. Pp. ccviii+3 plates. 6 rupees. (Calcutta.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čis. 174: Konstanty akustických oscilátorů (Über die Konstanten akustischer Oszillatoren). Napsal Josef Zahradníček. Pp. 27. Čis. 175: Sur la population de la Valachie morave et des quelques rapports à l'anthropologie de Roumanie de la méthode sélective. Considérations générales, par Prof. V. Suk; Partie speciale, par Dr. K. Augusta. Pp. 23+2 plates. Čis. 176: Kmity spřažených netlumených kyvadel (Sur les oscillations de deux pendules couplés non amorties). Napsal Rostislav Košťál. Pp. 30. Čis. 177: Pavlovský kraj (La région de Pavlov). Napsal Dr. Fr. Koláček. Pp. 61. Čis. 178: Comportement asymptotique des solutions d'un système d'équations linéaires et homogènes aux différences finies du premier ordre à coefficients constants. Par Maurice Fréchet. Pp. 24. Čis. 179: Sur le goniomètre à réflexion pour mesurer les très grands cristaux. Par V. Rosický. Pp. 9. Čis. 180: Příspěvky k mineralogii moravských pegmatitů (Beiträge zur Mineralogie der mahrischen Pegmatite). Napsal Dr. Josef Sekanina. Pp. 26+1 plate. Čis. 181: Vznik tónů v píšťalách (Über die Tonbildung in Pfeifen). Napsal J. Zahradníček. Pp. 21. Čis. 182: O vlivu solí na aktivitu vodíkových iontů (Influence of Salts on the Activity of Hydrogen Ions). Napsali V. Čupr a T. Krempaský. Pp. 27. Čis. 183: O difusních potenciálech, I (On the Diffusion Potentials, I). Napsali V. Čupr a J. Špaček. Pp. 25. Čis. 184: Úvod do theorie homologie (Introduction à la théorie de l'homologie). Napsal Eduard Čech. Pp. 36. (Brno: A. Píša.)

Biologické Spisy vysoké Školy Zvěrolékařské (Biologické Spisy Academiæ Veterinariæ), Brno. Svazek 9, Spis 127–140. Pp. 384. (Brno: A. Píša.)

Sborník vysoke Školy Zemědělskě v Brné (Bulletin de l'Institut National Agronomique, Brno). Sign C. 26: Soli v rostlině a v půdě. Napsal V. S. Iljin. Pp. 76. Sign C. 27: Individuální nepřetržité máčení ječného zrna v destilované vodě a jeho fysikální změny. Napsali Dr. O. Kopecký a V. Almendinger. Pp. 30. Sign D. 20: Výskyt vzácných kuklic (Tachinidæ) v ČSR. Napsal D. Jacentkovský. Pp. 7. (Brno: A. Píša.)

Zprávy komise na přírodovědecký výzkum Moravy a Slezska. Oddělení mineralogické, Čis. 6: Vápencový ostrůvek u Milatic sev. od Mor. Budějovic. Napsal Dr. Lad. Švábenský. Pp. 8. (Brno: A. Píša.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 16, No. 1: Catalogue of the Tertiary and Quartery Mollusca from the Island of Taiwan (Formosa) in the Institute of Geology and Palæontology, Tôhoku Imperial University, Sendai, Japan. Part 1: Pelecypoda. By Shichihei Nomura. Pp. 108+4 plates. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Science Reports of the Tokyo Bunrika Daigaku. Section C, No. 1: Limnological Reconnaissance of Lake Busyu, Hukui, Japan. By S. Yoshimura. Pp. 27. (Tokyo: Maruzen Co., Ltd.) 30 sen.

The Tôhoku Mathematical Journal. Vol. 38: Second Memorial Volume dedicated to T. Hayashi, Founder and Chief Editor of this Journal, on his 60th Birthday, by his Friends and Pupils. Pp. 480. (Sendai: Maruzen Co., Ltd.) 8 yen.

Physica. Vol. 1, No. 1, December. Pp. 96. (The Hague: Martinus Nijhoff.) 25 guilders yearly.

CATALOGUES, ETC.

Radiostoleum: the Industrial Application of a Scientific Achievement. Pp. 16. (London: The British Drug Houses, Ltd.)

Pocket Diary for 1934. Pp. 64+16 maps+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

Telcon Metals: Induction Melted Electrical Resistance Alloys in Rod, Wire and Tapes. Pp. 23. (London: Wild-Barfield Electric Furnaces, Ltd.)

Catalogue of B.D.H. Fine Chemical Products. (January 1934.) Pp. 159. (London: The British Drug Houses, Ltd.)

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