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The Science of Scenery.

THE study of scenery as land form has long been the subject of scientific inquiry. The slow but ever acting processes of earth sculpture have been observed, and the everlasting hills of our experience have become in mental vision but shadows of a changing earth flowing from form to form. Mountain and vale, river and coast, each can be explained from the texture of the rock and the character of the tools used by Nature in the shaping of the earth. What man naturally sees, however, is not land form but landscape, and his sympathetic appreciation of the latter rests on entirely different principles from his intellectual understanding of the former.

Landscape is too elusive in its composition, too fickle in its ever-changing form, to be bound by rigid laws of science, and yet it is obviously subject to certain laws of harmony. "Every landscape," states Prof. Alexander, "has to be composed. He who finds Nature beautiful does not manipulate with chisel or brush or voice the material he uses; he makes it beautiful by selection and composition, and, if need be, by imaginative addition. The fact is that the Nature we find beautiful is not bare Nature as she exists apart from us, but Nature as seen by the artistic eye." The laws of scenery may be compared with those of music. They are the laws of harmony.

It is to find a scientific foundation for the æsthetic study of scenery that Dr. Vaughan Cornish has of recent years turned his careful observation. Some of his results have formed the subject matter of many publications, and from these the following examples of his methods have been drawn.[1] The tones and colours of every landscape go through a cycle of change with the daily and annual revolution of the sun, and it is evident, therefore, that an æsthetic science of scenery must give an account of all these changes. They are exactly recurrent, and the results would be precise were it not that the atmosphere interposes a screen or veil of varying density according to the weather.

Dr. Vaughan Cornish is of the opinion, however, that, taking account both of the position of the sun and the state of the atmosphere, the effects observed are sufficiently definable to admit of a systematic and fairly simple description and explanation of the variation of tone and colour in the landscape. As an example he describes three varieties of atmospheric condition

[1] Presidential Address, Geographical Association, Jan. 1928. See also *Geographical Journal*, Nov. 1925; June and Nov. 1926.

as they affect an extensive view of lowland. On fine days, with the exceptionally clear air which often precedes rain, there is a broad foreground of lights, shadows, and local colours. In the far distance the landscape is richly dyed with atmospheric shades of purple and of blue. The middle band of relatively unattractive tone and colour is less noticeable and perhaps is actually narrowed. This constitutes the richest daylight harmony of light and landscape on the English plain. On a misty day the farthest parts of such extensive prospects are shut out and the foreground loses in stereoscopic strength and in contrast of light and shadow. The undulations of the middle distances are then revealed in unwonted emphasis by the increased rate of atmospheric absorption and with an attractive tint of silver grey.

During spells of fine summer weather of anticyclonic type there is no broad harmony of light and landscape in the English plain. The diffusion of the sun's rays in the upper air deprives the foreground of much of the vitality of tone and colour which are its proper charm and the means whereby it acts as a *distancer* for the rest of the landscape; the farthest undulations of the land lack atmospheric blue, and thin cloud, reflecting a crude white light from the sun, usually makes the sky near the horizon too garish to be viewed together with the distant land. These factors in tone and colour in relation to distance enter also into questions of apparent magnitude with its effect on landscape. Thus it is pointed out that distance affects the tone of clouds and mountains in opposite ways. Mountains physically compact look less massive from a distance, being then merely the opaque background of a translucent coloured medium. Cloud, on the contrary, being a sparse collection of small particles, is misty near at hand, but in its piled-up or cumulus form, appears compact and massive at a distance of a few miles. At close quarters, where clouds appear vaporous and mountains massive, the relation between them is altogether desirable.

From this example of natural scenery we turn to one in which man's work is superimposed on Nature. In his 'scenery of civilisation' Dr. Vaughan Cornish strikes a note of great practical significance. In its largest sense, Nature includes humanity, and the works of man may or may not blend with Nature to form harmonious groupings of æsthetic landscapes. The charm of old towns and places lies not solely in their age, but in the degree with which they conform to the laws of æsthetic geography. The city is the greatest expression of man's regional activity, and the stately avenues of a well-planned city are the crowning examples of one of the most characteristic contributions made by man to the scenery of the world—the vista—that pleasant path of converging lines which leads the eye to a point of rest in the far distance. The towering effect of buildings in the foreground, always considerable from the effect of vertical planes, is enhanced by columnar relief, which being imperceptible at a distance, does not interfere with the perspective of regular and strongly marked cornices reinforcing recessional effect in the remoter view.

Delight in the vista led men long since to plant trees in avenues of approach to lordly mansions, and later occurrences of a somewhat accidental character brought in the boulevard. Here we have not only the simultaneous pleasure of a vista of buildings and a vista of trees, with pleasant combination of colour in the season of the leaf, but also an enhancement of architecture, which, though appreciable at all seasons, is especially remarkable when the boughs are bare. The plane tree, which is mostly chosen for boulevard planting, is unsurpassed in winter for the combined delicacy and magnitude of the three-dimensioned lattice, which, as a foreground, makes space itself stereoscopic, distancing and magnifying the architectural background, to which, moreover, it imparts an atmospheric tone. The constructional lines of the dome, the crescent, and the archways of a stone-built bridge, are a monotonous repetition of balanced curves, but seen near by as they are in cities, perspective transforms monotony to rhythm, and the rhythm changes with every step of our approach, the curve of each element of the structure changing, the change different for each element according to its position, the change from form to form so subtle, so continuous in its flow, that it imparts the sense of infinity.

These two examples, culled from the records of Dr. Vaughan Cornish, illustrate the range of his inquiries and the principles upon which he is working. Investigation into the laws which govern scenery is of course valuable in itself. It points, however, to a practical maxim of great worth in view of man's increasing energy to change the surface of the earth. We are to-day great city builders, and even the countryside we tend to urbanise. The townward drift of men is everywhere observable, swelling to inordinate size our cities and city agglomerations. The evidence appears incontrovertible that, for good or ill, cities and culture go together. The higher men rise in

the social scale, the more they appear to desire to be within the circle of civic life.

No greater example of the national danger which comes from the absence of such institutions may be found than in the report which was issued some ten years ago by the Commission of Inquiry into Industrial Unrest in South Wales (Cd. 8668, 1917). Physical conditions in the narrow valleys of the coalfield have resulted in great populations being crowded in long rows of congested villages set in the shadow of slopes falling steeply to the stream bed where roads and railway and colliery workings are placed. The beauty of Nature has been destroyed and no 'scenery of civilisation' has taken its place. Cities and civic life are absent in these valleys, and to the present dismal surroundings the report traces the prime cause of social unrest there.

It is a characteristic of the industrial age that it has been one in which humanity has been crowded together round mill and factory. We have reached a stage in the evolution of cities, however, when the vulgar ugliness of industrial towns no longer satisfies. Town planning is the order of the day, but on what principles shall we develop constructive civic art or shape the countryside? Patrick Geddes notes that Aristotle wisely insisted upon the importance not only of comparing city institutions, but also of seeing our city with our own eyes. He urged that our view be truly *synoptic*, a word which had not then become abstract, but was vividly concrete as its make-up shows. It meant the seeing of the city as a whole, like Athens from the Acropolis, or rather of Athens and Acropolis together—the real Athens—from Lycabettos and from Piræus, from hill-top and from sea. Large views in the abstract depend on large views in the concrete.

The appreciation of scenery, in this fullest sense, is, like the quality of mercy, twice blessed. To the individual it gives a new pleasure in the world around him. To a community educated in scenery appreciation, it reveals principles which should guide constructive art in Nature, principles which will influence for abiding good the resettlement of England and of other countries consequent on a vigorous development of the economic resources of the earth with new means of transport and communication. The diagnosis of scenic beauty made by Dr. Cornish in his addresses should appeal particularly to all who are concerned in regional surveys and the preservation of rural scenery or the relation of architecture to landscape.

Palæometrology.

(1) *Glass Stamps and Weights: Illustrated from the Egyptian Collection in University College, London.* By Sir Flinders Petrie. Pp. vi+28+26 plates. (London: British School of Archæology in Egypt, 1926.) n.p.

(2) *Ancient Weights and Measures: Illustrated by the Egyptian Collection in University College, London.* By Sir Flinders Petrie. Pp. vi+51+54 plates. (London: Department of Egyptology, University College, 1926.) n.p.

FIFTY years ago there was published in London a small book with an ambitious title, "Inductive Metrology." It was an account of the author's attempts to discover from ancient structures, by an analysis of their ascertainable dimensions, the basic units of linear measurement that must have been employed by their builders. The adjective served to direct attention to the contrast between the author's method and the prevalent practice of spinning unverifiable hypotheses out of the vague data furnished by remains of a purely literary character. The method was not new, even in relation to the investigation of ancient metrology—it had been used by Newton in his endeavour to ascertain the length of the sacred cubit from certain dimensions of the Great Pyramid—but it had never hitherto been exercised upon so large a scale.

Now the applicability of the inductive method depends greatly upon the extent to which trustworthy observational data are envisaged, and this again depends upon the degree to which relevant material is available for observation. These considerations were clearly appreciated by the author of "Inductive Metrology," and, seeing that the supply of material or of observational data were deplorably lacking, such trivialities having been almost completely ignored alike by writer and excavator, he set himself with a will to remedy the deficiency. As a consequence the name of Flinders Petrie has become inseparable from mention not only of ancient metrology but also of scientific Egyptology in general.

Within a few years of the publication of his initial essay he was excavating, on behalf of the newly formed Egyptian Exploration Fund, the ancient cities of the Delta, whence, especially from Naucratis, Tanis, and Defenneh, he recovered *inter alia* great quantities of weights of various ages, shapes, sizes, materials, and states of preservation. To the data obtained from this material, carefully corrected for estimated losses and accretions, he applied the method of statistical analysis which had

proved so effective in his study of linear measurements, and arrived at certain conclusions with regard to ancient units of weight, duly publishing his results in the reports of his excavations. Since that time the store of Egyptian weights recovered has been periodically augmented through the labours of the British School, and now amounts to about six thousand specimens, of which number two-thirds are preserved in the collection at University College, London, together with a smaller but still important assemblage of measures of capacity and of length, and a few examples, mostly of late periods, of balances and steelyards.

The present volumes are primarily of the nature of a catalogue of all objects of a metrological character contained in that collection, and as such they have a value proportional to the importance and uniqueness of the collection; but they are considerably more than mere descriptive enumerations: they are studies in the art of scientific classification. In the introduction to the larger work, Sir Flinders Petrie modestly disclaims any attempt to deal with the whole field of ancient metrology. "This," he says, "is only a publication of material, and in the necessary classification of it we may reach some solid foundation for the whole subject." Whether the foundation that has been reached is solid enough to support a permanent edifice time will no doubt show, but if the prodigious industry, meticulous care, unwearying patience, and searching breadth of view to which these two books bear witness are insufficient for the purpose, we may have long to wait for the provision of a sounder basis.

All who have at any time been led by circumstance to seek for authentic information regarding ancient units of weights and measure, and have found themselves floundering amongst competing theories of derivation and inter-relationship, or staggering through mazes of pseudo-scientific hierophantics, must surely turn with grateful relief to the findings of one who restricts himself to the consideration of actual facts. We have here no airy speculations, no arguing from questionable premises or gratuitous assumptions, but the results of a prolonged and patient examination, at every practicable angle, of a vast amount of material evidence.

Naturally these results can scarcely be expressed in the form of pocket-book tables, nor do they readily lend themselves to popular presentation, though it must be admitted that they are set forth with as much clearness as the complexity of the subject will permit. In order to form some idea of that complexity, it should be realised that as regards the weights alone the objects dealt with are from periods ranging from an early prehistoric (Amratian) age to the thirteenth century A.D.; that several systems, often with overlapping multiples and sub-multiples, were in simultaneous use; that individual weights might vary considerably from the standards they were intended to represent; that the mean values of the basic units fluctuated throughout the ages; that some systems were confused by the existence of single and double (or 'light' and 'heavy') varieties of the same unit; that in any given system binary, ternary, decimal, and other series of multiples might exist side by side; that most of the specimens bear no markings, and that where markings are found they are frequently of an ambiguous or misleading character; that in many instances elaborate tests and calculations have been necessary in order to allow for injury or corrosion, or both, in estimating the original weight.

With these considerations in mind, one may without difficulty credit the statement made in the larger volume that "a large amount of tentative tabulating had to be done, on various lines, before a conclusive method of handling each part of the material could be reached."

It would, of course, have been impracticable to burden the catalogue with details of all this experimental work; all the 'scaffolding,' to use the author's own expression, has been removed and the extent of it might not be realised from a mere perusal of the stated conclusions.

With regard to the weights, excluding the Arabic series, it would appear that eight fundamental units emerge from the investigation, each forming the basis of a system. The specimens are catalogued in 'registers' and grouped under their respective systems, the serial number, material, form, ascertained weight, numercial relationship to basic unit, the value of that unit and details of markings, etc., in respect of each specimen being compactly tabulated. The ancient names of the basic units were not in every instance easy to determine; indeed, but for the clues furnished by the results of recent progress as regards Palestinian weights, it is doubtful whether it would have been possible to discover the names of certain of the units or to disentangle completely the corresponding systems.

In this connexion it is to be noted that the weights are very rarely marked, like modern weights, with their value in terms of a stated denomination. When they are marked at all it is

often with some numeral which may refer to their equivalence in some system other than that to which they belong; it is as if a kilogram weight were to be marked '35' because it is roughly equivalent to 35 ounces. Even where a denomination is marked, it is apt to be nothing more than the designation of some sort of a multiple common to more than one system, the term *teben* or *deben*, for example, being used for a weight of 10 qedets or one of 10 peyems (cf. *mina*, *shekel*, etc.). Fortunately, however, the names of three standards of weight, *Necef*, *Peyem*, and *Beqa*, have been found marked on weights from Palestine belonging respectively to hitherto unnamed series which occur also in Egypt, and others were discovered which bore, in common with one Egyptian example, a sign construed as a monogram of the letters X and O, and hence, having regard to the fact that some syenite weights of apparently the same series are shaped like the shell of the cowry, to be an abbreviation for the Greek name for that mollusc, χοιρίνη. The ancient names of the four remaining basic units having been already established on abundant evidence, these Palestinian sidelights afforded a very convenient key to the solution of the nomenclature problem and to the elucidation of all the Egyptian weights hitherto unclassified.

Lest the argument outlined above for the adoption of the name *khoirine* be criticised as far-fetched, it is only fair to add that it appears to receive no small support from the information contributed by competent zoological authorities, whose observations are appended to the text; it is hard to resist the conclusion that the standard derived its name and form from the Mediterranean *Cypræa lurida*.

The eight standards recognised, then, are: (1) the *peyem*, varying from about 112 to 125 grains; (2) the *daric*, a very early Mesopotamian unit, from 124 to 133 gr.; (3) the *stater*, so called after the famous gold coinage of Philip of Macedon though of much earlier origin, 132 to 138 gr.; (4) the typically Egyptian *qedet*, 137 to 152 gr.; (5) the Syrian *necef*, 152 to 169 gr.; (6) the *khoirine*, 170 to 189 gr.; (7) the *beqa*, also known as the 'gold' standard on account of the frequent occurrence of the 'nub' sign on its examples, 187 to 214 gr.; and (8) the *sela*, or Phœnician standard, 209 to 227 gr. By reason of the variation exhibited in their different examples, these units form a continuous overlapping series, but there are no grounds for concluding that they have diverged from a common predecessor. In an interesting appendix it is shown that, with the exception of the peyem and stater, the same standards must have been used in the weighing of the precious metals at a very early time in western Europe. A remarkable comparison is drawn between the widely spread system which connected Egypt with Babylonia, Assyria, etc., and those of India, China, and Etruria, leading to some curious speculations regarding the Etruscan migration.

Although, as already stated, the work is primarily a catalogue of the Gower Street collection, the very useful step has been taken of appending in brief outline an account of various other collections of weights to which reference is made in the main text, including a hitherto unpublished list of the weights in the Græco-Roman Department of the British Museum compiled by the author forty years ago and used by him in preparing his well-known article in the "Encyclopædia Britannica." No reference, however, is made to the Egyptian weights mentioned by Chisholm in his report on various ancient weights in the British Museum in 1873 (Annual Report of Warden of the Standards, 1874–5, Appendix XI.), though the data there given would appear to be not altogether devoid of interest.

In a chapter devoted to the steelyards, a very detailed account is given of the two large and elaborate specimens of Arabic date, the remaining sixteen examples being of Roman times, and a highly ingenious method is explained for arriving at the weight unit on which the graduations are based, notwithstanding mutilations and the absence of counterpoises. The balances, including the wonderfully preserved set in a combination 'pocket' case reminiscent of those in use in Great Britain a few centuries ago, are considered not with the steelyards but separately, after the measures. Only one example is pre-Roman, and that is apparently prehistoric, a red limestone scalebeam about $3\frac{1}{2}$ in. long. The inclusion of a George III. coin balance, a Chinese balance, an eighteenth-century nest of avoirdupois weights, and similar oddments in this section, strikes a note of incongruity.

The basic units deduced from the study of the measures of capacity are: (1) the Syrian standard, of 20·8 or $21{\cdot}4 \pm 0{\cdot}3$ cub. in.; (2) the native Egyptian *hen*, $29{\cdot}0 \pm 0{\cdot}3$ cub. in.; (3) the Syrian *log*, $33{\cdot}1 \pm 0{\cdot}2$ cub. in.; (4) the Attic *kotyle*, $17{\cdot}2 \pm 0{\cdot}2$ cub. in.; and (5) the Persian *kapetis*, $74{\cdot}9 \pm 0{\cdot}3$ cub. in. Most of the vessels in this section, like many of the weights, have nothing to show that they are intended as measures (or weights) except the fact that they are found to stand in more or less definite relationships to one another as regards capacity. One, however, is graduated internally and another is marked as "1/8th"; these prove to be respectively a 2-*hen* subdivided into $\frac{1}{2}$-*hen* and a 1/8th

hen. The weight of water-content of the measures shows some slight agreement with the systems of weight units so far as the *hen* and the Syrian standard are concerned, but practically none otherwise. The theory of a primitive connexion between units of weight and of lineal measure receives no support whatever; indeed, such a connexion is shown to be *prima facie* improbable.

The lineal measures in the collection include eight wooden cubits, some as old as the 12th dynasty, showing the royal cubit of about 20·6 inches divided into seven palms; four rods showing the Assyrian and Jewish cubit of 21·4 inches divided into six palms; and a limestone standard measure showing a 7-palm cubit of 26·8 inches, besides various fragmentary specimens. The description of this material is followed by a discussion of the relationship between the last-named standard and those of northern countries, some striking parallels being set forth.

The smaller volume is concerned solely with the glass stamps and weights characteristic of the Arabic period. Its range of interest is accordingly more circumscribed, though even here the non-specialist may find food for reflection in the evidence afforded of the astounding degree of precision to which the medieval craftsmen were able to adjust their weights. We know from other sources that the Arab scientists bestowed great attention on the development of the balance, both for weighings in air and for the Archimedean determination of specific gravities; but even so, it is rather startling to learn that they were in fact able, during their best period (during the caliphate of El Mahdy, *circ.* A.D. 775–785), to turn out weights agreeing with the standard and with one another to within a few thousandths of a grain, or about 0·01 per cent. of their nominal weight!

To the collector this catalogue should be of the highest value, for not only is the series dealt with larger than either of those previously listed (Brit. Mus. Coll., *catal.*, Lane-Poole, 1891, and the Fouquet Coll. at Cairo, *catal.*, Casanova, 1893), but also greater attention has been bestowed on exactitude of the weights and fuller use has been made of photographic illustration, every specimen except duplicates from the same die being portrayed. As the inscriptions are not always sufficiently clear in the photographs, they are all reproduced opposite the plates. The average error and the variation of the average standard of the *dinar* and the *dirhem* over the whole period are shown graphically. Of these two standards, the former varies from about 62 to 66 gr., the latter from 44 to 48 gr. The principal multiples appear to be the *wuqiyeh* of 10 dirhems (av. 443·4 gr. in glass weights and 445·6 in metal) and the *rotl* of 12 *wuqiyehs* (av. 5814 gr.), but many of the earlier weights are marked as a *fels* of so many *kharrubehs*. The *kharrubeh* or *carob* (also = *qirat*; Gr. *keration*) is about 3 grains. Our own *carat*, legalised in 1913 as the 'Metric Carat,' is 0·2 gramme = 3·086 gr. In addition to the registers of weights there is given a chronological scheme of caliphs, governors, and other officials, also a transliteration of the curious monograms on the Byzantine *solidus* weights.

In conclusion, it certainly seems no extravagance to state of these two volumes that not only do they constitute a worthy record of a unique collection, but that they may also be regarded, especially the major work, as forming a most valuable contribution to the foundation of a rational system of palæometrology. W. H. MATTHEWS.

The Study of Living Machinery.

(1) *Muscular Movement in Man: the Factors governing Speed and Recovery from Fatigue*. By Prof. A. V. Hill. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 3.) Pp. vi + 104 + 5 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 12*s*. 6*d*. net.

(2) *Living Machinery: Six Lectures delivered before a 'Juvenile Auditory' at the Royal Institution, Christmas 1926*. By Prof. A. V. Hill. Pp. xiv + 256 + 24 plates. (London: G. Bell and Sons, Ltd., 1927.) 7*s*. 6*d*. net.

(3) *Basal Metabolism in Health and Disease*. By Prof. Eugene F. Du Bois. Second edition, thoroughly revised. Pp. viii + 17-431. (London: Baillière, Tindall and Cox, 1927.) 22*s*. 6*d*. net.

(1) IT is not many years since critics of academic physiological research work were accustomed to illustrate their arguments by referring to the uselessness of the investigations which were being made on muscle function. It has now become clear that these investigations laid down basic knowledge which to-day underlies the scientific study of muscular activity in athletics, medical science, and industrial problems. In the preface of his book, "Muscular Movement in Man," Prof. A. V. Hill recounts an experience in America when, on being challenged by a member of the audience at the conclusion of a lecture to prove the value of his work, he replied that he performed experiments

because they were amusing. While it is apparent that Prof. Hill finds great amusement in his investigations, yet few physiologists are able to demonstrate the application of their work to the elucidation of practical problems as Prof. Hill has done in his recent publications.

The present-day views of muscular contraction have their origin in the investigations of Fletcher and Hopkins (1907) on the lactic acid content of muscle. These observers studied the lactic acid content of muscle under a variety of conditions, and showed that when a fatigued muscle was placed in oxygen the muscle regained its excitability and the lactic acid fell in value. These experiments suggested that lactic acid was formed by the breakdown of a carbohydrate substance (glucose) on contraction of muscle, and that the lactic acid played an important rôle in the initiation of the contraction. These investigations have, in recent years, been extended and confirmed. In the contraction of muscle, lactic acid is the most important known intermediary. It is probable, however, that the lactic acid is not further oxidised, but is re-transformed through hexosephosphate and glucose to glycogen, the energy for the process being supplied by the oxidation of a further supply of sugar; carbon dioxide, which is increased by the contraction, being formed from this later product.

The investigation of heat changes during muscular activity have confirmed the chemical findings. Recently attention has been directed by Prof. Hill and his co-workers to the viscosity of the muscle, and they have shown that during contraction the viscosity of the frog's muscle appears to rise about twenty times. The effects of viscosity changes are clearly seen in investigating the speed of shortening and the energy of contraction, for, on contraction of the muscle, the viscous elements act as a resistance to the movement. Therefore the greater the speed of shortening, the larger the proportion of energy wasted; on the other hand, if the muscle shortens too slowly, the energy is not utilised for work but is converted into heat. At some intermediate point an optimum speed may be obtained where the maximum work is done in a given time.

In "Muscular Movement in Man," which is based on a series of lectures delivered at Cornell University in 1926–27 under the non-resident lectureship in chemistry, Prof. Hill has applied the knowledge gained by investigations on the isolated frog's muscle to the problems of muscular movement in man with particular reference to athletics. The author shows how, from measurements of the oxygen consumption, information may be obtained of the change taking place in the muscle during exertion. The resting oxygen consumption is accurately measured and compared with the oxygen used during the period of exercise and period of rest following the exercise. During the period of exertion the oxygen which can be inspired is not sufficiently large to prevent the accumulation of lactic acid, and excess of oxygen must therefore be taken in during the recovery period to restore the muscles to their previous condition. The amount of oxygen used, in excess of the resting level, during the period commencing at the moment exercise ends and ending when recovery is complete, is called the 'oxygen debt.' The greatest speed which can be maintained during exercise is therefore determined by considerations of the energy expenditure. An example is given on p. 23, where the author estimates that a fit man might climb the Woolworth Building (792 ft.) in New York in eight seconds, finishing with an oxygen debt of fifteen litres, which is about all a man can tolerate. A footnote adds that the newspapers reported that the feat had actually been accomplished in nine seconds.

By an ingenious electric timing method the speed of a runner has been measured for varying distances. Plane coils of wire connected with a galvanometer were arranged parallel to the track. The runner carrying a magnet induced a current in the coil as he approached, which was recorded by the galvanometer. The author's experiments show that the slowing up during a maximal effort depends not only on the extent of the oxygen debt, but also on the increased viscosity of the fatigued muscle. The best athlete investigated took a longer time than other runners to attain his maximal speed in a 200 yards sprint, but this is due to the fact that his speed was considerably greater. It is suggested that his success in attaining so high a speed, while partly due to his skill in running, is mainly dependent on the low viscosity of his muscles. The important rôle played by the muscles in aiding the circulation during exercise is emphasised in the tables where a comparison of the oxygen consumption per kilogramme per minute is made between oarsmen and runners. The runner, by virtue of the pumping action of the muscles increasing the circulation rate, can consume per kilogramme of body weight considerably more oxygen than an oarsman.

"Muscular Movement in Man" is a book of exceptional interest. It gives the reader a clear and interesting account of muscular activity in relation to exercise, and Prof. Hill may feel assured

that his lectures will stimulate others to investigate the problems.

(2) In "Living Machinery," Prof. A. V. Hill has written in simple language a description not only of the muscles and functions of the body and how they work, but also of the body functions as a whole. The book is undoubtedly one of the best popular scientific expositions of physiology which has been published. It will be read with benefit by all those who are interested in their own machinery or the progress of physiology. Boys and girls of a mechanical and scientific turn of mind will be stimulated by the description of experiments carried out by Prof. Hill and his staff of four, whose ages ranged from six to eleven years. The book will also serve to demonstrate how the principles of chemistry and physics enter into our own daily life and regulate the activities of the tissues of the body.

(3) The metabolism of the body at rest has been recently dealt with by E. E. Du Bois, Medical Director of the Russell Sage Institute of Pathology. The work of Du Bois on the measurement of body surface in man and on the metabolism in diabetes and fever is of fundamental importance, while his figures for calories per square metre per hour in normal individuals of different age and sex are generally used as the standard from which the percentage increases or decreases in metabolism occurring in disease are calculated. The book, less condensed than the monographs of King and McCann, and containing less detailed description of technique than that of Boothby and Sandiford, is admirably written and covers the ground in a manner which leaves little to be desired. The book, though written for those "engaged in the practice of medicine and surgery, for medical students, for physiologists and for dietetians," should also be of value to general biologists interested in the problems of respiration and metabolism.

The schools of nutrition in America, founded by Benedict and Lusk, of whom Prof. Du Bois is a distinguished pupil, have for some years been applying the results obtained on studies of normal human basal metabolism to the problems of clinical medicine. The success of these methods may be judged by the wealth of information which has been accumulated on disorders of nutrition, disease of the thyroid gland, blood, and fevers. This book affords an excellent example of the extent to which quantitative methods of measurement may be applied to the study of the normal and disordered functions of man.

Modern Physics.

Lehrbuch der Physik. Von Theodor Wulf, S.J. Pp. xiv + 512. (Freiburg im Breisgau: Herder und Co., G.m.b.H., 1926.) 17·50 gold marks.

WULF'S "Lehrbuch" is the most recent edition of P. Ludwig Dressel's "Elementares Lehrbuch der Physik," which first appeared more than thirty years ago. It is not a rehash of the original or later editions, but an entirely new book. That this should be so is self-evident in view of the fundamental advances and far-reaching discoveries of the last few decades. During last century the main object of the science consisted in the observation and description of natural phenomena, and in the formulation of 'laws' embodying the results obtained. Now we seek to 'explain' them in terms of the smallest constituent bricks of the material world. From gross matter we have passed by way of the atom and molecule to the electron and the proton.

During recent years there have been many books, both for the layman and for the specialist, dealing with the newer physics. Here we have a book which deals with the fundamental results of the whole of physics, and is written from the modern point of view. Of mathematics, the book contains just that amount necessary, in the author's opinion, to stimulate a fuller appreciation and understanding of the subject. But it is not a text-book in the usual sense, that is, for students studying for examinations, though all who read it must derive much benefit and a keener and more enlightened grasp of the subject. It is not intended for the 'man in the street,' but for the young physicist, the engineer, the chemist, the schoolmaster, and in fact for anyone who would welcome an authoritative and trustworthy account of the present-day structure of physics, without all its finer detail.

The distribution of the subject matter is somewhat off the usual lines, and possesses many advantages over the pigeon-holed system of most text-books of physics, ancient and modern. Thus, instead of subdividing the subject into mechanics, heat, light, sound, magnetism, and electricity, the author has presented his subject under four main heads.

In Part I., "Die Körperwelt," perhaps best rendered as "The Material World," the author deals with bodies as they are directly revealed to our visual sense, and includes sections on the fundamental ideas of motion, the motion of bodies, the force of gravitation and general attraction of

masses, elasticity, impact, general wave theory, and sound. Now we have ample evidence that matter is composed of small particles—atoms—and although we cannot see them, we recognise their existence and know some of their properties. This aspect of physics is dealt with in Part II. on the atomic structure of the material world, which contains sections on the system of the elements, the three states of aggregation of matter, temperature, specific heat, heat and change of state, the three principles of thermodynamics, and the atom. Not content with the knowledge of the atomic constitution of matter, the physicist has probed in turn into the structure of the atom and its consequences, with which Part III. is concerned. In this, the sections deal respectively with magnetism, electrostatics, electric currents, 'interactions' between electricity and magnetism, electrolysis, ions and electrons, radioactivity, electro-magnetic rays, and atomic constitution. Finally, there are numerous phenomena which, apart from ponderable matter, require a medium—the so-called ether—for their explanation. Part IV. is devoted to such etherial phenomena, and contains sections on 'disturbed' (reflection, refraction, etc.) and 'undisturbed' propagation of light, interference and diffraction, polarisation, light and colour, and the ether—treated also from the relativistic viewpoint.

After a careful perusal of this book, one feels that the author has departed from the traditional 'dry as dust' presentation of physics which is the bugbear of so many young students. For this it is to be feared our examination system is largely to blame, for it has tended to foster the grouping of the branches of physics into somewhat disinterested watertight compartments. A treatment of physics on the lines of Prof. Wulf's "Lehrbuch" would, we believe, be of inestimable value to the junior classes in our universities, and serve to give them some of the enthusiasm for their subject that one usually meets with only amongst more advanced students.

Our Bookshelf.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe, assisted by eminent Contributors. Revised and enlarged edition. Vol. 7: Thalenite to Z. With an Index to the whole work by Frances M. G. Micklethwait. Pp. viii + 765. (London: Longmans, Green and Co., Ltd., 1927.) 60*s*. net.

THE first duty of a reviewer of the seventh and final volume of "Thorpe's Dictionary" is to congratulate those who have been responsible for the enterprise on the successful completion of their arduous task. As the first volume appeared in 1921, the publication of a fresh volume has become almost an annual event; but only five volumes had been completed when Sir Edward Thorpe died in February 1925. The work on the two remaining volumes has therefore been completed by Dr. Forster Morley, whilst Dr. Micklethwait has prepared an index to the whole work, which occupies more than 150 pages of the text of the last volume.

As in the earlier volumes, the emendation and enlargement has been so well distributed that it is not easy to discover where the new material has been incorporated, but the present volume is noteworthy for the addition of two articles on toluene and xylene by Prof. Rowe and Dr. Davies, which account for nearly 120 extra pages, and for an article by Prof. Briscoe on the physical and chemical properties of water, which covers rather more than 40 pages, compensation being provided by an expansion of about 4 pages in the article on wine. Prof. Hopkins has also contributed a new article on vitamins. These additions provide evidence of the thoroughness of the revision, and justify the expectation of a long lease of life for a work of reference which first appeared in 1890–1893.

Katalyse mit kolloiden Metallen. Von Walter Hückel. (Kolloidforschung in Einzeldarstellungen, herausgegeben von Richard Zsigmondy, Band 6.) Pp. viii + 86. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1927.) 6 gold marks.

IN presenting this account of laboratory methods of using colloidal metals as catalysts, attention is directed mainly to the work of Paal and of Skita on the application of metals of the platinum group to the hydrogenation of different types of organic compounds. The earlier investigations of the phenomena accompanying the decomposition of hydrogen peroxide are only introduced to elucidate the theory of the kinetics of colloidal catalysis, since they form the subject matter of a separate volume in the same series. The use of colloidal metals has greatly simplified the important process of hydrogenation, since many reductions can be carried out in solution at ordinary temperatures.

Paal's method has given very valuable results, particularly in the terpene series, but it is much more limited in scope than that of Skita, which appears to be applicable to most unsaturated compounds. Since, however, the latter method requires special apparatus in which a pressure of 2-3 atmospheres can be developed, it has received much less attention. Much less is known about the application of colloidal catalysts to the reduction of inorganic compounds or to oxidation processes. The volume ends with a chapter on the mechanism of catalytic hydrogenation, in which theories of hydrogen activation are discussed.

Evolution of the Drama in Hull and District. By Thomas Sheppard. Pp. xii + 254. (Hull: A. Brown and Sons, Ltd., 1927.) n.p.

IN this volume the versatile curator of the Hull Museum has published, with some expansion and numerous illustrations, an address delivered by

him in his office of president of the Hull Playgoers' Society. Properly speaking, theatrical history in Hull does not begin until 1767, except for an ordinance of the Mayor and Corporation forbidding burgesses to attend performances of the players in 1599. Nor does Hull itself contribute much to the history of the drama, although Beverley, which comes within Mr. Sheppard's area, celebrated Corpus Christi with the usual plays and gild processions, and is also credited with the first mention of miracle plays. Mr. Sheppard has drawn liberally on the material available from York, Chester, and elsewhere in elucidating the early stages of his subject. No Corpus Christi plays are recorded in Hull; but it is interesting to note that there was a performance of the Noah play on Plough Monday in medieval and later times, when a large ship which hung suspended in the transept of Holy Trinity Church was taken down, dragged round the town, and then served as the ark of the play in front of the church. Mr. Sheppard describes a Ploughboys' Monday celebration which he himself saw in his early youth, when a group of rustic players went from house to house and acted a play which seems to have been of the usual folk drama type, culminating in the killing of one of the characters.

The Mathematics of Engineering. By Prof. Ralph E. Root. Pp. xiii + 540. (London: Baillière, Tindall and Cox, 1927.) 34*s.* net.

AMERICAN text-books of mathematics rarely find favour in Great Britain, and this work, written by a professor of the U.S. Naval Academy to meet the requirements of student officers, is scarcely likely to prove an exception. The tendency throughout is to give an empirical and mechanical knowledge of the subject, so that the engineer uses his mathematics merely as a tool. This is typified by the fact that a student is encouraged at an early stage in his mathematical career to rely on a table of integrals, rather than to acquire the facility for evaluating them independently. The degree to which the subject has been condensed may be judged from the fact that the theory of errors, method of least squares, and curve fitting have been dismissed in 42 pages.

The printing is marred by the rendering of all letters used as symbols in ordinary Roman characters instead of in the customary italics. In these days of monotype setting such an innovation cannot be defended on the grounds of economy, and, as it increases the difficulty of reading, it is to be hoped that other publishers will not follow suit.

L. J. C.

Spherical Harmonics: an Elementary Treatise on Harmonic Functions, with Applications. By Prof. T. M. MacRobert. Pp. xii + 302. (London: Methuen and Co., Ltd., 1927.) 15*s.* net.

THE object of this work is to provide a text-book on the elements of the theory of spherical harmonics with applications to mathematical physics so far as this can be done without employing contour integration. Within these limitations the author has certainly provided a useful book. The actual treatment of spherical harmonics occupies ten chapters with gravitational, electric, and magnetic applications. There is also a treatment of spheroids. No applications to hydrodynamics are mentioned. Chap. i. contains an account of Fourier expansions subject to Dirichlet's conditions, which should prove useful. Chap. ii. deals with the conduction of heat, and in Chap. iii. an interesting discussion of the vibrations of harp, violin, and piano strings is given, which offers a striking contrast in the effect of initial conditions. The last three chapters of the book give a valuable account of Bessel functions and their applications to the vibrations of a circular membrane and the flow of heat.

L. M. M.-T.

Mathematical Statistics. By Prof. Henry Lewis Rietz. (The Carus Mathematical Monographs, No. 3.) Published for the Mathematical Association of America. Pp. xi + 181. (Chicago and London: The Open Court Publishing Co., 1927.) 10*s.* net.

PROF. RIETZ aims at explaining the mathematical theory underlying modern statistical analysis, and in particular to correct misleading impressions as to the place and importance of probability theory. He has succeeded in giving an admirable and connected survey of the more important methods, including an account of the Lexis theory. The mathematics used are elementary and the style elegant, but the language is that of the mathematician, and it is doubtful whether the author will succeed in reaching those whose knowledge is confined to the elements of the infinitesimal calculus. From the point of view of readers of this class, the book would have been improved by a list of definitions of the terms employed. To those of mathematical tastes the book can be recommended as offering a convenient conspectus of an important field of thought. L. M. M.-T.

Studies in Psychology: Memory, Emotion, Consciousness, Sleep, Dreams, and allied Mental Phenomena. By Dr. William Elder. Pp. xv + 212. (London: William Heinemann (Medical Books), Ltd., 1927.) 8*s.* 6*d.* net.

DR. ELDER writes very sincerely as a neurologist who is much interested in psychological theory but is quite unable to think of a mind without a brain. He has no sympathy with modern psycho-analytic theory and writes as a whole-hearted behaviourist. He looks on sleep as an instinct which has become a habit. Dreams are to him easily explained on old-fashioned lines without any need to invoke the aid of the censor, the symbol, manifest or latent contents, or any other Freudian concept. The author very sensibly points out that the interpretation of dreams must by their very nature be largely a matter of guess-work and far removed from any claim to scientific accuracy. Altogether a most refreshing book in an age where one has almost forgotten the existence of any other dream theories than those of Freud, Jung, Adler, and Rivers.

Letters to the Editor.

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

The Nebulium Spectrum.

IN an interesting note by C. T. Elvey (NATURE, **121**, p. 12, Jan. 7, 1928) a calculation has been given of the "density necessary to produce the nebulium spectrum," the example considered being the nebulosity originating in the new star Nova Aquilæ, 1918. The outburst of this star was observed early in June 1918; by October a bright nebulous envelope had appeared around the star; it continued to spread as long as the star was under spectroscopic observation (August 1926). The outward flying gases had an average velocity of some 2000 km./sec. The N_1 and N_2 lines (5007 A. and 4959 A.) were recognised in the spectrum about 19 days after the outburst. At that time the density of the envelope would be of about 10^{-17} grams/c.c. In the first years of the existence of the envelope the light of the gas consisted mainly of the nebulium lines N_1 and N_2; in 1926, however, these were extremely faint, and most of the light came from the Balmer lines of hydrogen and 4686 A. He^+ (E. Hubble and J. C. Duncan, *Astrophys. J.*, **66**, p. 60; 1927; and Plate IV.). Nine other novæ give similar density, 10^{-19} to 10^{-20} grams/c.c., that is, about 50 molecules/c.c.

This constancy was taken as indicating that "there is a limiting density above which the conditions are unfavourable for the production of the nebular spectrum" (10^{-17} grams/c.c.). This corresponds to some millions of H atoms/c.c., the free path being of the order of hundreds of kilometres. Forbidden lines, however, have been actually obtained at higher pressures, and without denying that the density is of great importance, it seems to us that another factor has been unduly neglected: the temperature. It is evident that the expansion of the star was accompanied by changes in temperature or at least by changes in the composition of the spreading matter. It is generally recognised at present that the light observed in nebulæ is in some way caused by neighbouring stars (in the diffuse galactic nebulæ) or where the luminosity is arranged around a brighter nucleus (planetary nebulæ) by the light from the central star. The nebulous material must be in a physical state sensitive to stellar radiation and close enough for the density of radiation to be effective.

An attempt has been made (Zanstra, *Astrophys. J.*, **65**, p. 50; 1927) to show that the light emitted by the diffuse nebulæ is, in the case of the Balmer lines, at least, due to the recombination of positive ions and electrons. The total number p_n of electrons which is captured by the nth level of the H atom is, according to Kramers, about

$$p_n = \frac{\dfrac{1}{n+Cn^3}}{\sum_{n=1}^{\infty} \dfrac{1}{n+Cn^3}} \quad \text{where } C = \frac{\frac{1}{2}mv^2}{W_1}$$

(W_1 the ionising energy of the first excited level, m and v the mass and the velocity respectively of the electron). If $\frac{1}{2}mv^2$ of the electron is comparable with W_1, an appreciable fraction of electrons will be captured by the first levels. Although the Balmer series and the associated continuum have been observed in many nebulæ, it is by no means clear how recombination phenomena can account for the majority of these clouds. The density of the gas itself is usually smaller than the concentration of charges obtainable in the positive column of a (rare) gas discharge, and in this case recombination is negligible.

Any theory of nebulæ emission has to account for the wide differences in the spectra of nebulæ. In this respect Hubble's results as to the type of stars associated with the gaseous matter are important (*Astrophys. J.*, **56**, pp. 162 and 400; 1922). The light emitted by the nebulæ is very often different from the spectra of these centres. There is, however, a close correspondence in that nebulæ giving bright lines are always connected with stars of earlier than B1 type, whereas when later types are involved the nebular spectrum is continuous, with or without dark absorption lines. B1 type stars correspond to a temperature of about 20,000°.

The typical nebular lines N_1 and N_2, the forbidden lines between the low-lying metastable levels of O^{++}, are as a rule much stronger in the planetaries than in the diffuse nebulæ. In the diffuse case H_β is about as strong as N_1, in the planetaries the ratio is $N_1 : N_2 : H_\beta = 10 : 3 : 1$. The strengthening of the nebulium lines in the planetaries is not accompanied by a corresponding increase of the continuous spectrum of the nuclei in this region; but the maximum of the continuous nuclear spectrum is shifted to the violet as compared with that of the stars associated with diffuse nebulæ. Thus the planetary nuclei have an extraordinary intensity in the ultra-violet, the maximum being certainly at a wave-length less than 3300 A. There are now two points to which we should like to direct attention. The first is that the energy to excite the nebulium lines would be very small if the material (oxygen) were already in an ionised state, so that the connexion between strong ultra-violet spectra and nebulium lines is difficult to understand on that basis. The second point is that the lines are essentially emission lines and have as yet no importance in absorption spectra. Both facts lead to the conclusion that the oxygen which is responsible for the nebular lines cannot be in an ionised state, but must be present as a molecule or molecular ion. As a molecular ion it ought to show absorption bands situated in the visible spectrum.

That forbidden lines between low metastable states of an atom may be expected from dissociating molecules was first pointed out by the authors in a paper published more than half a year ago (*Proc. Roy. Can. Soc.*, vol. 21, p. 27; 1927: cf. the discussion of the low metastable levels of I_2). We should like to add that not only the emission of forbidden lines must occur, but also their absorption. In the case of mercury vapour, for example, the heat of dissociation of the molecules is low; under the conditions of the experiment it is of the order of the energy of the faster molecules, so that a large number of molecules break up into atoms, while other atoms recombine to maintain the equilibrium. So long as in this process one mercury atom remains under the influence of the field of its companion of late, it may absorb forbidden lines. That forbidden lines are absorbed has indeed been strikingly demonstrated by Lord Rayleigh (*Proc. Roy. Soc.*, vol. 117, p. 294; 1927).

These relations will be more closely analysed in connexion with other work; their importance for our knowledge of the constitution of stars is evident.

J. C. MCLENNAN.
RICHARD RUEDY.

The Physical Laboratory,
University of Toronto, Jan. 27.

The Hydrogen Molecule.

IN his very interesting letter on this subject to NATURE of Jan. 28, Prof. Birge has decided that the first of the two alternatives which I proposed for the structure of the spectrum of H_2 is correct. I should have been very much pleased to obtain the support of so eminent and experienced a band spectroscopist for either view; but at the present time there is no material divergence between us. The last of the two or perhaps three papers [1] which Prof. Birge traverses was written nearly a year ago. At that time it was obvious that there was a misfit somewhere, and I indicated two alternative positions for it. Since then much information about the extreme ultra-violet, as well as the visible spectrum, has come to light. There are also the results of the calculated structure of the hydrogen molecule which have been obtained by the new quantum mechanics. It now seems fairly certain that the suspected coincidence of my 2^3P level with Dieke and Hopfield's C level is an accident. The case for the coincidence of my 2^1S level with their B level is much more convincing.

If this coincidence is correct the following fact is very curious. On Werner's plates taken in the visible, which he has kindly allowed me to inspect, I find the violet bands $2^1S - 3^1P$ and $2^1S - 4^1P$ strongly developed. On plates taken in the far ultra-violet under the same discharge conditions Werner finds his own bands, $A - C$ ($1^1S - C$), strongly developed, but if the Lyman bands, $A - B$ ($1^1S - B$), are present, they are very weak. The presence of the violet bands shows that the 2^1S states are formed; the weakness of the Lyman bands shows that they pass with difficulty into the 1^1S state, which is the only known deeper state. It looks as though they must get rid of their excitation energy by dissociating the hydrogen molecules with which they collide. The Lyman bands are present in the absorption spectrum of H_2, but they can only be excited efficiently in emission in presence of a large excess of argon. This will greatly reduce the opportunity of the excited hydrogen molecules to collide with other hydrogen molecules.

As regards the method by which I calculated B_0 (the band constant which is inversely proportional to the moment of inertia) for the 2^1S and 3^1P states, I used it because there was no other method available. I expressly stated that it was inaccurate in the data to which it had to be applied, and that the value obtained for the 2^1S state was likely to be too high. I now think that this error is due to some of the weaker lines being probably the wrong lines. Accepting Prof. Birge's value of about 28 for $2B_0$ for the 2^1S state, the second differences of the strong ${}_0A_0$ band in which the lines are probably trustworthy, show that the value 41 got by the same method for 3^1P was about right.

It is, at any rate, a cause for great satisfaction that there exists at the present time a complete harmony between the interpretation of the spectroscopic data for the molecule H_2 on one hand and the results of the theory of its structure according to the new quantum mechanics, as well as the theory of the specific heat of hydrogen, on the other. However, the last chapter of this story is not yet written. There are even now many important lines in the secondary hydrogen spectrum which are not understood and there may be room for some surprises still.

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[1] *Proc. Roy. Soc.*, A, vol. 111, p. 714; vol. 113, p. 368 (1926); vol. 115, p. 528 (1927).

The Dominant Species of Ostrea.

IN reviewing the characters of the dominant species of oysters, Ostrea, of which something is known of the life-history as well as the shell-characters, two distinct types are recognisable.

Type I. consists at present of

O. edulis, Linn., the European oyster (see Hoek [1] and Dean [2]).
O. lurida, Carpenter, the British Columbian oyster (see Stafford [3]).
O. Angasi, Sowerby, the south-west Australian oyster (see Roughley [4]).

In this type the shell is sub-circular; the egg is large; the adult larviparous; the individual is hermaphrodite; spawning occurs at medium temperatures, round about 15° C.; and the species flourish in temperate regions.

Type II. consists at present of

O. virginica (≡*elongata*), Gmelin, the American-Canadian oyster (see Stafford [3]).
O. angulata, Lamarck, the Portuguese oyster (see Dean [2]).
O. cucullata, Born, of world-wide distribution in sub-tropical and tropical parts (see Dean [5] and Roughley [6]).

In this type the shell is elongated in an antero-dorsal and postero-ventral direction; the egg is small; the adult non-larviparous; the individual of one sex only; spawning occurs at moderately high temperatures (round about 20° C.); and the species flourish in sub-tropical or tropical regions.

Although the species noted above are among the most abundant and most successful of the genus, a large number of other supposed species have been described (Sowerby [7])—from shell characters—at various times. Shell-characters are, however, now known to exhibit great range of variation within the species in the genus Ostrea, and it may be anticipated that in the—probably distant—future many supposed species will be found to be mere varieties. At present we are therefore confronted with a supposed large genus containing at least two well-defined groups of species amongst the best known and the most successful forms in the genus. These successful forms are, however, of such world-wide distribution that it is difficult for one individual to summarise into an accurate technical description the assemblage of characters occurring in the two types noted above.

It seems clear, nevertheless, that there is justification for recognising two groups of species, whether the groups be regarded as differing generically or only sub-generically. Type I. is clearly Ostrea, of generic, or type sub-generic value. while type II. may be regarded as Ostrea, sub-genus Gryphæa, or a separate genus, for which the name Gryphæa may be suggested, or a new generic name may be preferable, and Dioeciostrea is a suitable one.

In a question of this kind international co-operation would be highly desirable in order to avoid overweighting of the literature with names. On the other hand, a decision must be made by someone, and if sufficient care be devoted to the matter it should be possible to avoid complications in the literature and at the same time give a better expression to the relationships of known forms than exists at present.

[1] Hoek, P. P. C., *Tijd. Nederl. Dierk. Ver.*, Supp. Deel i., 1883–4.
[2] Dean, B., *Bull. U.S.F.C.*, **10**; 1890 (1892).
[3] Stafford, J., "The Canadian Oyster," 1913, Ottawa.
[4] Roughley, T. C., *Australian Museum Magazine*, **2**, 1925.
[5] Dean, B., *Bull. U.S.F.C.*, **22**; 1902 (1904).
[6] Roughley, T. C., *Proc. Linn. Soc. N.S.W.*, **2**, 4; 1926.
[7] Sowerby, G. B., in Reeve's *Conchologia Iconica*, Part 288, 1871.

Similar cases do no doubt occur in all groups of plants and animals where international co-operation might be of value, if the machinery to effect it could be devised. But there is a danger, in such a method, of problems being shelved. For example, in 1912, attention was directed to the fact that the species of Cucumaria at Plymouth could be divided into two groups on such fundamental characters as the gross morphology of the gonad and presence or absence of radial symmetry, but the author forebore to establish a separate genus or sub-genus for one of these groups on the ground that such a proceeding would be better performed by a specialist reviewing the whole genus. That work is still waiting to be performed, and may not be done for several decades, whereas if the sub-genera had been created, the species of the genus would have been allotted to their proper place when revised locally or regionally.

Ideally, species of sub-genera should be phylogenetically related, but such relationships can rarely be established and are usually intelligent assumptions with a great probable error. There is always a possibility of convergence in evolution, especially in closely related forms, so that groups with certain characters in common may frequently comprise members which have not arisen unilaterally from a single common species or stock. Nevertheless, until the contrary is proved, the current method of grouping species with common characters into a sub-genus or genus—or even larger groups—will give a maximum first approximation value to phylogenetic relationships. Thus the practice of grouping similar species is defensible. One might in a case like the facies, Ostrea, go farther, and in an ideal scheme scrap the old names for new and more useful ones, such as, Monoeciostrea for Ostrea, type sub-genus, and Dioeciostrea for all such forms as conform with the characters of type II. noted above; at the same time, more useful names for the species might be obtained by latinising the now well-known common names, to give, for example:

O. edulis ≡ *Monoeciostrea europa*
O. lurida ≡ *Monoeciostrea vancouverensis*
O. Angasi ≡ *Monoeciostrea sud-australis*
O. virginica ≡ *Dioeciostrea americana*
O. angulata ≡ *Dioeciostrea hispaniola*
O. cucullata ≡ *Dioeciostrea subtropica*

A glance at the suggested new names is sufficient to show their superiority in descriptiveness.

The more the names of organisms describe their fundamental characters, the greater their value, and the nearer the approach to a simplified biology. The chief objection to descriptive names is, however, the constant inadequacy of extant knowledge. We never know that we know enough to describe organisms accurately for all time. For example, many animals are known to be functionally bisexual, or dicœcious, but specifically hermaphrodite, or monœcious; and no doubt many other forms now supposed to be bisexual will be found in the future to be specifically hermaphrodite. Therefore, as we cannot expect to describe organisms for all time, we must expect and submit to change, but to avoid excess of change it is desirable that any effected change should be supported by either adequately proved individual or collective experience.

In the case of the two types of living species in Ostrea noted above, it is considered advisable to postpone the creation of new genera (with new or modified generic names) until more detailed information is available of their correlated morphological and biological characters. The names Monoeciostrea and Dioeciostrea are therefore mentioned merely as suitable types of names, and are not intended to be adopted in the literature until definition can be made, founded on adequate information. In the meantime, this discussion may stimulate inquiries into the characters of other less well-known species of the genus.

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Soft X-ray Emission and Absorption Spectra with Tangential Grating.

SINCE 1925 I have endeavoured to apply, for spectrographic work in the domain of the X-rays, the ruled glass grating, used with very high glancing angle, approaching 90°, which is particularly suited to give a high resolving power. Successively, I obtained direct diffraction and absolute measurement of wave-length for an X-ray beam of $K\alpha$ and $K\beta$ of copper and iron (*C. R. Acad. Sci.*, Dec. 21, 1925), and showed that the same arrangement could be utilised for extreme ultra-violet spectra (copper condensed spark spectrum between 140 A. and 3500 A.) by adjusting the 'tangential grating' in vacuum (*Revue d'Optique*, **5**, 97; 1926: *C. R.*, **182**, 1141; 1926: *Journal de Physique*, Jan. 1927). Afterwards, using as the source of rays for the vacuum spectrograph a water-cooled metal X-ray tube and a glass grating with 30,000 lines to the inch from Prof. R. W. Wood, I have been able to obtain line spectra of soft X-rays (10 A.-100 A.) upon an ordinary photographic plate. The grating method seems, therefore, the most suitable to bridge the gap between the ultra-violet and X-rays (*C. R. Acad. Sci.*, **185**, 62; 1927: *Journal de Physique*, Nov. 1927) (Fig. 1). Soltan and I

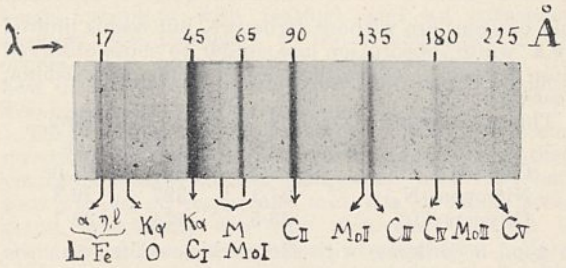

FIG. 1.—Line spectrum.

have registered and measured the $K\alpha$ lines of boron (68·0 A.), carbon (44·9 A.), nitrogen (31·8 A.), oxygen (23·8 A.), the L spectrum of iron, the M lines of molybdenum (65·0 A., 54·9 A.), and a regular doublet ($\Delta\lambda = 3$ A.) from N series of heavier elements (for tantalum, tungsten, platinum, gold; lying between 46·8 A. and 61·4 A.) (*C. R. Acad. Sci.*, **185**, 642; 1927: *Journal de Physique*, Dec. 1927, in which there are numerous reproductions of spectra).

In these earlier line spectra I have never noted the emission of a continuous radiation. Recently, however, using elements of high atomic weight as anticathode and intense electronic current in the tube (100 milliamp., 1000 volts), I have been able to demonstrate the emission of a continuous spectrum from solid bodies between 15 A. and 250 A. with similar properties to the independent background of a Coolidge tube.

The continuous background registered in my spectra is not uniform, but divided by a succession of fine bands with abrupt edges on the short wave-length

sides (Figs. 2, 3). The absorption of soft X-rays, then, varies discontinuously whenever the frequency of the independent radiation reaches a discontinuity of atomic absorption of elements present in the path of the rays. The elements present in the vacuum

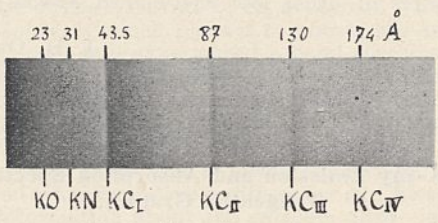

FIG. 2.—Absorption spectrum.

spectrograph, at a pressure much less than a barye, are carbon (vapour from grease used in joints), nitrogen, and oxygen, and, in fact, we observe the intense K band of carbon (in five orders), and also of nitrogen and oxygen. It is hence a very sensitive method for revealing minute quantities of gaseous matter. The three absorption edges (carbon, nitrogen,

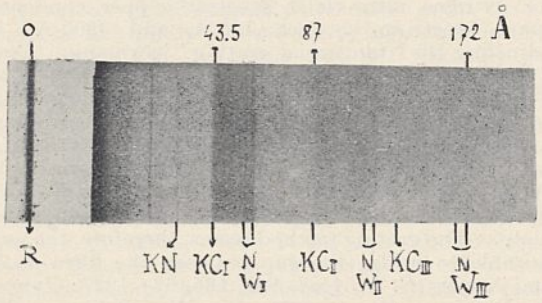

FIG. 3.—Emission and absorption spectrum.

and oxygen) are without structure, but seems limited by a 'white' absorption line similar to those observed close to the L edges of heavier elements (Nishina, Coster).

The wave-lengths of the K edges are as follows :

	λ(A.).	V (volts).	ν/R.
Carbon (C) . .	43·5	284	21·0
Nitrogen (N_2) .	31·1	397	29·3
Oxygen (O_2) .	23·5	524	38·7

in good accordance with Holweck's results from the ionisation method.

The absorption spectra reproduced herewith are the first to be recorded by a photographic method in the gap between the ultra-violet and X-rays.

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The Highly Penetrating Cosmic Rays.

IN their interesting account of new results on cosmic rays, published in the supplement to NATURE of Jan. 7, Prof. Millikan and Dr. Cameron direct attention to the statement made by Dr. E. Steinke (*Zeitschr. f. Physik*, **42**, 570 ; 1927) that the very careful measurements on highly-penetrating rays at sea-level performed by him do not show any real variations as to the intensity of these rays. I wish, however, to point out, as a matter of fact, that when the values of Dr. Steinke's measurements are arranged directly *according to sidereal time*, and when small systematic differences between the values of the different registering films are eliminated, these measurements show variations which are completely in accordance with those found by W. Kolhörster and G. von Salis (*Sitz. Ber. Preuss. Akad. d. Wiss.*, **11** ; 1927) and by K. Büttner (*Zeitschr. f. Physik*, **45**, 588 ; 1927), but are only in percentage smaller.

Although sidereal time shifts 50 minutes with respect to civil time during the thirteen days of Dr. Steinke's measurements, he has only computed the means and the mean errors for every hour of *civil* time (MEZ), and he regards these as valid also for sidereal hours. This may be excused in a careful experimental investigator who is not an astronomer, nevertheless it is evident that if we are seeking a possible correlation with respect to the sidereal time, the measurements must be arranged *from the beginning* according to this time. If we arrange the values in Steinke's Table 3 (where they are corrected for barometric effect) according to sidereal hours ($0^h = 23^h\ 30^m - 0^h\ 30^m$, *etc.*), and also according to the different registering films, we may first compute the means for every sidereal hour. Comparing, then, all values of a certain film with the corresponding last-mentioned means, we find the following systematic corrections for the films :

1926 Nov.	13-14 :	− 0·022 volt/58^m
,,	15-16 :	+ 0·027 ,,
,,	16-17 :	+ 0·008 ,,
,,	17-18 :	− 0·022 ,,
,,	18-19 :	+ 0·012 ,,
,,	19-20 :	− 0·004 ,,
,,	20-21 :	+ 0·012 ,,
,,	21-22 :	− 0·014 ,,
,,	22-23 :	− 0·004 ,,
,,	23-24 :	+ 0·020 ,,
,,	24-25 :	− 0·015 ,,

When we apply these corrections to the values of the corresponding films and then compute anew the mean, the mean error of every value, and the mean error of the mean for every sidereal hour, we find primarily that the means are very little affected by the systematic corrections. The weighted mean error of a single value is, however, here ± 0·0226 $V/58^m$ instead of ± 0·0295 $V/58^m$ as given by Steinke, and the weighted mean error of a point on the curve of the means is ± 0·0074 $V/58^m$ instead of ± 0·010 $V/58^m$ as given by Steinke. The curve shows the same maxima at 0^h, 5^h-7^h, 13^h-16^h, and 20^h (and in addition one maximum at 3^h), and the same minima at 4^h, 8^h-12^h, and 19^h sidereal time that were found by Kolhörster and Büttner (*loc. cit.*), and these extremes deviate about 0·016 $V/58^m$, or more than twice the mean error from the general mean ($= 1{\cdot}961\ V/58^m = 1{\cdot}765\ J$ cm.$^{-2}$ sec.$^{-1}$). Steinke's curve of the means for each hour of *civil* time agrees in some features with those of Kolhörster and Büttner, as was remarked by Büttner in his paper cited above.

As the curves of three authors, who have not only made their measurements at different times and places, and in different ways, but also hold different views, thus agree in the fundamental point of showing maxima and minima for the same sidereal times, and, moreover, greater percentage variations for increasing height over the sea-level, I think we must now consider the existence of these variations to be confirmed. The failure of Prof. Millikan's and Dr. Cameron's experiments to detect variations is puzzling and may have some unknown physical cause. I should like to suggest the possibility of the variations being caused mainly by somewhat softer cosmic rays (coming from the 'heated vacuum' of the Mira stars ?—see *Astr. Nachr.*, 5529) than those found by Prof. Millikan and Dr. Cameron when their apparatus was sunk deep below the

levels of the lakes used by them. In fact, the greater absorption coefficients (of Kolhörster) are found by such apparatus and experiments, which have also revealed great variations, whereas the smallest absorption coefficients are related to those experiments (of Millikan, Cameron, and Steinke), which show only small variations or none. In the mountain, or balloon, experiments, a mixture of both kinds of rays may have been measured. For full consideration of the lack of agreement of the measurements, it would, however, be most valuable if Prof. Millikan would, like the German workers, publish also the particulars of his measurements.

AXEL CORLIN.

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Jan. 26.

The Relation of Specific Heat to Ferromagnetism.

FERROMAGNETIC substances, in addition to their purely magnetic qualities, have other properties which are distinctive. For example, the temperature coefficient of resistance and the thermo-electric power behave abnormally up to the critical temperature, and become approximately normal above this point. But notably the true specific heat shows abnormal behaviour with rise of temperature. It increases to a high value (C_θ) at the critical temperature, and then immediately above this temperature there is an abrupt change (ΔC) to a much lower value.

An equation connecting C_θ and ΔC, which is derived from observations on iron, cobalt, and nickel, is

$$m.a.C_\theta = 5n.a.\ \Delta C \quad . \quad . \quad . \quad . \quad (1)$$

where $m.a$ and $n.a$ are the molecular weights below and above the critical temperature, m and n being the number of atoms of atomic weight a in the molecule. Thus the molecular heat at the critical temperature is five times the molecular heat of the discontinuity, a result which is of significance. The discontinuity (ΔC) is intimately connected with two magnetic constants, the maximum intensity of magnetisation (I_0) and the reciprocal of Curie's constant (R') as follows:

$$n.\Delta C.J.\rho = 278\ R'\ I^2_0 \quad . \quad . \quad . \quad . \quad (2)$$

J and ρ being Joule's equivalent and the density of the material respectively.

Both equations are satisfied by the numerical values derived from experiments on iron, cobalt, nickel, and magnetite, and it is of interest and importance to inquire if the abnormal behaviour of the specific heat is always to be found with ferromagnetism, and if the magnetic constants have always a definite relation to the specific heat.

There is, fortunately, one other ferromagnetic substance on which experiments may be made for the answering of this question, namely, Heusler's alloy.

I am indebted to Prof. F. C. Thompson for a sample of this alloy with an analysis of it, and I have made a number of experiments on its properties. Briefly, it may be said that Heusler's alloy shows the same kind of abnormality with temperature in its thermo-electric power and electrical resistance as do other ferromagnetics. Further, the true specific heat increases rapidly up to the critical temperature and then exhibits a discontinuity such that the equation first given is satisfied, and also the maximum magnetic intensity and Curie's constant are related to the discontinuity of the true specific heat according to the second equation.

The specimen I have of Heusler's alloy has magnetic qualities which are similar to those of nickel. Its maximum intensity is 420, and its absolute critical temperature (θ) is 360° + 273, so that it conforms to the equation,

$$\frac{\theta}{I_0} = 8/27 \times q \quad . \quad . \quad . \quad . \quad (3)$$

where q is a whole number—the number 5—and it forms one of the whole number series 2, 3, 4, and 6, which are the q-values for iron, cobalt, nickel, and magnetite respectively. With Heusler's alloy, both C_θ and ΔC are, as with nickel, about half the values found in the other ferromagnetics.

Lastly, the alloy satisfies the general equation

$$\rho \cdot R_{an} = R'\ I^2_0 \quad . \quad . \quad . \quad . \quad (4)$$

in which R_{an} is the gas constant, if this is taken to be that of manganese with two atoms to the molecule.

Thus Heusler's alloy, like other ferromagnetics, conforms to the four equations given above which are characteristic of ferromagnetism, and the conclusion is that abnormal electric and thermal properties are necessarily associated with ferromagnetism, all of them being connected together by energy considerations.

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Bird Feathers and the Antirachitic Vitamin D.

ON reading the article entitled "The Antirachitic Vitamin D" in NATURE of Dec. 31, which has just come to hand, it struck me that it might be worth while to record the following. In my student days I at one time kept various hawks and owls as pets. Many of these were taken from the nest and hand-reared, their food being in the main 'lights'—in the broadest sense—including liver. The majority died of rickets before attaining maturity. Among the exceptions were two favoured young tawny owls, which were fed almost exclusively on mice and sparrows. Success with these led me to add chicken heads complete with feathers and an occasional sparrow, also feathered, to the commissariat of the others. The only essential difference between the new diet and the old was the inclusion of feathers. The birds ceased to be troubled with rickets.

That feathers may be a source of vitamin D seems questionable in view of the general nature of a feather, yet birds possess nothing comparable with the sebaceous glands of mammals, and the so-called preen gland, practically the only skin gland known to occur in birds, is not present in all species. Many birds are entirely cereal eaters, except at such times as they are rearing young, which suggests that they may get their supply of vitamin D mainly from the solar radiation via their external covering of feathers. This need not necessarily mean through the substance of the feather, for most feathers have an oily coating. How much of this owes its origin to the preen gland is highly problematical, but so far as the gland itself is concerned, Prof. J. B. Collip tells me that he has found it to be rich in colesterol in the domestic fowl; and this may apply, and probably does, to feather oil generally, whatever its origin.

However, in view of these things, the following episode from the life-history of the merlin (*Falco columbarius æsalon*) seems worthy of note. As recorded in Pt. III. of my observations on this species in *British Birds* (Mar. 1922), another aspect of which drew comment in these columns (NATURE, Dec. 8, 1921, p. 478), the hen fed her chicks entirely on birds. These were nearly always brought to the eyrie plucked, the young being given the meat and less frequently the entrails, the bones as a rule being swallowed by the parent. The diet thus far compared excellently with the rickets-encouraging lights fed to

my pet birds. But the growing merlins did not develop rickets, and it appears that the mother was 'aware' of the remedy, for from time to time she would bring in a victim entirely or partially feathered and feed mouthfuls of *feathers only* to all her offspring in turn. They quite evidently objected to it and regarded it as 'medicine,' for the mouthful invariably had to be thrust well down into the maw, and even then proved very difficult to swallow. Possibly it is true that there is nothing new under the sun, and we may here be witnessing a crude method of administering the antirachitic vitamin D that has, no doubt, been in practice for countless centuries.

WM. ROWAN.

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The Cause of Fishiness in Dairy Products.

THE action of Fenton's reagent (hydrogen peroxide in the presence of small amounts of ferrous salt) on lecithins in alcoholic solution causes the oxidation of the choline and amino-ethyl alcohol portions to trimethylamine and methylamine respectively (together with some ammonia).

The olein of butterfat, owing to its unsaturation, easily absorbs oxygen to form a labile peroxide, the absorption being strongly catalysed by compounds of heavy metals, especially those of copper. The peroxide thus formed is an active oxidising agent in fatty media and is also a catalyst to more advanced oxidation. Lecithin is intimately associated with the fat peroxide in the fat phase of dairy products, and its nitrogenous base portion is oxidised through the agencies of the fat peroxide and the catalytic activity of the metallic (copper) compounds present, forming volatile bases possessing a fishy odour. That is, the reaction involved is a modified Fenton reaction in the fat phase. These volatile bases (trimethylamine mostly), together with the easily hydrolysable salts of these bases with free fatty acids (butyric and oleic), are the causes of fishy flavours and smells in dairy products.

The importance of small amounts of metallic compounds, copper especially, in strongly catalysing the oxidation must be realised, since, without metallic contamination, the formation of labile peroxide would be slow, and, since rancidity is a precursor to fishiness, that degree of rancidity necessary for fishiness to develop would not have been reached during the normal storage of products free from metallic contamination. In the examination of all products which were fishy, copper in appreciable quantity has been found to be present.

That such oxidation is possible in butterfat also demonstrates the need of inquiry into the fate of fat-soluble vitamins during the development of rancidity.

W. L. DAVIES.
A. T. R. MATTICK.

The National Institute for Research in Dairying,
University of Reading.
Feb. 7.

Nomenclature of Eruptive Rocks.

THE reviewer of my book "Eruptive Rocks" (NATURE, Dec. 17, 1927) says that I have not accomplished my expressed purpose of cleaning up "the jungle of rock names." The *wisdom* of my procedure is open to question, but the *facts* can be ascertained by simple enumeration. Prof. Arthur Holmes collected about 470 names of eruptive rocks in his "Nomenclature of Petrology," and the total number in use at the present time is certainly not less than 500. Of these I have used only 56 in my system, a reduction of about 88 per cent. This seems to me to be a fairly thorough 'cleaning-up,' and I wonder what more the reviewer wants? Of course, I use some qualifying terms in conjunction with these names, but so does every petrologist, no matter what system he follows.

S. J. SHAND.

University of Stellenbosch,
Jan. 11.

PROF. SHAND has been led astray by his metaphor. He imagines that petrographic nomenclature is to be cleaned up by the simple process of chopping down names to the extent of 88 per cent. (as he claims), just as a jungle would be cleaned up by chopping down trees and clearing undergrowth. In denying that he has cleaned up the jungle of rock names I merely meant to imply, following his metaphor, that he has not, in my opinion, succeeded in his task of reforming petrographic nomenclature. I do not deny that he has eliminated, or attempted to eliminate, a large number of rock names, some desirable, others undesirable; but he has also added a number of fungoid growths such as per-, sub-, meta-, -oid, to the names he has spared, a procedure which, in my opinion, neither lessens the confusion nor contributes to the beauty of the nomenclatorial jungle.

It may further be questioned whether Prof. Shand has really cleaned up the jungle to the extent of 88 per cent. Of the 470 igneous rock names given in Holmes's "Nomenclature of Petrology," probably at least half have never been used more than once, and are, therefore, seeds that never took root.

THE REVIEWER.

Mammoths and Man in the Transvaal.

IN the supplement to NATURE of Dec. 10 is an interesting contribution by Prof. Dart on "Mammoths and Man in the Transvaal." The paper is valuable in directing attention to the importance of the Vaal River diamond gravel terraces, and the light which they will probably throw on early man in South Africa, and possibly on the wild animals associated with him. Whether Prof. Dart's conclusions are confirmed or not, the paper will result in more intensive work being done. Some of us who for years have been interested in the matter, have come to conclusions which differ from those of Prof. Dart.

Two years ago Miss Wilman, director of the Kimberley Museum, sent to Prof. Osborn, at my suggestion, two elephant teeth from the gravels of Barkly West. These Prof. Osborn determined as two species of Archidiskodon, one of which he regarded as a Middle Pliocene type and the other as an Upper Pliocene or Lower Pleistocene type. Three years ago I described the molar of an extinct giant pig from another gravel deposit. At present I have on hand four specimens collected by diggers, evidences of a huge extinct horse, and of a second type of large pig. All these teeth show some signs of being water worn, and if Prof. Osborn is right in regarding the elephant teeth as of Pliocene or Lower Pleistocene type, we must conclude, I think, that the teeth have been carried into the deposit from a much earlier one. If, as seems probable, Prof. Dart's Archidiskodon teeth are similar to those examined by Prof. Osborn, then it may be regarded as almost certain that they are very much older than the lowest gravels of the Vaal, which cannot be of great geological antiquity.

R. BROOM.

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The Influence of Diet upon the Teeth.

OWING to the prevalence of dental caries under our present conditions of living and dieting, knowledge of its cause, and the means by which it may be prevented or its ravages mitigated, is of great importance not only to the individual but also to the nation. During the last decade, attention has been directed by a number of observers to the influence which various types of diet may exert upon the structure of the teeth, often in conjunction with their effects upon other tissues of the body, especially the skeleton. This work has demonstrated that diet plays an important part in producing abnormalities of the teeth of experimental animals: the relationship of these abnormalities to dental caries is not so clear, since animals comparatively rarely suffer from this type of dental disease. Some evidence has been produced that there is a definite relationship between the structure of the teeth and caries, but it has not met with universal acceptance. In this article the influence of diet upon the structure of the teeth will be more especially considered, and the problem of dental caries only mentioned incidentally, where it appears to throw light upon the manner in which diet may affect the teeth. To illustrate the points raised, reference will be made to a few of the more recent papers dealing with the subject: further details will be found in these papers and also in those mentioned in their bibliographies.

There appear to be three ways in which diet can affect the teeth: food lodged in their crevices may undergo changes which lead to alterations in the enamel and other structures of the tooth; the diet may alter the composition of the saliva and thereby affect the teeth indirectly; or it may alter the structure of the tooth directly, in a comparable manner to its effect upon other tissues of the body. In the first two cases the agent acting upon the teeth attacks them, so to speak, from their outer or superficial surface; in the last, the changes depend upon an alteration in the composition of the blood and lymph reaching the tooth, and are thus initiated from the pulp or from within the tooth itself.

There is probably general agreement that caries is initiated by the fermentation of carbohydrate food stagnating between the cusps of the molar teeth, between the teeth themselves, and round their necks. According to J. Sim Wallace (*Med. Press and Circ.*, vol. 124, p. 487; 1927), diet cleanses the teeth mechanically, by initiating the secretion of ptyalin and by controlling the bacterial flora which digests remnants of food remaining between them. Efficient mastication is necessary both for keeping them clean and for ensuring their proper development together with that of the jaws. Inefficient mastication, leaving stagnating mucus on and around the teeth, encourages the development of tartar, since bacterial decomposition of the mucus leads to the production of alkali and the consequent precipitation of certain salts. On the other hand, the consumption of soft, sticky carbohydrate food leads to the production of acid, from the bacterial decomposition of the masses adhering to the crevices of the teeth, and this acid attacks the interprismatic areas of the enamel, initiating caries. Thus starchy or sugary foods favour the development of caries, whilst the more fibrous foods, such as fruits or raw vegetables, and fish and meats, tend to cleanse the teeth both mechanically and by increasing the secretion of saliva which washes away adhering remnants, and thus hinder or prevent dental decay. Experiments have shown that acid-forming bacteria can initiate caries when grown *in vitro* in the presence of teeth, the acid attacking the enamel: at least two organisms have been found in or on carious teeth which can form acid from carbohydrate, but whether either of them is specific for this disease is not yet certain. Penetration of the enamel is very slow unless the acidity is of the order of *p*H 5·0 (I. H. Maclean, *Proc. Roy. Soc. Med.*, vol. 20 (Sect. Odont.), p. 873; 1927).

Little is known about the possibility of altering the composition of the saliva by changes in the diet. Although saliva is a secretion, it is possible that certain changes in the composition of the blood may be reflected in this secretion: in health, the variations in the different constituents of the blood lie within very narrow limits, but they are more marked in disease, and variations from the average normal might then be observed in the composition of the saliva. In fact, C. L. Pattison has found definite changes in the calcium with variations in the diet (*Brit. Med. Jour.*, vol. 2, p. 6; 1926). The work was carried out on children suffering from tuberculosis of the bones and joints. On admission to hospital the average salivary calcium was 4·77 mgm. per 100 c.c. On the ordinary hospital diet this rose to 7·79 mgm.; on a diet containing little milk, no cod-liver oil or eggs, but oatmeal and olive oil, the figure was almost unchanged (4·68 mgm.); but when plenty of milk and cod-liver oil and an egg, but no oatmeal, were given daily, the salivary calcium rose to 10·68 mgm. per 100 c.c. In the light of our present knowledge, there is little doubt that these results are to be explained by the improvement in absorption and retention of calcium which occurs on the administration of adequate amounts of vitamin D, following a relative or absolute deficiency in the intake of this compound. Addition of a calcium salt to the diet for a short period was without effect on the salivary calcium. Whether changes in the composition of the saliva can influence the teeth is not known: a possible indirect effect might be suggested by means of subsequent alterations in the bacterial flora of the mouth.

It is now known that the structure and composition of the teeth can be affected by changes in the amounts of calcium and phosphorus and of vitamins C or D in the diet: in general, it may be said that the proper development of the teeth usually shows a close relationship to the proper development of the bony skeleton. In producing imperfect calcification and structure of the teeth, deficient intake of calcium or phosphorus, or an improper ratio between these two elements in the diet, has most often been associated with a deficiency of vitamin D.

also. J. A. Marshall, however, found that pups exposed to sunlight and kept on a diet containing an adequate amount of vitamins, but with improper quantities of calcium and phosphorus, developed gross changes in their teeth, including imperfect calcification of the enamel and relative absence of the dentine: there was marked delay in dentition, and the deciduous teeth were not shed (*Jour. Amer. Med. Ass.*, vol. 81, p. 1665; 1923). G. Toverud also observed that in white rats maintained on a diet deficient in calcium the teeth contained less mineral ash than normal teeth (*Jour. Biol. Chem.*, vol. 58, p. 583; 1923); whilst M. R. Jones and F. V. Simonton found that the addition of alkali (sodium carbonate) to a diet complete in every other respect produced changes in the teeth and jaws of puppies (*Proc. Soc. Exper. Biol. and Med.*, vol. 23, p. 734; 1926). It is known that the absorption of calcium and phosphorus is influenced by the hydrogen ion concentration of the contents of the intestine, alkali interfering with this absorption and acid increasing it. C. J. Grieves (*Jour. Amer. Med. Ass.*, vol. 79, p. 1567; 1922) also found that a deficiency of calcium in the diet increased the amount of dental caries in the teeth of rats. Decay also occurred when the calcium was increased above the optimal amount: thus the effective factor appeared to be an improper calcium-phosphorus ratio rather than a simple change in the amount of calcium alone.

Among the symptoms of scurvy, due to deficiency of vitamin C in the diet, are hæmorrhages in various parts of the body, including the gums, in which situation they are accompanied by a loosening of the teeth in the jaws. Experimentally, changes in the teeth have been described by several authors: P. R. Howe (*Jour. Amer. Med. Ass.*, vol. 79, p. 1565; 1922), has observed decalcification of guinea-pigs' teeth, when the animals were kept on a scorbutic diet, with recalcification when a source of vitamin C, such as orange juice, was added to the food. Dental caries was present in the animals on the faulty diet. F. M. Wells (*Proc. Roy. Soc. Med.*, vol. 12 (Sect. Odont.), p. 22; 1919) and Toverud (*loc. cit.*) have described changes in the pulp of the teeth of scorbutic guinea-pigs with replacement of the orthodentine by osteodentine: the degeneration of the pulp may occur before other clinical signs of scurvy are present.

Probably the most important factor in producing alterations in the teeth is a shortage of vitamin D, or the antirachitic vitamin, with or without accompanying defects in the diet, such as variations in the calcium-phosphorus ratio. E. V. McCollum and his collaborators described changes in the teeth of rats maintained on diets low in protein, calcium, and fat-soluble vitamins (*Bull. Johns Hopkins Hosp.*, vol. 33, p. 202; 1922), and Grieves (*loc. cit.*) found that caries was worse in rats when the diet was deficient in fat-soluble vitamin as well as calcium than when it was deficient in calcium alone. In puppies, May Mellanby has shown that the most important variables affecting the formation of the teeth are variations in the amount and type of cereal in the food, in the amount of fat-soluble vitamin present, and in the degree of exposure of the animals to ultra-violet light (M. Mellanby, *Proc. Roy. Soc. Med.*, vol. 16 (Sect. Odont.), p. 74; 1923, etc., summarised by E. Mellanby, *Brit. Med. Jour.*, vol. 1, p. 515; 1926). The less vitamin and the more cereal present in the diet, the worse was the structure of the teeth. When the bitch was fed on the deficient diet during pregnancy and lactation, the deciduous teeth of the pups were affected; if the latter were given the diet after weaning, the defects were disclosed in the permanent teeth. It thus seems possible that the influence of carbohydrates upon dental caries is not only due to their fermentation in the mouth, but also to their effect, in association with the fat-soluble vitamin, and after their digestion and absorption, upon the structure of the teeth.

How far are these results applicable to human beings? It is beyond the scope of this article to discuss the relationship between the structure of human teeth and dental caries, but it may be mentioned that May Mellanby has adduced evidence of a close relationship between defective structure and caries, based on the microscopic examination of a large number of teeth. Discrepancies are explained as due to alterations in the structure of the teeth after they have erupted. That the defective structure is due to deficiencies in the diet is possible but unproven, since the diets of the patients from whom the teeth were obtained were not known or regulated; but where it has been possible to control the diet, a definite relationship between it and the spread of caries has been observed. About thirty children in an institution were divided into three groups, and each group given a carefully selected diet (May Mellanby, C. L. Pattison, and J. M. Proud, *Brit. Med. Jour.*, vol. 2, p. 354; 1924). Careful examination of the teeth was made at the beginning and end of the experimental period of seven to eight months, and the general condition as regards defective structure and the position and extent of caries noted. One of the diets was the ordinary hospital diet: on this the average number of teeth per child in which caries had spread was 2·9; on a diet containing less milk and no butter, but more oatmeal, *i.e.* low in calcifying vitamin (vitamin D) and calcium, the spread of caries was represented by 5·1 teeth becoming more affected in each child; whilst on a diet containing more milk and no oatmeal, *i.e.* abundant vitamin D and calcium, the figure was 1·4 only. Thus there appears to be a close relationship between the diet and the spread of dental caries in human beings.

More recently, May Mellanby has published some work on the structure of human teeth, the results of which suggest that diet plays an important part in producing defects of structure (*Brit. Dental Jour.*, July 1, 1927). More than 1000 deciduous and more than 250 permanent teeth were examined both macroscopically and microscopically: in many cases the first examination was made whilst they were still in the mouth. The results obtained depend, of course, upon the definitions of the terms 'normal' and 'abnormal' as regards tooth structure. Descriptions are given of the naked-eye

appearance of the enamel in various degrees of hypoplasia, and of the microscopic picture of the dentine: any uncalcified areas in the dentine are considered to be abnormal, but are so common that it is possible some authorities would consider them normal. Close agreement between the macroscopic and microscopic appearances was obtained in more than 85 per cent. of the examinations. Of the deciduous teeth, 14 per cent. were found to be perfectly calcified, 21 per cent. were slightly, and 64 per cent. definitely, hypoplastic. The incisors were the best calcified, 49 per cent. being normal: 8 per cent. of the canines, 7 per cent. of the first molars, and only 1 per cent. of the second molars could be so classed. Slighter defects appeared among the remaining incisors and canines, and the more severe degrees of hypoplasia were observed in the majority of the defective molars. The teeth obtained from private sources, as opposed to those from dental clinics, were less defective in structure. Of the permanent teeth examined, none was normal, and 92 per cent. showed definite hypoplasia; but these figures give no indication of the condition of permanent teeth in Great Britain, since all those examined had been extracted for caries, or to help in the adjustment of irregularities.

These results also indicate that there is less chance of interference with calcification before birth than afterwards, and that the more rapid the development of the tooth, the more defective is its structure likely to be. The defects in structure are probably to be correlated with the diet during the time the teeth are developing in the jaws: thus before birth, even if the mother is on a deficient diet, the fœtus can obtain its requirements of salts and vitamins by the sacrifice of the maternal stores. After weaning, the child has to depend entirely on its food and on its own stores, which are likely to be low if the mother's diet has been poor, for its supply of the substances necessary for the proper development and calcification of the teeth. At the same time, the diet frequently contains a large amount of cereal products, the influence of which is exerted against proper calcification. The incisors are the most advanced in development at birth, and are also the best developed structurally. The second molars are the least developed at birth; they grow rapidly after birth, and have the worst structure of any of the teeth.

In conclusion, it may be said that diet affects the teeth as it affects the other tissues of the body, and that the teeth, like the other tissues, respond more easily to some defects in the diet than to others, but that the same defect rarely affects more than a few of the tissues to a marked degree. In addition, the diet can affect the teeth locally by causing alterations in their environment, the changes in the teeth then starting from their oral surfaces.

The degree to which diet directly affects the structure of the teeth depends in part on the definition of the terms 'normal' and 'abnormal' as regards this structure: and on this depends again the relationship between abnormality of structure and dental decay. In any case, caries will not be initiated unless acid is present on the oral surfaces of the tooth. It may be pointed out that it is difficult to produce caries in animals unless at the same time the conditions are such as to lead to defective structure also.

The Enhancement Principle in X-ray Photographs.

By Sir WILLIAM BRAGG, K.B.E., F.R.S.

AN interesting phenomenon is often shown in the X-ray rotation photographs of crystals. Photographs of this kind are obtained by causing a crystal to revolve steadily about an axis perpendicular to the direction of a fine pencil of homogeneous X-rays. As the crystal revolves, one set of planes after another comes to a favourable condition for reflecting the pencil and a corresponding spot appears upon the plate. The crystal is usually very small indeed, and the shape of the crystal largely determines the form of the spot. The complete photograph shows an array of spots which displays certain regularities of arrangement as exemplified in Figs. 1, 2, and 3. When the photographic plate is flat, the spots arrange themselves on hyperbolæ as in Fig. 1; if a circular film is used the hyperbolæ are replaced by straight lines as in Figs. 2 and 3. The phenomenon to which attention is now directed consists in the enhancement, sometimes a very great enhancement, of certain groups of the spots. The explanation is more readily understood if consideration is first given to an analogous case of greater simplicity.

An ordinary optical grating gives a series of spectra: if the incident light is homogeneous, each spectrum is limited to a line. If now every fifth line in the grating were intensified or altered in some way, there would be added to the series already referred to a second series consisting of lines five times as close-packed, and every fifth line of the new spectrum would coincide with one of the old. For the sake of what follows, this may be put in another way.

If, in the first place, the grating had contained only lines corresponding to those which we have spoken of above as being intensified in some way, the more numerous series of spectra also referred to above would have appeared upon the plate. If, now, four other lines were intercalated uniformly between the lines already drawn upon the grating, every fifth line of the series of spectra would be enhanced.

From this simple case we may now proceed to the more complicated three-dimensional case of the crystal. A first example may be taken from the work on the structure of the silicates which has been carried out by Prof. W. L. Bragg and his colleagues at Manchester. They have shown that a silicate may be regarded in the first instance as a compilation of close-packed spherical oxygen atoms: the other atoms belonging to the silicate are to be thought of as inserted in the interstices in the

close-packed structure. Sometimes the inserted atoms, for example, when they are beryllium or silicon, do not strain the structure, and again larger atoms such as calcium or magnesium distort it more or less. But in all cases the silicate structure may be described as consisting of a basis of close-packed oxygens on which a larger pattern of other atoms has been superimposed. This is the very condition which was exemplified in simpler form in the optical case already described. When the rotation photographs are considered, the parallel consequences are also to be found. Certain spots are strongly enhanced; these are the spots which would be given by the oxygens acting alone in close-packed structure. The multiplicity of other spots which fill the photograph, including those which have been enhanced, are such as would appear if the structure consisted only of all the atoms except the oxygens. An example of these photographs was given in NATURE, Sept. 17, 1927, and is reproduced here (Fig. 1). This one picture is sufficient to show the exceedingly interesting and beautiful structure of the silicate family.

A second example may be taken from the work of

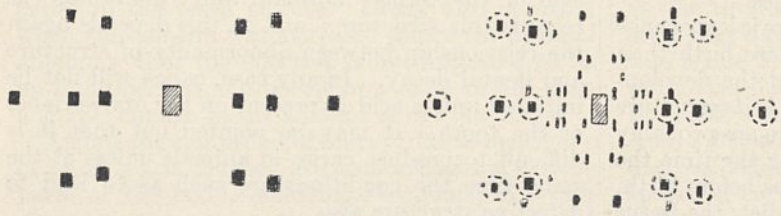

FIG. 1.—Rotation photograph around *b*-axis of disthene (right) compared with ideal rotation photograph around cube edge for close-packed atoms (left). Spots in the right-hand diagram corresponding to spots in the left-hand diagram are contained in circles.

Dr. Müller on the long chain compounds (*Proc. Roy. Soc.*, vol. 114, p. 542). In this case also there are two periodicities in the structure. There is that which depends on the length of the chain, which in stearic acid is 48·84 A. Along the axis of the chain there is a second and finer periodicity due to the regular arrangement of the carbon atoms. The repetition takes place every second atom and its length is 2·52: the one periodicity is approximately nineteen times that of the other. A rotation photograph of stearic acid shows a multiplicity of spots due to the many sets of planes which are capable of reflecting the homogeneous X-rays usually employed. Some of these spots are very strongly enhanced for similar reasons to those already given. For example, the sets of planes denoted by (2, 0, 19), (2, 0, 38), (0, 1, 20), (0, 2, 19), (0, 3, 19), (0, 0, 18), (0, 0, 20), all show up on the plate, and indeed are almost the only high indices planes to appear. Such sets divide the *c*-axis into 18, 19, 20 . . . equal parts, as their designation implies. Consequently, their periodicities nearly coincide with that of the carbons of the chain. It is not necessary that the one periodicity should be an exact submultiple of the other.

A third example may be taken from the photographs of naphthalene and anthracene about the *c*-axis. It will be seen from a comparison of the two accompanying illustrations (Figs. 2 and 3) that whole rows of spots are here enhanced. Proceeding upwards or downwards from the central horizontal

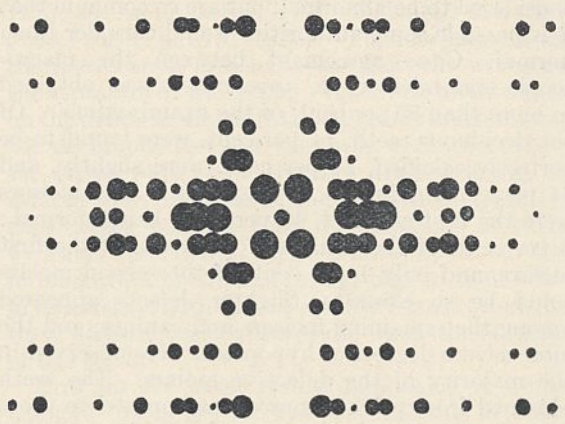

FIG. 2.—Rotation photograph about the *c*-axis of anthracene. The size of a spot is intended to represent its strength on the photographic film.

row, which is called the equator, the first row in each case is still strong; but in naphthalene the second row almost fails, and in anthracene the second and third. There is, in fact, a maximum between the third and fourth rows in naphthalene and the fourth and fifth rows in anthracene. The succeeding minima of intensity of rows are not shown in these pictures, because it is somewhat inconvenient to obtain photographs sufficiently extended upwards and downwards to include them, but it is easy to find out from other observations, which need not be given here, that minima do follow and are succeeded again by maxima. Thus, for example, the eighth and ninth rows of anthracene are strong. This enhancement of whole rows means

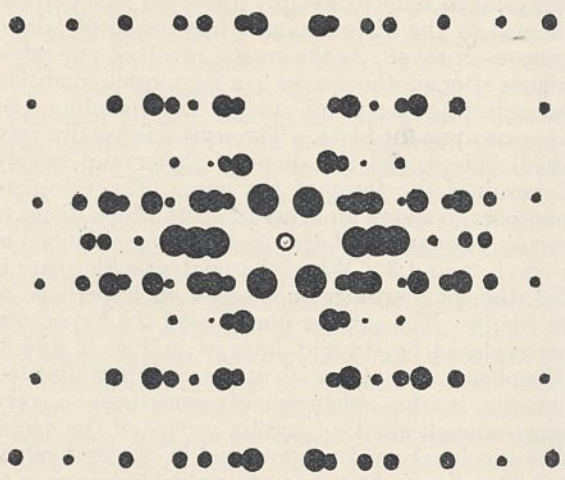

FIG. 3.—Rotation photograph about the *c*-axis of naphthalene.

that there is a certain repetition along the *c*-axis of a distribution of matter which in the case of naphthalene divides it into between three and four

parts ; in the case of anthracene, between four and five. This is just what is to be expected if the structure of these crystals is that which was given by the author some years ago. The axis of a crystal in each case lies along the *c*-axis and the repetition is of the width of a benzene ring, namely, 2·52. The length of the *c*-axis of naphthalene is 8·69 and of anthracene 11·18. The axis of the former case is $3\frac{1}{2}$ times the width of the ring, and of the latter case about $4\frac{1}{2}$ times. The enhancement of the ninth row is due to the fact that the diameter of the ring divides it into two equal halves ; there are periodicities of both 1·26 and 2·52 along the *c*-axis. The distribution of the intensities of the various lines in these figures is, in fact, an index of the distribution of matter or electrons along the axis about which the crystal was rotated.

There is one further point of interest in these last photographs. It will be observed that the distribution of spots on the equator is exactly the same for the two crystals. Even in the next row there is very little difference for the two, though the difference increases with the distance of the rows from the equator. Assuming the structure of the crystals to be that already referred to, to an eye looking along the *c*-axis the crystals would seem exactly alike. To what may be called to an X-ray eye looking in the same direction the crystals would look very nearly alike, but there would be a small difference because such an eye would see in depth as well as in plan. The eye would not observe, and the X-ray eye would, that certain atoms were hiding behind one another. The spots on the equator are due to planes which pass through the *c*-axis. The very close correspondence between the positions and intensities of the equator spots in the two crystals shows that to an eye, supposed capable of looking along the *c*-axis and observing the disposition of the atoms, the two crystals would appear exactly the same. This is confirmatory evidence of the structures assigned to them.

A somewhat different use of the same principle has been made by W. T. Astbury in his work on the acetyl-acetones (*Proc. Roy. Soc.*, **112**, p. 457). From a consideration of the relative intensities of the rows, he has drawn conclusions as to the relative positions of the molecules in the unit cell of the crystal.

Obituary.

MR. ALEXANDER SIEMENS.

ALEXANDER SIEMENS was born in Hanover in January 1847. He belonged to the second generation of the four brothers Siemens whose names are so well known. He used to tell how his parents owed allegiance to the King of England until 1837, when, under the Salic Law, Hanover was separated from England and given to the Duke of Cumberland, the fifth son of George III. In 1866 Hanover was annexed by Prussia, and Siemens automatically became a Prussian. He was educated at Hanover and Berlin, and in 1867 entered the telegraph workshops of Siemens' Brothers at Woolwich, of which Sir William Siemens, the first president of the Institution of Electrical Engineers, was a director. He was then employed in the erection of the Indo-European telegraph line in Persia and in laying cables in the Black Sea. He also worked in the cable ship *Faraday*. He served in the German Army during the Franco-Prussian War and was awarded the Iron Cross. In 1878 he became a naturalised British subject.

After his release from the German Army, Siemens came to England and assisted Sir William Siemens in developing the regenerative furnace. About 1879 he developed a system of lighting public halls by means of arc lamps. The systems adopted at the Albert Hall and in the British Museum Reading Room were done under his direction. He also carried out the electric lighting of Godalming, the first town in England to have an electric light supply.

Siemens had the greatest faith in science, in scientific training, and especially in scientific management. He considered that scientific management was quite as important as either capital or labour in developing the industry of the country. He was enthusiastically in favour of the decimal system, and in 1902 strongly advocated its universal adoption in a discussion held at the Institution of Electrical Engineers. His great protagonist was the late Sir Frederick Bramwell. The sympathies of most of the auditors were in favour of the decimal system, but the older generation of engineers seemed to think that engineering in Great Britain would be hopelessly handicapped internationally were we to abolish the inch and the pound. There was one thing said at this meeting which the writer never saw contradicted, and that was that without the decimal system it would not be possible to extract square roots. It is quite easy, however, to turn the square root of any number or fraction into a continued fraction and then find its value to any required degree of accuracy as a vulgar fraction.

Siemens was president of the Institution of Electrical Engineers in 1894 and 1904, and of the Institution of Civil Engineers in 1910. In his presidential address in 1894 he discussed, among other subjects, the possibility of trebling the speed of our trains. Although he considered it rash to say that such a speed could not be obtained, yet the necessity of strengthening the permanent way, etc., made it very unlikely that it would be adopted commercially. He contributed many papers and gave many lectures to scientific bodies. One of his most interesting papers was an account of experiments carried out by German engineers on the military railway connecting Marienfelde and Zossen. In these experiments, train speeds up to 125 miles per hour were obtained. The A.E.G. Co. insured the lives of their engineers before the experiments. After the tests, the front of the engine was coated with dead insects, and amongst them a dead swallow. The speeds

attained seem small now, but twenty-six years ago they excited the greatest interest. The writer remembers also how Siemens showed that the empirical formula found by the German engineers for the air resistance was in almost exact agreement with that obtained by Sir Isaac Newton.

Alexander Siemens was a member of the committee which in 1897 discussed the desirability of establishing a National Physical Laboratory in Great Britain. Later on he served on the executive council. He married in 1881 Frances Dodwell, of Campden, Gloucestershire, and had three daughters, the eldest of whom married the late Prof. Bertram Hopkinson, of Cambridge. For many years Siemens used to attend the Council dinners and meetings of the Institution of Electrical Engineers, and his kindly nature and interesting conversation made him many friends.

A. R.

Col. S. W. H. Rawlins.

Col.-Commandant Stuart William Hughes Rawlins died on Dec. 16 last, from acute pneumonia, near Aldershot, where he commanded the artillery of the 2nd Division. Born in 1880, Rawlins' name was on the list of successful competitors at the 1893 election of scholars at Eton. His family tradition was closely bound up both with Eton and with academic life. His father, William Donaldson Rawlins, was a life fellow of Trinity College, Cambridge. His uncle, Francis Hay Rawlins, became lower master and ultimately vice-provost at Eton, and was one of the last fellows of King's under the statutes by which a fellowship was retained for life. Leaving Eton rather sooner than many boys, Rawlins went into the Royal Marines, in which he saw five years' service and from which he transferred to the Army.

During the years before the War, apart from fighting in South Africa, Rawlins saw much foreign service, chiefly in India and Central Africa, an experience which gave him every opportunity of indulging his naturally great linguistic powers. He could converse in numerous dialects, chiefly of Swahili. His taste for languages was coupled with an active interest in ethnology and archæology, add to these considerable musical sympathy, and it is clear that Rawlins, even outside his professional skill, was no common person.

To the scientific reader, the feature of greatest interest in Col. Rawlins' career is no doubt his association with the chemical warfare organisation in Great Britain as Commandant of the Experimental Station at Porton. Porton, from consisting of two or three huts at the commencement of 1917, underwent remarkable development under the direction of the late Dr. (Lieut.-Col.) A. W. Crossley, so that before the date of the Armistice it consisted of numerous departments and employed more than six hundred persons. Its activities then were chiefly on the offensive side. Parallel with Porton, the late Lieut.-Col. E. F. Harrison developed, first at Millbank and later at University College, London, the extensive organisation which in the first three months of 1918 manufactured three million respirators. The Navy had its own organisation. With the Armistice, the activities of these stations were suspended, and remained so until the Cabinet was able to define its international obligations.

Towards the end of 1920, the present Chemical Warfare Committee was formed, and at the start the whole of its experimental work, focused on defence, was concentrated at Porton, to the command of which Col. Rawlins was appointed on Aug. 29, 1921. From that date until he left to become Director of Artillery in November 1924, Rawlins with untiring energy bent his great mental powers to the development of the station. Many a soldier in his place would have regarded the appointment as a purely military one and would have left the scientific side entirely to his technical experts. Not so Rawlins. He made up his mind to understand the activities of each department and to be able to contribute intelligent constructive criticism to the scientific reports over which his name appeared. So successful was he that when ill-health overtook the director of experiments, Rawlins himself largely filled the gap. Porton having become the Experimental Station not only of the Army but also of the Navy, Rawlins' early years of training in the Royal Marines gave him a practical knowledge of the naval point of view which was of great value. On the technical side, Rawlins had the unique qualification of having served in the War as right-hand man to Sir Noel Birch, who was chief artillery adviser at G.H.Q. during the latter years of the War. Rawlins therefore had complete knowledge of the requirements of the Army in all that pertained to smoke and gas.

Of Rawlins, Sir Noel writes: "He was a master organiser, as proved by his work at the War Office," that is, during his tenure of the office of Director of Artillery.

Rawlins' high intellectual equipment, his varied experience, and his untiring power of work would not by themselves have sufficed for the solution of many of the problems which beset Porton. His success was in great measure due to his personality. Full of vigour, full of hope, full of cheerfulness, full of generosity, full of helpfulness, Rawlins attached friends to himself from all walks of life, and, aided in full measure by his wife, he has left a community in every locality in which he has been stationed who cherish a thousand memories of his devotion.

We regret to announce the following deaths:

Mr. Martin J. Cole, part author of "Modern Microscopy" (Cross and Cole) and an expert on the preparation of microscope specimens, on Feb. 8, aged eighty-one years.

Prof. Willis L. Moore, professor of applied meteorology at George Washington University and an honorary member of the Royal Meteorological Society, on Dec. 18, aged seventy-one years.

Sir Dawson Williams, who retired in January last from the editorship of the *British Medical Journal* after thirty years of distinguished service in that office, on Feb. 27, aged seventy-three years.

News and Views.

CHAULMOOGRA oil is an old drug in the treatment of leprosy, but it is only in comparatively recent years that a really useful remedy has been evolved from it. Long trials and experiments by Manson, Roux, Heiser, Rogers, and others have culminated in 'alepol,' a preparation of sodium hydnocarpate suitable for injection, and from the account given by Sir Leonard Rogers at the annual meeting of the British Empire Leprosy Relief Association on Feb. 24, it seems that it is possible with this to achieve a cure or something very near a cure in a sensible proportion of cases, especially if treatment is commenced at an early stage. Renewed interest in leprosy and its intensive investigation has also shown that the disease is more prevalent in Great Britain and elsewhere than had been supposed, and the Association has a considerable task before it. Besides surveying the problem, it has distributed the remedy on a large scale, and has provided seeds of the plant (*Taraxtogenos kurzii*) from which the oil and ultimately the separated gynocardic acid is prepared, so that the drug may be grown locally in the various foci where it is needed. No one should imagine that a certain cure for all cases of leprosy has been discovered, but there is no doubt that the new remedy represents a very important advance in that direction.

FEW of the many claims for the discovery in America of human remains of high antiquity have withstood the test of rigorous examination on strictly scientific lines. Even when, as in a number of recent discoveries, a *prima facie* case appears to have been made out, the verdict still must be regarded as in suspense. Especial interest, therefore, attaches to an expedition of the Smithsonian Institution to Florida under the leadership of Dr. J. W. Gidley, of the National Museum, of which the object is to test the evidence for pleistocene man on sites in the neighbourhood of Vero and Melbourne on the east coast, where human skeletal remains have been found in association with pleistocene fauna. In the latest of three geological strata which have been examined by previous expeditions, there is clear evidence of disturbance in the presence of modern remains; but the question has to be decided whether the second stratum, in which human remains are associated with an undoubted pleistocene fauna, is to be regarded as undisturbed throughout or can be shown to be partly the result of a redeposit which has brought recent remains into association with the material of a pleistocene stratum.

THE lure of the treasure hunt is eternal. The latest venture, which is to be financed by a limited company formed recently, has as its object the discovery of a treasure hidden by Jesuits in Bolivia, when they were deported from the country by the Spanish authorities in 1778. For eleven years they had resisted the Government, and had been blockaded. During that time they had been unable to export any of the gold and silver derived from their mines or their precious stones. Two of these mines were known to be very rich, but they have never been located. It was agreed finally, that the Jesuits were to be allowed to depart, provided that they gave up this accumulation of treasure to the authorities. Rather than do this, they concealed it, and it has never been recovered, although a number of expeditions have looked for it. One of the Jesuits, Father Gregorio San Román, left with his brother, the Prefect of Callao, a description of the hiding place. This was handed down in the family until the beginning of the present century, when it came into the hands of Mr. Cecil Prodgers, who in 1920 passed it to Mr. Edgar Sandars, the organiser of the expedition which will proceed to Bolivia in the present year. Mr. Sandars believes that in excavations carried out in 1925 and 1926, he has discovered one of the entrances to the treasure chamber which the Jesuits constructed with the help of 500 Indians, some, and perhaps all, of whom they killed. He has, at any rate, found in a shaft which he partially cleared, a silver crucifix and a parchment warning intruders to withdraw from a spot dedicated to God Almighty in which 'a dolorous death' awaits him who dares to enter. Father San Román's document also suggested caution, as "enough poison to kill a regiment of the king has been laid about." The value of the treasure in present currency is estimated as £12,000,000.

MR. WOOLLEY'S report on the excavations at Ur in the *Times* of Feb. 22, while adding further discoveries of human victims sacrificed in the royal tombs to those mentioned in his special interim report, records the discovery of the body of Queen Shub-ad, with the jewels which once covered her garments, and jewelled head-dresses, and suggests how and when the tomb of the king was rifled. As further discoveries are made, the more remarkable this revelation of the funerary customs of Ur and the beliefs they connote appears to be. One of the most important recent discoveries, though by no means so spectacular as some, is the form of the tomb itself. In the stone wall there was a doorway crowned by a true arch of brick, the tomb chamber was vaulted with arches, and the end was brought round to apsidal form and roofed with a half dome which was a cross between corbel work and a true dome building. A crudely fashioned arch had been found roofing a drain at Nippur belonging to the third millennium B.C. The present discovery makes it clear that the arch, corbel work, and the dome were familiar to Sumerian builders so early as the fourth millennium B.C.—a discovery of the greatest importance in the history of architecture.

THE original Wright biplane of 1903, the first power-driven man-carrying aeroplane to make a free and sustained flight, has been received at the Science Museum, South Kensington, on loan from Mr. Orville Wright, and will shortly be exhibited for the first time in Europe. Mr. Orville Wright and his brother, the late Mr. Wilbur Wright, began the

study of aeronautics in 1896 subsequent to the death of Otto Lilienthal, whose gliding experiments had aroused their interest, and they made and conducted experiments with man-carrying gliders, utilising such knowledge as was then available. In 1901 they turned their attention to the application of power, and their research led to the production of this, the first successful aeroplane. The first flight was made by Orville Wright on the morning of Dec. 17, 1903, at Kitty Hawk, North Carolina, in the presence of several witnesses; and it lasted twelve seconds. It was followed by three other flights, the last being one of 59 seconds, when the distance covered was 852 feet; the machine was then overturned by a gust of wind while left unattended, and the damage resulting prevented further experiments at that time. Since the first flights were made, the aeroplane has been preserved in the Wright laboratory, and certain parts which were damaged beyond repair have been replaced by Mr. Wright himself.

FLYING in an Avro-Avian biplane with a 30-80 h.p. Cirrus engine, Mr. B. Hinkler reached Darwin, in northern Australia, on Feb. 22, sixteen days after leaving Croydon. This compares with the 28 days taken by Sir Keith Smith and Sir Ross Smith on the first flight to Australia in 1919. The *Times* gives the total distance flown as 10,400 miles, measured from point to point of the flight, but points out that the actual distance flown was probably more than 12,000 miles. Mr. Hinkler covered the distance in fifteen stages, of which the last was the longest, involving 950 miles from Bima, in the Dutch East Indies, to Darwin. Another long flight was the 870 miles from Croydon to Rome, which occupied nearly thirteen hours. No second person was carried, and the passenger space was used for an extra petrol tank. A collapsible rubber raft was carried but was not required. There was no engine trouble at any point of the flight, and the only forced landing was in northern Africa and due to darkness. The weather was favourable throughout, but the flight was nevertheless a remarkable one, and brings nearer the day when the projected air-mail route to Australia will be accomplished. Mr. Hinkler has since continued his flight to Bundaberg, Queensland.

SIR SAMUEL HOARE, Secretary for Air, replying to a question in the House of Commons on Feb. 27 relating to Mr. Hinkler's flight, summarised excellently the main facts of the achievement. He said that the flight established several 'records.' "Mr. Hinkler achieved the fastest flight to date between England and Australia, shortening the time taken by Sir Ross Smith in 1919 by between 12 and 13 days; the longest solo and the longest light aeroplane flights yet made; and the first non-stop flight to Rome; whilst all places beyond India were reached in a shorter time than has been achieved by any other form of transport. The total flying time was 134 hours, so that the flight would have taken five days 14 hours if it had been made continuously, flying by day and night. Taking the total time spent on the flight, including nights and halts in the daytime on the ground, the average speed per hour throughout was well over 30 miles; whilst taking the time spent in the air only, it works out at an average of about 89 miles per hour. Further, 12,000 miles were covered without any repairs, a striking testimony to the reliability of machine and engine. One of the most striking features of the flight is that the machine employed was a standard Avro 'Avian,' with a Cirrus engine, which has been in use since 1926, and the only alteration made prior to the flight was the incorporation of extra tankage. A machine of this type costs, complete, apart from the extra tanks, only some £730, and an approximate estimate of the cost of the flight in terms of the petrol and oil consumed—as I have already said, no repairs were carried out—is £50. These figures are a striking indication of the great potentialities of aircraft for improving communications in the vast stretches of the Empire in which other means of communication are as yet non-existent or relatively undeveloped."

THE Air Ministry has sent us a copy of the log of the Royal Air Force flight from Felixstowe to Karachi last autumn. This was the first part of the flight which was afterwards continued to the Far East. The machines were four metal supermarine Southampton flying boats, under the command of Captain H. M. Cave-Brown-Cave. The flight left Felixstowe on Oct. 14 and took a course via Plymouth, Bordeaux, Marseilles, Naples, and Athens to Aboukir. From there the course continued via Alexandretta, Ramadi, Basra, Bushire, Henjam, and Gwadar to Karachi. Stops were made at these and other places, but the log contains no mention of any accident or forced landing. All went well on the journey. The total flying distance was 4834 miles, and the average flying time of each aircraft at 67 knots was a few minutes under 72 hours.

BRITISH chemists will this year be afforded a unique opportunity of intercourse, both professional and social, with their colleagues in the United States of America and in Canada. Arrangements for the annual general meeting of the Society of Chemical Industry, which is to be held in New York, and for participation with the American Institute of Chemical Engineers and the (British) Institution of Chemical Engineers in visits in the United States and Canada are already nearing completion. The provisional itinerary commences on Aug. 11 at Southampton, and embraces Quebec, Shawinigan Falls, Montreal and Ottawa, Kirtland Lake, Niagara Falls, Akron (Ohio), Pittsburgh, Washington, Edgewood Arsenal, Wilmington, and New York, Great Britain being reached about Sept. 17. A number of 'tourist third cabin' berths have been reserved, and special facilities are being accorded by the White Star Line to members making their arrangements through the Society. It is believed that the total expenses of the complete trip need not exceed £150. The Society has allocated from the Messel fund ten grants of £50 each

to members of the Society who wish to participate in the round trip and travel 'tourist third cabin,' and members wishing to take advantage of this offer are asked to apply promptly to the secretary. Those desiring to participate in the visit are urged to make early application to Mr. J. P. Longstaff, the secretary of the Society of Chemical Industry, or to Prof. J. W. Hinchley, the honorary secretary of the Institution of Chemical Engineers. Recent events in the political arena have shown how much good may accrue from opportunities of personal contact; it is to be hoped that the facilities which these arrangements afford may be largely used by chemists and chemical industrialists in Great Britain in the promotion of her own legitimate interests and in attaining a closer understanding of and regard for her friends and competitors.

ELECTRICAL engineers are watching with keen interest the development in Great Britain of the interlinking schemes which form an integral part of the Electricity Act of 1926. These schemes will ultimately tie together the power stations of the country. A beginning has already been made in connexion with the 132 kilovolt lines of the Central Scotland area. By linking the power stations together a more steady load is attained, and so a reduction in the amount of spare plant is effected. In other countries interlinking is also being effected, and power can be interchanged over distances of hundreds of miles. From a purely economic view, the heavier the load the greater the advantage of using high pressure. It is possible that in a few years' time pressures of 380 kilovolts may be employed. Progress in the design of electrical apparatus has been very rapid, and there seems to be no limit either to the output or the voltage of machines. By suitable coverings corona losses can be suppressed and the dielectric losses at very high pressures, whilst appreciable, are far from prohibitive. Probably the smallest-sized link between two networks will consist of two three-phase lines with suitable transformers. For economical reasons these transformers must be very large, and so the difficulties of transportation by road and rail limit their size. In the *English Electric Journal* for January, the total power loss at full load for a 100,000 kilowatt transformer is given as 850 kilowatts. This is converted into heat in the transformer, so very special arrangements have to be made for keeping it cool. As a rule the transformers are immersed in oil, which is kept circulating through pipes passing through external water coolers. A considerable supply of water is necessary. The rise of temperature of the oil at full load is about 30° C., and for a 50,000 kilowatt transformer working at this load, 15,000 gallons of water per hour are required.

RAILWAY electrification in India is making steady progress. On Jan. 5 the electrified suburban lines of the Bombay, Baroda, and Central India Railway, from Colaba in the south to Borivli in the north, a distance of 57 miles of track, was opened. Two lines of rails are electrified for the whole distance, and four for part of the distance. The power for the operation of the railway is purchased from the Tata Company's hydro-electric power stations, situated some fifty miles from Bombay on the Western Ghats. Power is transmitted to a receiving station at a pressure of 100,000 volts, and from thence is retransmitted to the substations situated along the line at 22,000 volts. At the substations the pressure is reduced and then converted into direct current at the working pressure of 1500 volts. The motor coaches are equipped with four motors each of 275 horse-power. The overhead high-tension wires are supported by lattice steel structures, which when necessary span eight tracks. The pantographs which collect the current from the overhead wires are operated by a vacuum pump, which also works the vacuum brakes. The sanding gear is of the gravity type and is controlled by electrically operated valves. In the event of mechanical failure, each mile of the equipment can be at once isolated. Each section also can be rapidly isolated by air break switches. Special care has been taken to prevent birds causing short circuits accidentally. All the cross-arms and beams are carefully insulated, so that it is practically impossible for the legs and the beak of the bird to be each in contact with separate conductors having a great difference of potential between them. In the overhead equipment alone, approximately 2000 tons of steel and 500 tons of copper were used.

A RECENT addition to the Department of Zoology of the British Museum (Natural History) is a mounted specimen of an immature Snow leopard from the north-west Himalayas; owing probably to the commercial value of the fur, museum specimens of this animal are rare. Mr. J. J. Joicey has presented to the Department of Entomology his complete series of Lymantriidæ, consisting of nearly 6000 specimens from all parts of the world. The Department has also received a valuable series of fleas from Manchurian ground squirrels; these fleas include species of practical importance, on account of the possibility that, like the tropical rat-flea, they may be concerned in the spread of plague. Recent acquisitions for the Department of Mineralogy include a series of fluorspars from the iron mines of west Cumberland, showing colourless, blue, and yellow cubes on the hæmatite ore. These are small, and as a rule quite inconspicuous, and very little is as yet known about them; but they must be taken into account in any theories dealing with the origin of the iron ores, and this of course has an important bearing on the finding of new ore-bodies. Various minerals, including willemite (zinc silicate), native silver, silver iodide, mimetite, scheelite, and copper ores from Northern Rhodesia, have been presented by Mr. R. Murray-Hughes. A sample of the meteoric dust ('red rain') that fell at Melbourne, Victoria, on Jan. 1, 1928, has been sent by Mr. E. J. Dunn. The trustees have authorised the purchase of a magnificent crystal of topaz from Madagascar. As an exhibition specimen this far surpasses any topaz previously in the collection, and it forms a companion crystal to the fine beryl purchased last year. It measures 12 cm. × 11 cm. × 10 cm., and weighs 2290 grams (11,450 carats, or just over 5 lb.). It is water-clear with a pale blue tinge and of gem quality.

The well-developed and brilliant crystal-faces are marked by complex and intricate pyramids and lines of growth, and the specimen is an instructive example of a crystal in which the process of growth has been abruptly arrested.

A NEW egg grading and marketing scheme has recently been brought out by the Poultry Advisory Committee, by which it is hoped to stabilise prices throughout the year. The National Poultry Council and two important associations of retail distributors in Great Britain have already assented to the principles of the scheme, and it is understood that the Government may provide time for the necessary legislation. At present there is no large, recognised market for English eggs, and transactions are made with comparatively small consignments, the organisation being insufficient for the development of the industry. Foreign eggs, however, are properly graded and packed, and it was only owing to the risk of their obtaining a better market on this account that an order as to the labelling of imported eggs was not recommended by the committee under the Merchandise Marks Act, 1926, until improvements in the grading and packing of British produce had been secured. The present scheme is to be voluntary, and available to all country and town packers provided they deal with a stated minimum quantity of eggs, registration under the scheme permitting the use of a 'national mark.' It is suggested that the Minister should be given power by act of parliament to define grades of eggs, the terms 'Specials,' 'Standards,' 'Mediums,' and 'Smalls' being recommended, and that only first quality eggs should be dealt with, sale being by weight. In addition, the scheme provides that all preserved British eggs should be marked as such, and imported eggs afterwards stored in Great Britain should also be appropriately labelled. It is hoped that all large egg producers will see the wisdom of coming under the scheme. It may well be the means of developing the egg industry in Great Britain.

DR. R. A. MILLIKAN, Director of the Norman Bridge Laboratory of Physics in the California Institute of Technology, Pasadena, has been awarded the Messel Medal of the Society of Chemical Industry.

AT the meeting of the London Mathematical Society at 5 P.M. on Thursday, Mar. 8, Prof. A. E. H. Love will deliver a lecture on "Biharmonic Analysis, especially in a Rectangle, and its Applications to the Theory of Elasticity." Members of other scientific societies are invited to attend.

THE Council of the Institution of Naval Architects has invited Admiral of the Fleet the Right Hon. Lord Wester Wemyss to succeed His Grace the Duke of Northumberland as President of the Institution. The election will take place at the opening of the annual general meeting at the Royal Society of Arts on Mar. 28 at 11 A.M. The Council of the Institution has awarded two premiums for the year 1927, one to Mr. H. J. R. Biles, for his paper on the "Effect of Wind Resistance on Superstructures and Ship Resistance," and the other to Mr. W. C. S. Wigley, for his paper on "Ship Wave Resistance—A Comparison of Mathematical Theory with Experimental Results—Part 2."

THE two Boyle Medals awarded by the Council of the Royal Dublin Society to Dr. W. R. G. Atkins (Pure Science) and to Prof. W. E. Adeney (Applied Science) were presented at a special scientific meeting of the Society on Feb. 15. The statements setting forth the grounds of these awards referred in Dr. Adeney's case to the valuable work he has accomplished during the last twenty years with respect to river pollution; this work has done much to elucidate the biological and chemical factors involved and had been generally recognised as of fundamental importance. In the case of Dr. Atkins, emphasis was laid on his work on the cryoscopic examination of physiological fluids; his researches on the osmotic pressures occurring in plants; his work on the relation of the pH value of the soil to plant distribution; on the photosynthetic changes in sea water; and on the significance of the phosphate content as a limiting factor in plant and animal production in the sea.

THE Carnegie Institute of Technology has issued a preliminary announcement of a second International Conference on Bituminous Coal, to be held at Pittsburgh on Nov. 19-24. The purpose of this Congress is again to present the results of recent studies of coal bearing on improved methods of utilisation and combustion. The programme will include the discussion of the fixation of nitrogen, the manufacture of substitutes for gasoline from coal, complete gasification of coal, high temperature distillation, low temperature distillation, coal-tar products, power, smokeless fuel, etc. An invitation is extended to scientific workers of all countries to take part in this conference. The president of the Carnegie Institute of Technology, Thomas S. Baker, will visit Europe during March and April to confer with fuel technologists who may consider the possibility of presenting papers or taking part in the congress in any other way. President Baker's address will be c/o Guaranty Trust Company, 1 rue des Italiens, Paris, where he will be glad to receive correspondence in regard to the meeting.

WE have received the annual report of the Society for the Provision of Birth Control Clinics for 1926–27. Two new clinics at Oxford and at Birmingham have been opened, making a total of nine clinics in operation in Great Britain. An increasing number of poor women is attending, and it is believed that much valuable assistance is rendered. The Society is entirely dependent upon private donations.

THE annual report of the South African Institute for Medical Research for 1926 has been issued. Sir Spencer Lister is now Director in succession to Dr. Watkins-Pitchford, who has resigned on account of ill-health. A summary of the work of the Institute is given; much of it has been devoted to plague research. A mosquito survey of the Union and a tuberculosis survey of the Native Territories are being undertaken.

THE secretary of the Royal Horticultural Society reminds us that "Index Londinensis" has been prepared under the auspices of that Society. This was not mentioned in our note in the issue of Feb. 25, p. 296, referring to the publication. Messrs. Dulau and Co., Ltd., are now accepting subscriptions for the work.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A chemist for research work for the improvement of mine rescue breathing apparatus, a physiologist to assist in investigations regarding mine rescue breathing apparatus and methods of resuscitation, and an investigator for research work on mechanical appliances for use in mines, each under the Safety in Mines Research Board —The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Mar. 10). An assistant to the lecturer in systematic forest botany, and a herbarium assistant, at the Imperial Forestry Institute, University of Oxford—The Secretary, Imperial Forestry Institute, Oxford (Mar. 12). A research student for work on bulb-growing problems at the Royal Horticultural Society's Experimental Gardens — The Director, R.H.S. Gardens, Wisley, Ripley, Surrey (Mar. 13). A bio-chemist at the Forest Research Institute, Dehra Dun, India—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Mar. 15). A reader in geography and education at Raffles College, Singapore—C.A. [T.], the Secretary, Board of Education, Whitehall, S.W.1 ; Scottish candidates, [T.], the Secretary, Scottish Education Department, Whitehall, S.W.1 (Mar. 17). Junior assistants at the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Mar. 17). A full-time lecturer in chemistry at the Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, Manresa Road, S.W.3 (Mar. 24). A lecturer in geography in the Durham Colleges, University of Durham—The Secretary to the Council of the Durham Colleges, 38 North Bailey, Durham (Mar. 31). A lecturer or an assistant lecturer in zoology in the University of Bristol—The Registrar, The University, Bristol (April 14). A principal of Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, Manresa Road, S.W.3 (April 30). A handicraft teacher for woodwork and light metal work under the Leicestershire County Council Education Committee—The Director of Education, County Education Offices, Grey Friars, Leicester.

Our Astronomical Column.

NEW COMET.—The first comet of 1928 was discovered photographically by Herr K. Reinmuth, assistant at Königstuhl Observatory, Heidelberg. Herr Reinmuth is well known as a discoverer of minor planets, having found more than a hundred of them, but this is his first comet ; as the new comet is near the ecliptic, it was doubtless found in the course of the routine search for minor planets. Its magnitude is $12\frac{1}{2}$. The following positions have been obtained at Königstuhl and circulated by the I.A.U. Bureau, Copenhagen :

U.T.	R.A. (1928.0).	N.Decl.(1928.0).
Feb. 22. 96160	$9^h\ 15^m\ 4^s$	21° 44′ 0″
,, 23. 96368	9 14 54·93	21 52 39
,, 24. 95736	9 14 42·20	22 0 6
,, 25. 93181	9 14 33·93	22 6 57

The motion is getting slower ; an estimated prediction for Mar. 4.0 is $9^h\ 15^m\ 36^s$, N. Decl. 22° 43′ ; the full moon will, however, prevent observation for a few days. There has not been time as yet to compute an orbit ; in any case, the above arc is too short to determine reliable elements. The slow motion probably implies that the object is at a considerable distance.

There is occasionally a double solution to the problem of finding an orbit from three observations ; an interesting case of this arose last year in the orbit of Gale's comet ; the observations of the first six weeks could be satisfied with periods of either 11 or 13 years, the former being found to be correct when a longer series of observations was available. Prof. T. Banachiewicz discusses this question in *Acta Astronomica* for Feb. 7, and gives the discriminating rules in a simple form ; the case to which he applies them (Orkisz's comet) has only a single solution ; an example with a double solution would have been more instructive.

A LARGE SUNSPOT.—A large sunspot, nearest the centre of the sun's disc on Feb. 21, was seen in London by many people through the screen of mist or fog prevailing about that time. A small telescope showed that the group consisted of a principal spot accompanied by an aggregation of irregular spots or penumbral markings to the south. The latter decreased considerably as the group crossed the disc. No unusual disturbance of the earth's magnetic elements has been reported. In NATURE of Feb. 11, p. 220, a short account was given of a large prominence which was observed near a spot when at the sun's west limb. The recent group is either a return or a revival in the place of this earlier spot. Other particulars of the later and larger spot are given below, and it may be added that this is the first one this year to be recorded generally as a naked-eye object, although several other large spots are mentioned in NATURE of Feb. 11.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
1	Feb. 15-28	Feb. 21·6	6° N.	1/700 of hemisphere

THE GREGORIAN CALENDAR IN EGYPT.—The 'Old Style' or Julian Calendar has now become practically obsolete, having taken nearly three and a half centuries to do so. The Orthodox Church in Greece adopted some years ago a modified form of the Gregorian Calendar ; instead of the 400-year cycle of the Gregorian calendar, it uses a 900-year one ; but as the two calendars are exactly the same for about seven centuries from the present time, the difference is not of immediate importance. The *Times* of Feb. 15 announces that the Synod of the Patriarchate of Alexandria, representing the Orthodox Church in Egypt, has decided to adopt the Gregorian calendar from Oct. 1, 1928 (Sept. 18, Old Style). Presumably it is following the same form of it as the Greek Orthodox Church ; the latter body also differs from western usage in the manner of computing Easter, which is made to depend on the actual moon, instead of using the simplified 'ecclesiastical moon.' The day used is that of the meridian of Jerusalem, thus getting rid of difficulties of longitude.

Research Items.

THE EVOLUTION OF MAN AND APES.—In volume I. of the new journal *Palæobiologica*, edited by Prof. Othenio Abel and published in Vienna and Leipzig (Emil Haim and Co.), there appears a paper by Prof. H. F. Osborn entitled "Recent Discoveries relating to the Origin and Antiquity of Man." This paper is less a review of recent discovery than a statement of Prof. Osborn's own opinion on the course that the evolution of man has taken. This differs from that usually held by the majority of investigators, in that it denies any close connexion between ape and man and places the ancestor common to the two stocks back to a period so remote as the Oligocene. While admitting that there are some anatomical resemblances, Prof. Osborn lays more stress on the difference in 'behaviourism' between man and the ape, and thinks that "scientific mythology has accumulated around the anthropoid apes, falsifying and exaggerating their human resemblances, minimising and ignoring their profound differences from man in habit and gait and in the anatomy and functions of the brain. . . ." Some resemblances, moreover, are to be attributed to convergence. There are two diagrams, both dated 1927, which express graphically Prof. Osborn's views on primate evolution. Propliopithecus at the base of the Oligocene is the common meeting ground of the two stocks. Dryopithecus and Pliopithecus are Miocene representatives of the Simian division, but with the exception of Hesperopithecus, on whose primate nature very great doubt has been cast (*v.* NATURE, Jan. 28, p. 148), there is no human representative actually known until towards the top of the Pliocene. This emphasises how much palæontological exploration has yet to do before there is enough evidence to form a clear opinion on this great problem of our own ancestry.

CARNIVOROUS HABIT OF AMERICAN MAGPIES.—In view of the well-known change of feeding habit in the New Zealand kea, a parrot of vegetarian tastes, which has developed a liking for the kidneys of living sheep, and has caused very serious damage to flocks in certain areas of the South Island, the description by E. R. Kalmbach of a similar development in the American magpie is of great interest (*U.S. Dept. Agr. Tech. Bull.*, No. 24, Oct. 1927). During the past ten years the magpie has begun to attack live stock on the western ranches, and since the first reports came to hand in 1917, its depredations have extended from Utah to Colorado, Wyoming, and Montana. Sheep, cattle, and horses have been attacked so severely that many have succumbed: recent reports mention that in one area several hundreds of cattle are destroyed each winter, and in another the magpie has become one of the greatest problems with which the ranchers have to deal. The magpies generally attack the animals about the loins, sometimes penetrating to the body cavity, sometimes reaching and devouring the kidneys. The origin of this habit in the States may throw some light on the predisposing causes which gave rise to the kea's depredations in New Zealand. It has been found that sheep were first attacked when they showed fresh wounds caused during shearing, cattle on fresh brand marks, and horses on unhealed saddle-sores. But the habit having been formed, the magpies learned to begin an attack without any direct incentive such as exposed raw flesh. The magpie concerned is the black-billed magpie (*Pica pica hudsonia*), a geographical race of the British magpie, and in normal circumstances the feeding habits of the two are similar.

DIURNAL VARIATION OF OXYGEN IN RIVER WATER.—The degree of saturation of river water with oxygen is an important criterion in forming a judgment as to the suitability of a river for maintaining fish life. This property is one frequently determined in work dealing with the pollution of rivers, as the proportion of dissolved oxygen falls in the presence of oxidisable organic matter. It has recently been found, however (Butcher, Pentelow, and Woodley, *Biochem. Jour.*, **21**, 945, and 1423-1435; 1927), that there are both diurnal and seasonable variations in the proportions of dissolved oxygen and ammoniacal nitrogen in river waters. This has been established by making hourly determinations over periods of 24 hours both on a contaminated stream in Suffolk and on a pure and unpolluted Hampshire trout stream. The diurnal variations in the oxygen dissolved were greater in the case of the River Lark in Suffolk, although quite distinct in the pure River Itchen. The ammoniacal nitrogen, which varies in a sense opposite to that of the dissolved oxygen, also showed a diurnal variation in the Lark, but was constant in the Itchen. The variations, especially in dissolved oxygen, are very large, ranging in some cases from 60 per cent. of saturation shortly after midnight, to 150 per cent. shortly after midday. The rise is attributed to the photochemical evolution of oxygen from organisms, and the fall to the absorption of this oxygen by organic matter, and by processes of respiration. It has thus become clear that in conducting a field survey of a river, the value of a single determination of the dissolved oxygen is of little value. Investigations over a period of 24 hours are necessary, and consideration must be given to such factors as time of year, actinic conditions, nature of plant and animal life present, as well as to the character of the river bed and its history with regard to past pollution. It is probable also that the diurnal variation in the supply of oxygen available for the needs of fish may have a bearing on their movements, a subject of constant interest to the fisher.

THE WHEAT BULB FLY.—The late Prof. J. F. Gemmill's observations on the life-history and bionomics of this fly, *Leptohylemyia coarctata*, have recently been published in *Proc. R. Phys. Soc. Edin.*, vol. 21, part 3, 1927. The fertilised eggs are laid during July, August, and early September in bare, loose soil, preferably among early potatoes and scarcely ever among cereals or in pasture. The egg develops slowly and the larva does not hatch until towards the end of January or in February. The newly hatched larvæ seek out, and by means of their mouth hooks bore into, young wheat plants, entering just above the so-called bulb. Reaching the centre of the plant they ascend for one to three inches, and the infected wheat plant soon shows withering of the central blade, and in early or poorly growing wheat the whole plant withers and dies. The larva makes its way to a second plant, which it affects in the same way, and it may destroy a third or even a fourth plant. If, however, the wheat plant is so far advanced when attacked as to show good lateral buds, the larva completes its growth in one of these and the plant saves itself by sending out additional lateral buds. The larvæ, which undergo two or three moults, are fully grown by the beginning of May; they then leave the plant and pupate in the soil half an inch or more below the surface. The flies emerge in late June and early July and, after having laid eggs, die off by the end of September.

The larvæ can infect barley, rye, and couch grass, and in these can complete their life-history. Couch grass appears to be the natural wild host in the area investigated. Prof. Gemmill recommended that in an infected area wheat should not be sown after potatoes or other root crop or fallow, and stated that if this were done in a single year he believed the numbers of the fly would be so reduced that it would not be a menace for many years to come. Short of this drastic action, he recommended to avoid sowing wheat after early potatoes, or to sow it after the middle of February, to arrange that potato fields shall not adjoin wheat fields in any one year, to get rid of couch grass, and to avoid deep burial of the wheat seed, for shallow-rooted plants form lateral shoots earlier. A field may be regarded as being badly infected in which during November the soil contains half a million to one million eggs of the fly per acre.

TEXTILE PROPERTIES OF INDIAN COTTONS.—Progress in research work on the textile properties of standard Indian cottons is reported by A. J. Turner in *Bulletin 11*, issued by the Technological Laboratory of the Indian Central Cotton Committee. The foundation of the work lies in the annual testing of the fibre characteristics and spinning properties of some eighteen pure strains, the objects being generally, to accumulate data for the investigation of the methods of determining the intrinsic value of a cotton, and specifically: (1) to prepare a series of standards by which to judge other cottons, particularly new cottons produced by cotton breeders; (2) to determine the extent to which these standard cottons are affected by seasonal variations; (3) to determine the minimum weight on which a spinning test can be carried out satisfactorily; and (4) to assist in the marketing of these cottons by providing the cotton trade with detailed information concerning them. These objects have been achieved by submitting, year by year, typical samples of each variety to spinning tests which, though carried out on full-size machines, require only small quantities of material. The significance of small-scale tests has been investigated in accordance with object (3) above, and it has been shown that trustworthy results can be obtained by spinning duplicate lots weighing 5 lb. each. In addition, efforts have been made to determine the relationship between the physical properties of the fibres with spinning value, and while no conclusions of a positive character have been arrived at, the way seems to have been cleared for a more definite attack. Among the supplementary problems that have arisen in the course of work are those of the effect of temperature and humidity on cotton spinning, and the effect of subjecting cotton to repeated blow-room treatment. These are the subjects of *Bulletin 9* and *Bulletin 10* respectively. The latter has perhaps more of a technical than a general scientific appeal, but the former is interesting inasmuch as it embraces a very lucid résumé and criticism of previous work on the subject, and shows that Lancashire is by no means unique in the suitability of its climate for the manufacture of cotton goods.

THE ANTHRAXOLITE OF SUDBURY:—The so-called 'coal' occurring in the pre-Cambrian rocks of Chelmsford, near Sudbury, has given rise to the suggestion "that terrestrial floras had a long pre-Devonian history." In the *Amer. Jour. Sci.*, Jan. 1928, Prof. A. P. Coleman shows conclusively that there is no need to assume pre-Cambrian land plants to account for the deposits in question. He finds that the veins of supposed coal cut across the stratification of a black slate, and reaches the conclusion that the slate was originally an oil-shale, and that the coal-like material must have reached its present position while it was plastic and still retained its original volatile hydrocarbons. The latter were probably driven off by the heat of the nickel-bearing eruptive of the Sudbury basin, residual carbon being left behind. Since the material differs both in origin and properties from *anthracite*, it is important that this name, with its inevitable implications, should not be applied. The term *anthraxolite*, used for coal-like deposits forming the end-products of the metamorphism of petroleum, is clearly more fitting. There remains the problem of the formation of oil-shales in the pre-Cambrian. At least one can conclude that the waters of the time were thronged with lowly types of plants and animals.

APPARATUS FOR THE INVESTIGATION OF FLUORESCENCE.—A new and simplified apparatus designed for the investigation of fluorescence is described in the *Chemiker Zeitung* of Jan. 11, by Dr. F. W. Müller, of Essen, from whom it may be obtained. Instead of the quartz mercury lamp, the source of ultra-violet light is a carbon arc lamp fitted with carbons containing iron and tungsten, which provide an almost completely continuous spectrum. The apparatus can be used even in daylight, and the ultra-violet light, filtered from visible rays, may be directed either from above or in a horizontal direction. A suitable resistance is provided with the apparatus, which can be used for direct or alternating current.

A MICRO-METHOD FOR THE DETERMINATION OF SURFACE TENSION AND DENSITY.—A method for the determination of surface tension and density, using only one piece of apparatus and a very small sample of liquid, down to 0·1 c.c., is described by V. R. Damerell in the *Journal of the American Chemical Society* for December. This apparatus is very simple in design and operation and may readily be constructed from the materials available in any laboratory. The results obtained were satisfactory for all except the most volatile liquids, such as ether, and the method has an accuracy of between 1 part in 100 and 1 part in 300.

THE INTERACTION BETWEEN RADIATION AND ELECTRONS.—The main problems presented by the absorption and scattering of X-rays are discussed by Prof. A. H. Compton in the January number of the *Physical Review*. In his opinion the two phenomena are essentially similar, in that the whole momentum lost by the radiation is transferred to the electron, indicating that the action is sensibly instantaneous, but they differ in the extent to which they conform to classical electron theory. Experiment shows that the direction of emission of photoelectrons is given, at least statistically, by the Lorentz equations, whereas the preferred direction of motion of recoil electrons is perpendicular to the electric vector of the incident rays. Prof. Compton points out that conservation of angular momentum has also to be taken into account when dealing with circularly polarised waves. The point of view which he has adopted throughout is that of the older quantum theory, only one reference being made to the wave mechanics, in connexion with Wentzel's analysis of the angular distribution of photoelectrons.

AN IMPROVED APPARATUS FOR THE REMOVAL OF DISSOLVED GASES FROM WATER.—The various forms of apparatus used for removing dissolved gases from water depend upon the use of heat and a vacuum, either separately or both at once. Those employing both heat and a vacuum are the most efficient, and a new apparatus of this type is described by Lorch, Williams, and Thompson in the *Journal of the American*

Chemical Society for December 1927. This apparatus is of simple construction and is adaptable to any amount of liquid or gas.

THE ESTIMATION OF GOLD AND SILVER IN SEA WATERS.—It is well known that sea water contains traces of gold and silver, and a new method for their estimation is described by M. Yasuda in the *Bulletin of the Chemical Society of Japan*, vol. 2, No. 12. Mercuric chloride is added to the sea water and then reduced to a fine suspension of metallic mercury, which removes the gold and silver (with the exception of that present in organic colloids) as it settles down. The amalgam thus obtained is absorbed in a bead of pure lead and, finally, the gold is obtained free by dissolving the other metals in nitric acid.

COLOURING MATTERS OF CARAJURA.—Carajura (or crajura or chica red) is a rare colouring material prepared from certain leaves and bark and used by various American Indian tribes. The main colouring matter is a crystallisable substance known as *carajurin*, and an interesting investigation of its constitution by E. Chapman, A. G. Perkin, and R. Robinson is described in the issue for December last of the *Journal of the Chemical Society*. Perkin (1914) considered carajurin to have the empirical formula $C_{18}H_{16}O_5$, but it is now shown to be $C_{17}H_{14}O_5$. Carajurin on demethylation yields salts of *carajuretin*, and these have been shown to be identical with certain flavylium salts prepared synthetically, thus enabling a provisional formula to be advanced for the constitution of carajurin. The synthesis of this substance is now being attempted and a second colouring matter, *carajurone*, has been isolated from carajura. The investigation involved a large amount of experimental work, including the synthesis of a number of new compounds.

YIELD-POINT IN IRON AT VARIOUS TEMPERATURES.—The *Journal of the Royal Technical College, Glasgow*, for December 1927 contains several papers of considerable importance, not the least interesting of which is one on the yield-point in iron by Prof. J. Muir. The work was carried out on some hard-drawn wrought-iron wire, 0·024 in. in diameter and of composition: carbon, 0·05 per cent.; manganese, 0·30 per cent.; phosphorus, 0·016 per cent.; sulphur, 0·032 per cent. Before use the material was annealed in nitrogen at a temperature of approximately 800° C. The stress at the yield-point, the extension taking place there, and the time required for that extension were all measured at temperatures ranging from 17° C. to 250° C. Excluding two results at 185° C. and 215° C., which were doubtful, the amount of the extension at the yield-point shows a progressive drop from 4·65 per cent. at 17° C. until at the highest temperature used (250° C.) the yield-point so characteristic of iron at ordinary temperatures has practically disappeared (0·5 per cent.), a stress-strain curve similar to that, for example, of a non-ferrous metal being obtained. Another interesting observation was concerned with the rapidity with which these extensions took place. At 17° C., 150 minutes were required for the extension to complete itself. At 52° C. the extension took place very much more rapidly and was complete in about 8 minutes. At 210° C. and 215° C. the yielding took place with startling rapidity in about a second, and was characterised by a number of very rapid jerks, a phenomenon which had entirely disappeared at 250° C. The loads at which the yield-point occurred varied from 19·4 lb. at 17° C. to 20·25 lb. at 195° C. to 14 lb. at 250° C. A load of 1 lb. corresponded very nearly to a stress of 1 ton per square inch.

DOMESTIC APPLICATIONS OF ELECTRICITY.—Two papers were read on the domestic applications of electricity on Feb. 16 to the Institution of Electrical Engineers. The load on the various power stations has been rapidly increasing in Great Britain for a number of years owing to the extensive use of labour-saving appliances. The importance of standardising the systems of wiring in use and of making provision during the building of houses for the installing of the electric wires was emphasised. An experiment carried out recently at Birmingham showed that the saving in the cost of building an 'all electric' as compared with an ordinary house is about fifteen per cent. In the Weir system of houses for working classes the cost of wiring is reduced to a minimum. The parts of the houses are all duly wired in the factory, so that when the house is erected by ordinary workmen, an electrician can make all the requisite connexions in about two hours. The total cost comes to about £5 per house. Electric cooking is successful commercially, there being very few dissatisfied consumers. The standard rate of consumption for cooking is one unit per day per person. The radiant system of cooking is becoming popular. In this system the oven elements consist of two vertical radiators which radiate heat directly on to the food. As the food is grilled on both sides simultaneously, much time is saved, and it is claimed that the quality and flavour are greatly improved. The time required to cook a 5 lb. joint of beef is 40 minutes and the energy consumption is only half a unit. An ordinary electric oven takes more than twice as long and takes four times as much energy.

STRESSES ON HIGH TENSION CABLES.—A progress report by the Research Department of the Detroit Edison Company, which was presented at a meeting of the Association of Edison Illuminating Companies, held at Colorado Springs on Sept. 26, gives a very interesting study of the mechanism of the actions which cause the failure of high tension electric cables. In experiments with a new three-core lead-covered cable of modern type, it was found that internal pressures as high as 85 lb. per square inch were sometimes developed after the current had been flowing for several hours. If the current is kept flowing for many hours the pressure begins gradually to diminish, due largely to the stretching of the lead. When the current is now diminished to half its value, vacuous spaces develop in isolated regions along its length; the pressure falling to about 15 inches of mercury below atmospheric pressure. The vacuum in these spaces may exist for days if the cable is left unloaded. These vacuous spaces are subjected to a high electric stress, and cumulative ionisation ensues, an electric discharge taking place through them. The shape of these spaces being unknown, it is impossible to compute the electric stresses to which the insulating material is subjected. The experimental results prove the novel result that the cable insulation produces a definite rectifying action on the current flowing through it. The direct current component of the voltage thus produced was found to be of the order of eight per cent. of the peak value of the alternating current voltage. It is stated that this is detrimental to the cable and that the relative magnitude of this effect increases with the length of time the cable has been in use. Resin oil evolves large quantities of gas under electrical bombardment. From this point of view its use is deleterious. On the other hand, its conductivity improves with temperature, and this generally has the beneficial effect of relieving the electric stress on the air cavities.

The Seventh Congress of the Far Eastern Association of Tropical Medicine.

THE seventh Congress of the Far Eastern Association of Tropical Medicine was held in Calcutta on Dec. 5–24 last. The Association was founded at Manila in 1908, where the first congress was held in 1910. Since that date congresses have been held at intervals, usually of two years (except during and for a short interval after the War), at Hongkong, Saigon, Weltevreden, Singapore, and Tokyo. The Calcutta Congress was the largest that has so far been held, and was attended by about 900 members. The headquarters were in the School of Tropical Medicine and the adjacent Medical College.

The scientific business of the Congress was conducted in six sections: (i) Clinical medicine and surgery, ophthalmology, dermatology, etc. (apparently all that is not specifically included in the titles of the other sections); (ii) State medicine and hygiene, child welfare; (iii) plague, cholera, dysentery, sprue, intestinal infections, bacteriophage, leprosy, tuberculosis, and bacteriology; (iv) malaria, kala-azar, protozoology, typhus-like diseases, leptospiræ, medical entomology, and helminthology; (v) nutrition, deficiency and endocrine diseases, immunology, chemicotherapeutics, rabies, and pharmacology; (vi) veterinary. Several of these were divided into subsections.

A total of 228 papers was read; abstracts of these were published beforehand [1] and were available for all members. Judging from these abstracts, the meetings of the sections must have been packed with interest. It is impossible to mention even a tithe of the titles that attract attention on turning over the pages of the handbook; and the following notes on a few of the papers are really only in the nature of a random sampling.

Dr. Gian Singh considered the incidence of pulmonary tuberculosis in Multan City, according to sex, religion, age, occupation, and residence in different parts of the city. His study leads him to recommend that Government should oblige municipalities to take housing schemes in hand, to open up congested areas, and to enforce building by-laws prohibiting high houses in narrow lanes; that municipalities should employ health visitors to carry on propaganda among the women against certain customs observed by them in the puerperal period; that the people themselves should form anti-purdah and anti-child marriage societies, and that the working and economic conditions of low-paid Government servants should be improved by Government.

Lieut.-Colonel Russell, considering population and public health in India, finds that the population is outrunning the means of subsistence, hence unemployment, rising prices, and reductions in the standard of living of agricultural and industrial workers. As to the possibility of these phenomena being countered by improved agricultural methods and the production of much larger quantities of food, the author considers it unlikely that the situation can be thus influenced to any extent in the long run. In the Madras Presidency the population is within a million of the upper asymptotic limit, and even now considerable quantities of rice are being imported from Burma and Ceylon.

Dr. d'Herelle has three papers on bacteriophage, a subject with which his name is especially connected, and which has attracted much interest in recent years. Bacteriophage is a 'principle' which effects the dissolution of bacteria, reproducing itself as it does so. According to d'Herelle, it is a filter-passing parasite (*Protobios bacteriophagus* d'Herelle 1918) of the bacteria. It is present in the intestine of every man and animal, and in normal individuals develops upon the saprophytic flora there present; by a process of adaptation (demonstrable *in vitro*), which is more or less rapid according to circumstances, it becomes able to parasitise any invading bacteria. The end result, recovery or death, in the bacterial intestinal diseases of man and animals, depends on the power of the bacteriophage to attack and destroy the pathogenic organisms. Bacteriophagy is thus the result of an infectious disease prevailing amongst bacteria. Bacteriophage treatment has been eminently successful in bacillary dysentery, and in cholera has been fully efficient in the great majority of cases.

Lieut.-Colonel Acton and Major Chopra, investigating the action of quinine on the malarial parasites, found that by increasing the degree of alkalinity in the intestines they obtained a greater diffusion of quinine into the circulating blood; hence the blood concentration of quinine was higher when alkalis were administered at the same time. Still, the concentration attained in the circulating blood is considered to be insufficient directly to kill the parasites; but sublethal concentrations are able to paralyse their movements to a certain extent, and the parasites fail to penetrate the envelope of the red blood corpuscle and so to reach their food. These sluggish parasites are swept off the corpuscles by the friction of the blood stream and die of starvation.

Lieut.-Colonel Christophers and Dr. I. M. Puri ("Why do Anopheles Larvæ feed at the Surface, and How?") show that the Anopheles larva is morphologically adapted to feed at the surface, and point out the advantages it obtains by doing so. (Most waters have a special bacterial and flagellate surface film; there is also a subsurface layer of organisms that aggregate below the surface film, either because they are lighter than water, or because they actively seek this position.) The feeding process is described.

Lieut.-Colonel S. P. James and Drs. Nicol and Shute consider the habits of Anopheles in relation to their rôle in the spread of malaria—an interesting paper, since the work was done in England, in connexion with the provision of supplies of infected mosquitoes for transmitting malaria to certain mental patients. The same authors have a paper on experiments on the treatment of malaria in England. Lieut.-Colonel James contributes some remarks on anti-malarial measures for poverty-stricken regions; no one doubts, he says, the efficacy of the established methods of malaria control, but they are difficult and expensive, and it is important to discover a method which can be applied in poorer countries, such as those of south-eastern Europe. In spite of the Commission appointed by the League of Nations Health Committee, such a method is not yet forthcoming; but the first aim should be to reduce the severity rather than the incidence, to combat the disease itself on its appearance in the human or insect hosts; the disease then soon ceases to be of importance. Besides doing this by direct methods, it is essential to improve the economic and social conditions of the people and their general well-being and standard of life; Dutch and Italian schemes for such purposes are already in existence.

Lieut.-Colonel Knowles considers the kala-azar transmission problem and the factor of resistance; he tells the interesting story of recent research into this problem, the arguments which led to the incrimination of the sandfly *Phlebotomus argentipes* as the trans-

[1] Guide to the Seventh Congress of the Far Eastern Association of Tropical Medicine, Calcutta, December 5th to 24th, 1927. Pp. vi+115. Abstracts of Papers and Programme of Scientific Sessions. Pp. iv+176. The Indian Empire: being a Brief Description of the Chief Features of India and its Medical and Sanitary Problems. Pp. vii+346+20 plates+4 maps. (Calcutta: Far Eastern Association of Tropical Medicine.)

mitter, feeding experiments and their results, the working out of the history of the parasite in the fly (the whole life-cycle of the parasite is fully considered in a paper by Major Shortt), and refers to the parallel work of Patton and Hindle in China. The final link in the chain of proof, namely, transmission from man to a human volunteer by means of the sandfly, is still lacking, probably owing to the fact that man, instead of being very susceptible, is extremely resistant to infection by kala-azar.

There are numerous papers on helminthology and on medical entomology; but these notes must close with a mention of Mr. Senior-White's paper on progress towards the realisation of the biological control of mosquito breeding, in which, after recounting the older methods, the author considers the connexion between the hydrogen-ion concentration of the water and the species of mosquitoes that breed in it. Acidity other than that due to carbon dioxide is definitely inhibitory to anophelines; but only extremes of 'natural' *p*H have any such effect. The presence of very small amounts of ammonia, however, are destructive to larvæ; and the probability that bacteriophages (*v. sup.*) can be isolated by which the nitrifying bacteria can be destroyed, and hence the conversion of ammonia into nitrites and nitrates delayed, gives a hope that practical measures may be devised on these lines.

Perhaps it is scarcely necessary to add that all the activities of the Congress were not on these strenuous lines. The programme specifies such things as an evening reception by H.E. the Governor of Bengal at Government House, another by the Trustees of the Indian Museum at the Museum, a conversazione by the Asiatic Society of Bengal, a garden party at Government House, river trips and 'bus tours, visits to works, scientific cinema films, a play in an Indian theatre, as well as other diversions. The scientific meetings concluded on Dec. 11, after which three tours were arranged, one through northern India, one through southern India (these lasting a fortnight), and one through Bihar and Orissa (lasting a week). The "Souvenir—The Indian Empire," presented to all members, is "a brief description of the chief features of India and its medical and sanitary problems"; it fulfils a similar function to the Local Handbook of the meetings of the British Association. Among its 18 chapters are included a résumé of Indian history, and accounts of the history of European medicine in India, of indigenous systems of medicine, of Indian archæology, zoology, botany, geology, weather, and art. Its 340 pages are illustrated by 20 plates of photographic reproductions, several—including the frontispiece, a magnificent peak in the Sikkim Himalayas—of great beauty. Everything seems to have been done to make the Congress a success; and the members can scarcely fail to have enjoyed an intensely interesting as well as a very profitable visit to Calcutta.

J. STEPHENSON.

The Origin of the Japanese Earthquake of 1923.

DR. N. YAMASAKI, professor of geography in the Imperial University, Tokyo, contributed to the official report some valuable physiographic studies on the Japanese earthquake of 1923, which

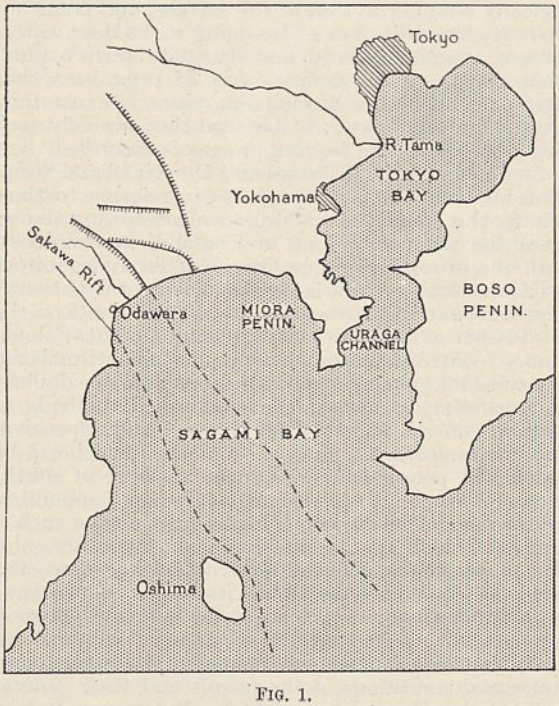

FIG. 1.

he has recently brought to the knowledge of western readers by translating them into English (*Jour. Fac. Sci.*, Imp. Univ., Tokyo, vol. 2, pp. 77-119; 1926). They are of great interest, chiefly on account of the light which they throw on the origin of this remarkable earthquake.

The principal features of Prof. Yamasaki's map are here reproduced (Fig. 1). The river Sakawa runs into the Bay of Sagami on its north-west side. The valley is part of a remarkable rift valley, bounded on the north-east side by a fault-scarp from 200 to 300 metres in height. It was formed by blocking movements of comparatively recent date. Earthquakes, indeed, still occur in the district, one of the latest being the strong Odawara earthquake of 1633. The earthquake of 1923 was very severe in this part. Many villages at the foot of the scarp were totally ruined and the level surface of the fields was thrown into gentle undulations. Still more remarkable than the rift valley on land is its continuation into Sagami Bay. A great trench runs along the axis of the bay in the direction S. 35° E. Near the bottom of the trench the slope is gentle, while the straight side walls are steep and high. The north-east wall is an extension of the fault-scarp on the same side of the Sakawa valley, while the south-west wall is also a steep scarp passing a short distance to the east of the volcanic island of Oshima.

Before the earthquake of 1923, the depth of the trench varied from 1500 to 2000 metres. On the north-east side of the trench, the submarine plateau consists of two steps, the lower one 12 km. wide at a depth of from 1000 to 700 metres, the upper one forming a shelf with a depth of less than 200 metres. One other feature deserves notice—a fiord-like furrow along the floor of the Uraga Channel, with a branch on the east continued into the Boso peninsula as the depressed tract around Tateyama.

The earthquake of 1923, in Prof. Yamasaki's opinion, may be considered as the direct effect of an enormous blocking movement in the district. The most remarkable displacement was of course that which occurred in Sagami Bay. The subsidence was greatest, from 100 to 210 metres, along the axis of the trench. The margin of the uplifted block on its north-east side was raised 250 metres, that on the south-west side 120 metres. Besides these tilted blocks in the deep sea, the shelf of land along the

coast was also uplifted, though to a much less extent. The land was tilted as a whole with its raised margin to the south, the uplift gradually decreasing to the north as far as the Tama valley, after which elevation gave place to depression, never great in amount but covering a wide area. In consequence of these great movements, many fault-lines have newly appeared in the Boso and Miura peninsulas. Slips also occurred on the sea-bed where the slope is steep, those on both sides of the Uraga furrow being the most remarkable.

In this and other memoirs, attention is concentrated chiefly on the vertical displacements. The re-survey of the district has, however, revealed horizontal movements. These are described by Prof. A. Imamura in a brief paper read before the International Union of Geodesy and Geophysics at the Prague meeting in September last. Assuming that the positions of two points about fifty miles north of Tokyo have remained unmoved, it appears that the island of Oshima has shifted 3·78 metres in the direction N. 8° E., Manziro-dake on the west coast of Sagami Bay 2·86 metres N. 9° E., Sengen-yama on the north coast 2·75 metres N. 112° E., and Nokogiri-yama on the east coast 2·57 metres N. 145° E. Thus, generally speaking, the whole epicentral district has made a clockwise twist about a vertical axis somewhere in Sagami Bay. C. D.

British Industries Fair.

THE distinguished general who called the English a "Nation of Shopkeepers" was aiming a scathing insult at our people. By the same token, Adam Smith and the older economists must have turned in their graves when the Government decided to take active steps for the encouragement of commerce. Times have changed. We now aspire to the proud title of a "Nation of Shopkeepers." In order to pay the appalling bill for the War and to restore our country to its pristine wealth, production and trade, especially export trade, must be stimulated by every resource, private or public. Faced by intensified foreign competition and the loss of our pre-eminence in the control of raw material, we are turning to scientific research, to a higher organisation of industry, and not least to a reasonable propaganda on the commercial side. A useful exhibition of our industrial effort is now organised annually by a Government department, the Department of Overseas Trade (Development and Intelligence).

This year's Fair, held in London and Birmingham on Feb. 20–Mar. 2, showed a marked increase in the number of exhibitors and the range of industry represented. By the admission of the general public during the daytime at a nominal charge, the cathedral-like silence of the earlier fairs has been replaced by a livelier atmosphere, without derogation of the serious purpose the organisers of the Fair have in view. Noticeable this year was the evidence of rapid exploitation of recent scientific discoveries. The British Drug Houses, Ltd., for example, already have on the market Vitamin D in the form of a sugared pill, equivalent to so many hours of sunshine. This firm has also prepared a form of malt containing three vitamins. Several forms of apparatus, some of them fitted with electric clocks, were on view for the administration of ultra-violet rays. Even powder puffs are now treated with these rays.

In the wireless section, many portable sets were shown, giving excellent results, in some instances at quite a moderate price. Lilley's sounding instrument warns a ship approaching rocks and records the depth of water under a ship's bottom. Even in the realm of toys, science has raised its standard. 'Thirsty' is the name of a toy dog the protruding tongue of which indicates changes of weather. The whole world will welcome the new instrument for testing the accuracy of singers' voices, exhibited by the Institute of Patentees.

Complexity is not necessarily a characteristic of modern invention. There is, for example, a simple pad called the 'Solapad,' worn next to the skin over the abdominal nerves, which claims to prevent travel sickness in its various forms—sea, train, motor-car, etc. The Ice Store Portable Refrigerator makes ice of the purest quality at an operating cost of one penny per day. Attention may again be directed to the 'Thermega' electro-radiant blanket, a simple and cheap but most useful electrical application. We have no difficulty in accepting the makers' assurance that dampness in beds is a source of great danger, lowering the vitality even when not a direct cause of disease. The blanket has also many obvious medical applications. Messrs. Grieve and Gordon are extending the use of eucalyptus oil as a disinfectant. Imperial Chemical Industries, Ltd., again provided an interesting exhibit, enlivened by a cinema show. Their nitrogen campaign for the improvement of grassland is making good progress. A new fertiliser, called 'Nitro-chalk,' has been placed on the market, consisting of a mixture of ammonium nitrate and dried carbonate of lime. Ammonium nitrate is unsuitable as a direct fertiliser, but can be made available as a fertiliser by mixing with carbonate of lime, of which the company has an ample supply at Billingham. The mixture has a nitrogen content of 10 per cent., and its price will be such that the farmer will only be paying for the nitrogen, the lime—itself a valuable fertiliser in certain soil conditions—being given to him free of charge.

Apart from the evidence provided by statistics of sales effected by the exhibitors, the visitor will be left in no doubt as to the usefulness of this Fair, and for those who are despondent about the future of British industry, it should serve as a tonic.

Spectra and Atoms.

"SPECTRA and Atoms" formed the subject of a lecture by Prof. A. Fowler before the Chemical Society on Feb. 23, when he gave in brief outline an account of the relations existing between series lines in the spectra of elements, and discussed how these relations harmonise with modern views concerning the electronic configuration of the atom.

Early investigations were primarily directed to the identification of regular series of lines which can be represented by simple formulæ, each line being described as the difference of two wave-numbers or terms. Recognition was early extended to different types of series—principal, diffuse, sharp, and fundamental—and Rydberg showed how the various series in the same spectrum are closely interrelated, leading to a simplification in the mode of representation. Prof. Fowler proceeded to discuss the application of Ritz's combination principle, and the restrictive effect therein of certain selection rules. In some spectra, all terms other than those of S type have two values, giving rise to series consisting of doublet lines, and in others three values yielding triplets, but a combination of two doublet terms does not give four lines, and one of two triplet terms yields

only six of the nine lines arithmetically possible. For the application of the relevant selection principle, the components of each multiple term must be distinguished by so-called inner quantum numbers.

In 1913, Bohr's theory came to illuminate the subject of spectral structure by its interpretation of spectroscopic terms as energy levels of the atom; spectral lines are regarded as representing the energy lost by an atom when it passes from a stationary or non-radiating state of a certain energy to another of smaller energy, the possible states being governed by quantum considerations. In its normal unexcited state the atom is in the condition of lowest energy, but it may pass to states of greater energy by the absorption of radiation or by collisions of certain types.

Prof. Fowler continued his discourse with a discussion of electronic orbits. The energy representative of a particular orbit is dependent on its size and—on account of the varying velocity of the electron and the consequent relativity variation of its mass—slightly different for orbits of the same major axis but different eccentricities. This view led to an explanation of the 'fine structure' of the lines of the Balmer series of hydrogen. Of the two quantum numbers employed, one, the principal quantum number, determines the size of the orbit, and the other, the azimuthal quantum number, determines its shape.

Bohr's ideas regarding the probable distribution of the electrons in atoms have been extended remarkably in recent years, so that it has become possible to specify with certainty the electron arrangement for most of the elements and the most probable arrangement for the remainder. These developments were made possible by advances in the analysis of complex spectra, and particularly by the discovery by Catalan, at that time working in Prof. Fowler's laboratory, of higher multiplicities. Another great advance originated in an investigation by Russell and Saunders of the spectrum of calcium, when it was observed that some of the new triplet terms, which also violated the familiar selection rule, represented amounts of energy greater than were necessary to drive a single electron completely out of the atomic system, indicating that a second electron was displaced while the other still remained in the system. Hence spectroscopic terms now have to be defined by 'group quantum' numbers, representing a kind of resultant of the orbital numbers.

Prof. Fowler referred to the important contributions of Pauli, Heisenberg, and Hund, and to the significance of two other quantum numbers involving the orientation of the orbit and the orientation of the spin of the electron respectively, and then surveyed the spectra of some of the elements in relation to the new table of atomic structures. The general conclusion is that all the main features of the spectrum of an atom can now be theoretically predicted if the electron configurations are known, and vice versa. The spectra of ionised atoms are also of great importance; Prof. Fowler referred in this connexion to Paschen's work on aluminium, to his own work on magnesium and silicon, and to the results of Millikan and Bowen. When atoms resemble one another in everything but nuclear charge and mass they are said to be 'isoelectronic,' and the relations between their spectra are beautifully simple. The lecture terminated with a description of Bowen's recent investigations leading to recognition of the 'nebulium' lines—lines appearing in the spectra of nebulæ and hitherto attributed to an unknown element—as being due to singly ionised oxygen and nitrogen and doubly ionised oxygen.

University and Educational Intelligence.

EDINBURGH.—The chair of chemistry, which will become vacant at the end of the current academic year by the resignation of Sir James Walker, has been offered by the Curators to Prof. James Kendall, professor of chemistry and Dean of the Graduate School in the University of New York, who has intimated his acceptance. Prof. Kendall, after graduating in Edinburgh, engaged in research under Arrhenius in Stockholm. In 1913 he was appointed instructor in chemistry in Columbia University, New York, and in 1922 succeeded Prof. Alexander Smith in the chair of chemistry in Columbia University. He went as professor of chemistry to the University of New York in 1926.

LONDON.—Dr. W. E. Gibbs has been appointed as from April 24 to the Ramsay Memorial chair of chemical engineering tenable at University College. Dr. Gibbs was educated at the Liverpool Institute High School and the University of Liverpool. He has had considerable technical experience, and since 1918 he has been chief chemist to the Salt Union, Ltd., where he has been responsible for the formation and organisation of the Research Department and the design and construction of the research laboratories. His published work includes "Report on Disperse Systems in Gases" (Brit. Assoc., Fourth Colloid Report, 1922) and "Clouds and Smokes: The Properties of Disperse Systems in Gases and their Practical Applications" (Churchill, 1924).

OXFORD.—A new mathematical professorship has been founded in accordance with the provisions of a trust created by the late Mr. Walter Rouse Ball, senior Fellow of Trinity College, Cambridge, who expressed a hope (but without making it in any way a condition) that it might be found practicable for the professor to include in his lectures and treatment historical and philosophical aspects of the subject. The holder of the office will be known as the Rouse Ball professor of mathematics, and he will receive a stipend of £1200 a year from the endowment fund of £25,000. Mr. Applebey, in introducing the statute, stated that it is proposed to establish a professorship on mathematical physics which will be attached to Wadham College.

Mr. John Purdon Maxton, of the University of Glasgow, has been appointed a research officer in the Agricultural Economics Research Institute.

Dr. T. V. Barker, of Brasenose College, reader in crystallography, has been appointed secretary to the curators of the University Chest as from April 1 next.

In his annual report on the University Observatory, published in the *University Gazette* for Feb. 22, Prof. H. H. Turner reviews the work that remains to be done before the international astrographic survey of the whole sky is completed. For one reason or another, several of the countries which originally agreed to co-operate, have failed to carry out their intended programmes. The Oxford staff has been able to assist the Vatican Observatory with its section, and it is now proposed, if funds be forthcoming, to undertake the section to the north of the Oxford section, so as to cover that part of the sky which should have been surveyed by the Potsdam Observatory. The seismological investigations initiated by John Milne in 1913 are being continued, and studies of the mass of Venus have been reviewed by Dr. Fotheringham.

A vacancy in the office of Keeper of the Department of Antiquities in the Ashmolean Museum is advertised. The stipend has been fixed at £1000 per annum.

Calendar of Customs and Festivals.

March 2.

ST. NUNNE, or Nuanita, daughter of an Earl of Cornwall and mother of St. Patrick. Two wells were sacred to her, one at St. David's, one in Cornwall, at Alternon, the latter having miraculous powers of curing insanity.

March 4.

From Feb. 25 until Mar. 4 (O.S.) is a period of eight days and seven nights known in Algiers and Morocco by various names, such as *lā-hsûm* or *tamĝart*, meaning 'the old woman,' presumably because the winter is coming to an end, or the 'Master of the Snow,' *Ḥaiyan*. This period, which is represented as a bitterly cold time of the year, is marked for its rain, wind, and snows, dangerous to people, animals, and crops. No one cares to travel, agricultural operations are suspended, and flocks and herds are kept under shelter so far as possible. A thunderstorm at this time is hurtful to little children, animals, and bees, and makes milk and honey scarce; but if an east wind blows, the year will turn out good without scarcity. It is believed that the world will come to an end during this period. Moreover, legends indicate that this is a period of 'borrowed days.'

Variants current in the East, and especially a Palestinian version, put the matter clearly. An old woman, while feeding her flocks, mocked February because he had sent no rain. Three days only of the month remained. February borrowed three days from March and sent rain for six days, which washed the old woman and her flocks into the sea. Therefore the first three days of March are known as *El Mustakridât*—the 'Lent out ones' (see Westermarck, "Ritual and Belief in Morocco," vol. 2, p. 174 *sqq.*). In England, March 'borrows' days from April.

March 5.

ST. PIRAN, PERRAN, or PERAN.—One of the many Irish saints who are conspicuous in Cornish hagiology. Very little is known of his life and acts. He is said to have been born in Cork or Ossory about A.D. 352, and after passing the greater part of his life in Ireland, to have retired to Cornwall, where he lived near Padstow and died at the age of two hundred years. This remarkable span of life may be an attempt to eliminate chronological inconsistencies in the lives of the saint which appear to confuse him with St. Kieran, the precursor of St. Columba, who went to Scotland in the year A.D. 560.

St. Piran is an important figure in Cornish legend. His miracles in Ireland and his voyage to Cornwall on a millstone have already been mentioned (NATURE, Jan. 21, p. 121). At least three localities in the country are known by his name, Perran-aworthan (Perran on the noted river), Perran-uthno (Perran the lesser), and Perran-Zabulo (S. Perrani-in Sabulo—Perran in the Sands), where he lived. The Church of Perran is also associated with the cult of St. Agnes. St. Piran is the patron of the miners, and Mar. 5 is kept as a holiday in his honour. According to the legend, he discovered tin; a black stone which he used in building his hearth melted and produced a beautiful white metal. St. Chiwidden, to whom he communicated his discovery, devised a method of producing the metal in quantity. The saints imparted their knowledge to the Cornish people and the occasion was celebrated by great rejoicing so that 'as drunk as a Piraner' became proverbial. The fame of Cornish tin spread far and wide, eventually reaching Tyre and giving rise to the Phœnician trade. To protect the sources of tin from foreigners, the markets for this trade were confined to the islands, and the tribes of St. Piran and St. Agnes built the rounds and earthworks as a further protection. St. Piran is thus anachronistically associated with two phases of Cornish prehistory—the discovery and working of tin, and the construction of prehistoric forts and earthworks.

Although it is possible that this story may be merely a piece of folk mythology of comparatively modern origin, it is also possible that it preserves a tradition from an older dispensation. St. Chiwidden is an entirely mythical personage, but Chi-wadden means 'a white house,' *i.e.* the blowing or smelting house, and in the corrupt form of Jewwhidn or Jew's house is applied to the old blowing houses. St. Piran was patron of a holy well at Perranzabulo, which had the property of healing sick children, and here may certainly be regarded as the representative of an earlier local deity.

ST. CASIMIR OF POLAND.—Son of Casimir III., King of Poland, *b.* 1458, *d.* 1483, led a life of abstinence and chastity, studied to advance the Catholic religion in Poland and drive out heresy. Thirty-six years after his death he appeared in glittering armour, gallantly mounted, and led the Poles across an impassable river to defeat the Muscovites. In the following year he marched before the Poles in the air and again defeated their enemy. One hundred and twenty years after his death, his body and the rich stuffs in which it was wrapped were found entire and a sweet smell exhaling therefrom.

March 10.

THE FORTY MARTYRS OF SEBASTE suffered at Sebaste in Lesser Armenia, A.D. 320, under the Emperor Licinius. The history of their martyrdom is chiefly remarkable for a novel form of torture devised by Agricola, Governor of the Province. They were exposed naked for three days on a frozen pond outside the walls of the town, in the blast of a bitter north wind, a warm bath being placed nearby. Only one of their number weakened, but he expired as he entered the warm water. His place was taken by the guard, who had been converted in the meantime by a vision. The relics of these martyrs, portions of which reached Constantinople, performed many miracles and healed many sick.

ST. MACKERROGE or KERROCK, bishop in the Province of Levin and Boin in Scotland, A.D. 560, illustrious for miracles. Under his counsel the pious King Congal II. ruled with prudence, zeal, and sanctity. The Scots for a time used his name as their battle-cry, but afterwards changed it for that of St. Andrew. St. Kerroge is sometimes represented in military habit with bent bow and arrow. His name has been given to a ferry (*Port a Chearaig*) and a market for hiring held at Callander, Perthshire, on Mar. 10, O.S. (Mar. 22). This fair is known also as 'tenth-day,' while a rock at the west end of the village is called by his name. "On the Feast of Kerrock every eel is pregnant," is proverbial in Gaelic.

ADDENDA.—THE FIRST SUNDAY IN LENT in one of the Roman Liturgies of 1496 is called *Les Brandons*. In the *Gentleman's Magazine* for 1754 this is taken to refer to the custom among the French peasants of dancing around straw bonfires on this Sunday, and the brandon is said to be one of the sacred dances performed in church choirs as late as the seventeenth century, and only suppressed by ecclesiastical and civil authority after much popular opposition. (*Brandon* = lighted wisp of straw.) That the dance was regarded as an act of worship is shown by the popular Limousin liturgical response, "S. Martial pray for us and we will dance for thee."

Societies and Academies.

LONDON.

Royal Society, Feb. 23.—**Sir Leonard Rogers**: The yearly variations in plague in India in relation to climate: Forecasting epidemics. The seasonal incidence of plague in India depends on monthly variations in mean temperature and humidity, expressed as saturation deficiency, as pointed out by St. John Brooks. Mean monthly temperature variations in hot weather and monsoon periods influence subsequent plague, through high temperatures reducing, and low ones favouring, its prevalence. Saturation deficiency in cold weather as well as in the hot season influences plague incidence, through high saturation deficiency, indicating low relative humidity, reducing prevalence of plague, and vice versa. The great yearly variations in plague can nearly all be explained by the influence of these climatic factors. In the three northern areas, Punjab, United Provinces, and Bihar, four of the six climatic factors become evident before the annual increase of plague from December onwards, and thus allow the more important yearly increases and decreases to be forecast, as a rule. This is also the case to a large extent in Central Provinces. In Deccan, with early increase of plague during monsoon months, forecasts are of less value.

W. S. Patton and **E. Hindle**: The North Chinese species of the genus Phlebotomus. Three species of sandflies were found in North China, namely, *P. major* var. *chinensis*, a variety of *P. sergenti*, and a third species now first described, *P. taianensis*. The first two, in Nature, seem to feed only on human blood; the latter on reptiles and batrachians. The former are of particular interest in connexion with transmission of Leishmania, as in both species the parasite readily develops to the flagellate stage, but only in one of them, *P. major* var. *chinensis*, is there any invasion of the anterior part of the alimentary canal. *P. major* var. *chinensis* normally has only one brood each year. The eggs are usually laid in June, the four larval stages are passed through during summer; the fourth stage larva remains unchanged throughout winter. About mid-May the larva pupates, the adult insect emerging about ten days later. This species only occurs for about six weeks, disappearing in July. *P. sergenti* has a similar life-cycle, but frequently the larvæ complete their development, pupate, and produce another generation in one season. *P. taianensis*, n. sp., resembles the latter in its seasonal incidence, but whereas the two other species are found mainly in houses, this sandfly is especially prevalent in temples and open buildings. In Nature the larvæ of all three species live in cracks in the ground, and are able to withstand freezing. Chinese sandflies have been found only in regions north of the Yangtze Valley. Their distribution, so far as known, agrees with that of Chinese kala-azar, and supports the view that sandflies are responsible for transmission of this disease.

H. Eltringham: On the production of silk by species of the genus Hilara Meig. (Diptera). With an appendix on the habits of the species, by **A. H. Hamm**. The males of certain flies of the genus Hilara (Empidæ) are known to carry silken structures which may or may not contain insect prey or fragments of plants. These structures are transferred to the females just before or at the instant of coitus. The secretion of silk by a mature insect has been hitherto unknown, save in the Embiidæ, Psocidæ, and Hydrophilinæ. The silk of the male Hilara is secreted by numerous unicellular glands situated in the dilated basal tarsi of the anterior legs; the duct of each leads to the base of a short hollow spine, from the apex of which the secretion can be forced to flow, hardening instantaneously on exposure to the air. The cocoons are transferred to the females during flight.

Society of Public Analysts, Feb. 1.—**L. V. Cocks** and **E. Nightingale**: The determination of butter in margarine. Small amounts of sulphuric acid may be volatilised and included in the acids recorded in the Kirschner value, unless special precautions are taken. When the Kirschner value of the butter in a mixture is not known, it is not permissible to state the actual percentage of butter with greater accuracy than between the limits of minus 13 per cent. and plus 24 per cent., both figures being calculated on the reading that would be obtained from the standard graphs for a butter fat with a Kirschner value of 23·5.—**B. S. Evans**: A new method for the separation and determination of small amounts of lead. The method is based on the quantitative deposition of the lead on copper from a cyanide solution containing ammonium oxalate. A percolation apparatus containing copper filings is used. By working in the cold the interference of tin, antimony, zinc, cadmium, and nickel is eliminated; bismuth is deposited, but, in the amounts present in commercial coppers, does not interfere. The deposited lead is converted into sulphate and then into chromate, which is dissolved in nitric acid, and the chromate ion is determined colorimetrically. —**W. R. Schoeller** and **A. R. Powell**: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates. (10) The separation of silica from the earth acids. Accurate results are obtained by fusing the mixed oxides with bisulphate, extraction of the fused mass with oxalic or tartaric acid, and treatment of the impure silica residue with hydrofluoric acid. (11) The precipitation of titanium by tannin. Tannin produces a red precipitate in oxalic or tartaric solutions of titanium; the precipitation is quantitative in the neutralised solution. Titania interferes with the tannin precipitation of tantalum from niobium, if present in quantities greater than about one-hundredth of the tantalic oxide, by causing a discoloration of the yellow tantalum precipitate.—**J. Reilly** and **P. J. Drumm**: The determination of carvone in dill oil. Carvone is precipitated in the cold from an alcoholic solution of dill oil by means of semi-carbazide hydrochloride and sodium acetate. The carvone semi-carbazone thus obtained melts at 141°-142° C., whilst its isomer (m. pt. 163° C.) is formed if the temperature of the reaction mixture is allowed to rise.—**Norman Rae**: Seasonal variations in the composition of the latex of *Hevea Brasiliensis*. Nitrogen, potash, and phosphoric acid rise to a maximum in February, fall until May, increase somewhat until July, and then fall to August. Leaf fall and renewal of leaves coincide with the fall in March, and maturing of seeds with that of July. The latex seems to be a food reserve used up when leaf growth and seed growth are most actively proceeding.

Linnean Society, Feb. 2.—**Major R. W. G. Hingston**: Nature notes from Mount Everest. Major Hingston accompanied the Mount Everest Expedition of 1924 as medical officer and naturalist. Particular attention was given to the methods by which animals adapt themselves to the special conditions associated with high altitudes. Altitudinal distribution was specially studied. Fishes and reptiles ascended to 15,000 feet. A varied assemblage of mammals, birds, insects, and spiders was collected at 18,000 feet. Moths, butterflies, and humble-bees were carried by wind-currents to 21,000 feet. Birds followed the climbers up to 27,000 feet. The highest plant was

taken at 19,000 feet. Small spiders were found living permanently at 22,000 feet.—**W. T. Saxton**: The life-history of Lunularia, with special reference to the archegoniophore and sporophyte. Fertile plants of Lunularia are only rarely found. The course of development of the sporophyte is strikingly different from that of other members of the Marchantiales. The structure of the sessile antheridiophore is similar to that of Fimbriaria and several other Marchantiaceæ. The first divisions in the sporophyte up to the 16-celled stage are quite normal, and the formation of foot and seta from the basal half proceeds as usual, but the divisions in the apical half are exceedingly regular and constant; and the formation of a single group of elongated sporogenous cells, dividing for some time by longitudinal walls only, is a unique feature.

Geological Society, Feb. 8.—**W. J. Pugh**: The geology of the district around Dinas Mawddwy (Merioneth). The Dinas Mawddwy area includes about 22 square miles of country in south-eastern Merioneth. It forms part of the Central Wales Plateau, and is dissected by deep valleys, somewhat modified by glacial action. The rocks consist of mudstones, shales, and slates, with subordinate bands of grit and limestone. They belong to the Bala and the Valentian Series. The area is located on the south-eastern flank of the Harlech Dome, and the fact that the rocks are folded around that great anticline determines the general direction of the strike, which is from south-west to north-east. The faults trend in three directions: (1) north and south; (2) north-east and south-west; (3) north-west and south-east. The north-and-south faults were probably formed at the same time as the folding. The north-west and south-east faults are parallel to the general direction of the dip, which is south-eastward, and they probably belong to a later period of movement than the strike-faulting (south-west to north-east). The rocks are intensely cleaved, and the strike of the cleavage-planes is practically parallel to the general strike of the strata. The cleavage-planes are either vertical or highly inclined south-eastwards. Since they are unaffected by the folding, it is inferred that the cleavage was formed after the folding.

PARIS.

Academy of Sciences, Jan. 23.—**Hadamard**: Repeated operations in the calculus of probabilities.—**A. Cotton**: The automatic regulation of a spectrograph with concave grating. A method of mounting is described which automatically places the slit, grating, and photographic plate in the positions obtained with the mounting of Rowland and of Eagle.—**Charles Moureu** and **Charles Dufraisse**: Autoxidation and antioxygen action. The theory of the catalysis of autoxidation: the mechanism. The authors consider that their views of the mechanism of antioxygen action are not necessarily opposed to the principles of thermodynamics. Independent experimental confirmation of their conceptions is given by the work of H. Gaffron on the addition of oxygen to certain amines in the presence of chlorophyll.—**Gabriel Bertrand** and **Mme. M. Rosenblatt**: The general presence of sodium in plants. The presence of sodium in plants has been a matter of dispute, and this, as the authors point out, has been largely due to the defective methods of chemical analysis employed. The authors depend on the formation of the triple acetate of uranyl, magnesium, and sodium for their sodium estimations, and give results of sodium and potassium determinations in twenty-two plants, those species being selected which have generally been regarded as free from sodium. The results shew that sodium exists in determinable proportions in all plants examined. The ratio potassium to sodium found varies from 729 in potato to 2·05 in peas.—**C. Camichel, P. Dupin**, and **M. Teissié-Solier**: The existence of a periodic phenomenon following Poiseuille's law in the flow of a fluid round submerged cylinders.—Lucien Cayeux was elected a member of the section of mineralogy in the place of the late E. Haug.—**Paul Mentré**: The projective displacements of two plane bundles with a right line in common.—**Lainé**: The equations $s=f(x, y, z, p, q)$ integrable by the method of Darboux.—**S. Serghiesco**: The number of roots common to several simultaneous equations.—**Henri Milloux**: A property of growth of integral functions.—**Nikola Obrechkoff**: The absolute summation of Dirichlet's series.—**Swyngedauw**: The position of the neutral line in the pulley belt.—**R. Duchêne**: The propagation of combustion in mixtures of hydrocarbons. An application of the photographic method of Mallard and Le Chatelier, with special reference to the phenomena during the early stages of the combustion.—**M. Latour**: An electrocapillary microphone. A conical capillary tube dipping into mercury and covered with a layer of an electrolyte has one wire dipping into the electrolyte and another into the mercury. The apparatus works as a microphone.—**Edmond Rouelle**: Some properties of the frequency demultiplier.—**Henri Marcelet**: The examination of some varieties of cod-liver oil in Wood's light. The light was obtained from a mercury vapour lamp and filtered through a screen allowing light of wave-lengths 3340 A. to 3906 A. to pass. The true fluorescence of cod-liver oil is golden yellow, but this colour is modified in commercial oils, especially the dark varieties.—**B. Cabrera**: Concerning the evolution of the elements.—**Vasilesco Karpen**: Batteries with unalterable electrodes and Carnot's principle. From experiments with an element comprising carbon and platinised platinum electrodes with a solution of soda as electrolyte, the author has obtained results which are in contradiction with the second law of thermodynamics.—**M. Ballay**: A theory of the Ludwig-Soret effect.—**A. Duboin**: The complex silicates of copper. A description of the preparation and properties of the silicates K_2O, CuO, $4SiO_2$, and Al_2O_3, $2CuO$, $3K_2O$, $6SiO_2$.—**Raymond Quelet**: Parabrom-Δ-butenylbenzene.—**A. Mailhe** and **Renaudie**: The formation of hydrocarbons starting with propyl alcohol. A study of the products of the catalytic action of uranous oxide on the vapour of propyl alcohol at 400°-420° C.—**Georges Brus**: The action of chlorine and of bromine on nopinene.—**Pierre Pruvost**: Geological section of the boring of Terrières-en-Bray. This trial boring was carried down to a depth of 1173 metres, and details of the strata exposed are given. No indications of coal or petroleum were found.—**Paul Corbin** and **Nicolas Oulianoff**: The Prarion massif and the complex syncline of Chamonix.—**A. Demay**: The granulitic gneiss of the Pyfara and the Saint-Marcel syncline in the northern Cévennes.—**N. P. Péntcheff**: Researches on the rare gases of some thermal springs in Bulgaria.—**Henri Coupin**: The carbon nutrition of *Rhizopus nigricans*.—**J. Chaine** and **J. Duvergier**: Contribution to the determination of the species of fish of the genus Mugil.—**R. Lutembacher**: The structure of striated muscle from its optical properties. The experiments described suggest that the hypothesis of the presence in striated muscle of two different substances is unnecessary. It has been found possible to make membranes of celluloid or acetylcellulose from which photographs have been obtained, both in natural and polarised light, resembling the microphotographs obtained with muscle.—**R. Douris** and

J. Beck: The mode of action of reagents in the serum diagnosis of syphilis. The influence of *p*H.—N. Bezssonoff: The food regime based on oats and egg yolk and the duality of vitamin C.—Swigel Posternak and Théodore Posternak: A natural, optically active inosite-tetraphosphoric ester.—H. Bierry and M. Kollmann: The pancreas and the testicle in the course of polyneuritis in birds.—Marage: Deafness and musical composition.

CALCUTTA.

Asiatic Society of Bengal, Jan. 2.—R. B. S. Sewell: Prehistoric animal remains from the ancient Indian city of Mohenjo-daro, Sind. In the course of excavations at Mohenjo-daro in Sind, the Archæological Survey of India discovered a number of more or less fragmentary animal remains. Owing to the large amount of saltpetre in the soil, these bony remains rapidly deteriorate, and in the deeper, and presumably older, levels, comparatively few animals can be identified from these fragments. In all, some thirty species of animals, ranging from coral to the Mammalia, have been identified. Some of these were undoubtedly living in this region at the time when Mohenjo-daro was a flourishing city, but in other cases the remains, such as shells or horns, appear to have been brought from distant areas in the process of trade. This is the first find of prehistoric animal life in an Indian city.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 13, No. 12, December).—G. W. Stewart: X-ray diffraction in liquids: saturated normal fatty acids, isomers of primary normal alcohols, and normal paraffins. (*a*) Normal fatty acids. The lateral separation of the parallel collinear chains is 4·55 A.; the longitudinal spacing of the diffraction centres increases 2·00 A. for two carbon atoms, one for each of two molecules. (*b*) Isomers of primary *n*-alcohols. The attachment of CH_3 as a side branch alters the 'diameter' by 0·6 A., of OH by 0·4 A., of both by 0·65 A. (*c*) Normal paraffins. Lateral separation of molecules is approximately 4·6 A. The results all suggest the importance of molecular space array (cybotaxis) in liquids.—Jared Kirtland Morse: The structure and dimensions of the benzene ring. A model consisting of cubes having corners shared in common is put forward: such a model on a scale of 2 in. = 1 A. has been constructed. Twelve cube corners (electron positions) are on the surface of a sphere of radius 1·155 *R*, six cube centres (carbon nuclei) on a concentric sphere of radius 1·394 *R*, and the remaining twenty-four cube corners on another concentric sphere of radius 2·134 *R*, where *R* is the radius of the carbon atom.—Frank Peat Goeder: The space group of potassium, rubidium, and cæsium sulphates. From an examination of Laue photographs of the rhombic bipyramidal or holohedral crystals of the anhydrous salts, the space group is 2 *Di* − 13, (V_h^{13}).—S. C. Wang: The diamagnetic susceptibility of hydrogen molecule and of helium in the new quantum mechanics. The energy values obtained by the Ritz method from the approximate ψ functions developed agree fairly well with spectroscopic results.—J. R. Oppenheimer: On the quantum theory of the polarisation of impact radiation. Taking into account the spin of the impacting electron, the Heisenberg resonance principle, and the perturbing energy, it is shown that the polarisation diminishes with decreasing electronic velocity, changes sign at about 200 volts, increases to a maximum near the resonance potential and afterwards approaches zero. This is in accord with experimental evidence.—S. Lefschetz: The residual set of a complex on a manifold and related questions (second note).—Ernest P. Lane: Power series expansions in the neighbourhood of a point on a surface.—Marston Morse: The analysis and analysis situs of regular *n*-spreads in $(n+\nu)$-space.—H. L. Rietz: On certain properties of frequency distributions of the powers and roots of the variates of a given distribution.—Matilda Moldenhauer Brooks: The penetration of methylene blue into living cells. This dye penetrates into the sap of Valonia, but is gradually oxidised when the sap is exposed to air. The equilibrium quantity of dye in the sap is unaffected by the temperature and hydrogen ion concentration of the external solution, but its rate of entry decreases with decrease of temperature and increases with increase of hydrogen ion concentration within limits.—Leonell C. Strong: Studies on the effect of potassium alum–hydrochloric acid solutions on the growth and fate of neoplastic tissue (2). Result obtained on a rapidly growing transplantable sarcoma of the mouse. With this non-specific tumour, no slowing-up of the rate of growth could be observed with certainty.—Henry B. Ward: The influence of a power dam in modifying conditions affecting the migration of the salmon. Sockeye or red salmon spawn near the headwaters of coastal streams. In the Baker River, State of Washington, their course is determined by the impulse to 'buck' the current and, when a choice of waters is possible, as at the outflow of a tributary, they choose the cooler stream. A power dam 260 ft. high bars the normal salmon route up the Baker River; a fisher ladder and cable hoist have been installed to carry the salmon to the upper waters. Some fish exhaust themselves in the tail-race of the power-house, while others fight against the dam. Of those that are lifted over, only a portion go on to the headwaters. The dam has created a still lake with high surface temperature and cold depths with little current. This alters entirely the migratory conditions and may influence the type of fish.—Paul Slavenas: A note on the triple system, λ Tauri.—Hudson Hoagland: Quantitative aspects of tonic immobility in vertebrates. Measurements of the duration of 'death feigning' or tonic immobility in the lizard Anolis at carefully maintained temperatures indicate two independent reactions, one at 5°-35°, and the other at 5°-20° C., of a chemical nature. The presence is suggested of two independent inhibitory hormones which inhibit impulses from higher nervous centres, but pass impulses from tonic centres to the muscles.—Roland C. Travis and Raymond Dodge: Sensori-motor consequences of passive rotary and rectilinear oscillation of the body. The authors were tested on moving platforms, and the responses of the hands (an effort to keep the hands stationary) were observed. When blindfolded, compensatory movements were practically proportional to the acceleration. The higher the frequency of rectilinear oscillation, the more adequate was the perception of motion and its direction. The order of sensitivity of receptors for rectilinear oscillations is visual, kinæsthetic, and vestibular.—Barbara Stoddard Burks: Foster parent–foster child comparisons as evidence upon the nature–nurture problem. The results of Stanford-Binet intelligence tests of 200 sets of foster parents and foster children were compared with the results obtained from 100 sets of true parents and true children, and data as to the cultural, educational, and material aspects of the homes were considered. The contribution of home environment to intelligence is rated at 17 per cent.; environment may in exceptional cases raise or lower the intelligence quotient (I. Q.) by 20 points.—Herman C. Ramsperger: The thermal and photochemical decomposition of azo compounds and the problem of reaction rates.

Official Publications Received.

BRITISH.

Report on the Health of the Army for the Year 1926. Vol. 62. Pp. iv+136. (London: H.M. Stationery Office.) 3s. 6d. net.

Students from other Countries in the Universities and University Colleges of Great Britain and Ireland, Session 1927–28. Pp. 33. (London: Universities Bureau of the British Empire.) 1s.

The Carnegie Trust for the Universities of Scotland. Twenty-sixth Annual Report (for the Year 1926–27) submitted by the Executive Committee to the Trustees on 8th February 1928. Pp. iv + 82. (Edinburgh.)

Bird Sanctuaries in Royal Parks in Scotland. Pp. 10. (Edinburgh and London: H. M. Stationery Office.) 6d. net.

Proceedings of the Royal Society of Edinburgh, Session 1927–1928. Vol. 48, Part 1, No. 1: The Action of "Active" Nitrogen on Iodine Vapour. By L. H. Easson and R. W. Armour. Pp. 9. 9d. Vol. 48, Part 1, No. 2: Contribution to the Studies of the Origin of European Sheep. By B. Kaczkowski. Pp. 10-14. 6d. (Edinburgh: Robert Grant and Son.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 374, February. Pp. 165-240+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The Quarterly Journal of the Geological Society. Vol. 83, Part 5, No. 332. Pp. 653-815+xx. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

New Zealand Institute. Reference List of the Scientific Periodicals in the Libraries of New Zealand. Compiled by Gilbert Archey. Pp. 46. (Auckland, N.Z.) 5s.

1926 (Second Session), Legislative Assembly: New South Wales. Report (together with Appendices) of the Minister of Public Instruction for the Year 1925. Pp. 34. (Sydney, N.S.W.: Alfred James Kent.) 2s. 3d.

Hull Museum Publications. No. 144: Index to Hull Museum Publications, Nos. 96-143. Edited by T. Sheppard. Pp. 24. No. 150: The Mammals, Birds and Insects of East Yorkshire. (A Series of British Broadcasting Talks to School Children.) By T. Sheppard. Pp. 24. No. 151: Record of Additions. Edited by T. Sheppard. Pp. 31. No. 152: Exhibition of Contemporary British Sculpture (The Museums Association Circulating Collection), Wilberforce Museum, 11th February to 10th March 1928. Pp. 8. (Hull.)

FOREIGN.

Proceedings of the United States National Museum. Vol. 72, Art. 11: Rossite and Metarossite; two new Vanadates from Colorado. By William F. Foshag and Frank L. Hess. (No. 2707.) Pp. 12. Vol. 72, Art. 22: On newly discovered Meteoric Irons from the Wallapai (Hualapai) Indian Reservation, Arizona. By George P. Merrill. (No. 2718.) Pp. 4+3 plates. (Washington, D.C.: Government Printing Office.)

Occasional Papers of the Bingham Oceanographic Collection. No. 1: A Contribution to the Theoretical Analysis of the Schooling Behaviour of Fishes. By Albert Eide Parr. Pp. 32. (New York City: Bingham Oceanographic Collection.)

Bulletin of the Bingham Oceanographic Collection. Vol. 1, Art. 2: Scientific Results of the First Oceanographic Expedition of the *Pawnee*, 1925. Crustacea from Tropical East American Seas. By Lee Boone. Pp. 147. Vol. 3, Art. 2: Scientific Results of the Third Oceanographic Expedition of the *Pawnee*, 1927. The Stomiatod Fishes of the Suborder Gymnophotodermi (*Astronesthidae*, *Melanostomiatidae*, *Idiacanthidae*), with a complete Review of the Species. By Albert Eide Parr. Pp. 123. (New York City.)

Memoirs of the Bernice P. Bishop Museum. Vol. 9, No. 3: Jaws and Teeth of Ancient Hawaiians. By H. G. Chappel. Pp. 20+4 plates. Vol. 9, No. 4: Observations on Hawaiian Somatology. By Louis R. Sullivan. Prepared for publication by Clark Wissler. (Bayard Dominick Expedition, Publication No. 13.) Pp. 76+5 plates. Bulletin 42: Handcrafts of the Society Islands. By Willowdean Chatterson Handy. Pp. 118+16 plates. Bulletin 43: Artemisia, Scaevola, Santalum and Vaccinium of Hawaii. By C. Skottsberg. Pp. 89+8 plates. Bulletin 44: Vegetation of Pacific Equatorial Islands. By Erling Christopherson. (Whippoorwill Expedition, Publication No. 2.) Pp. 79+7 plates. (Honolulu, Hawaii.)

National Research Council. Organization and Members, 1927–1928. Pp. 64. (Washington, D.C.: National Academy of Sciences.)

National Research Council of Japan. Japanese Journal of Mathematics: Transactions and Abstracts. Vol. 4, No. 3. Pp. 103-213. Japanese Journal of Botany: Transactions and Abstracts. Vol. 3, No. 4. Pp. vi+267-349+77-122. (Tokyo.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 1, Part 10. Pp. 371-416. 1.50 yen. Section 4: Zoology. Vol. 1, Part 4. Pp. 243-275. 0.80 yen. (Tokyo.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 18, Part 5: Untersuchungen über die natürliche Waldverjüngung bei Larix Dahurica Turcz. Von Shuzo Goto. Pp. 207-396+Tafeln 16-18. (Tokyo: Maruzen Co., Ltd.)

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30, 1927. Pp. vi+302+15 plates. (Washington, D.C.: Government Printing Office.)

First Pan Pacific Conference on Education, Rehabilitation, Reclamation and Recreation, called by the President of the United States of America in conformity with a Joint Resolution of the Senate and House of Representatives of the United States and held under the Auspices of the Department of the Interior at Honolulu, Hawaii, April 11 to 16, 1927. Report of the Proceedings. Pp. 493. (Washington, D.C.: Government Printing Office.) 1 dollar.

CATALOGUE.

Sands, Clays and Economic Minerals for all Industrial Purposes. Fourth edition. Pp. 32. (Chatteris: Algernon Lewin Curtis.)

Diary of Societies.

SATURDAY, MARCH 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—C. Dodgson: The Life and Work of Albrecht Dürer (II.).

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—Dr. Saidullah: A Note on the Theory of 'Shape' in the Light of some Recent Experimental Work.—E. R. Clarke: The Evaluation of the Heterogeneity of the Binet Tests and the Resulting Fallacy of the I.Q.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—Prof. C. H. Desch: Crystallisation in Non-ferrous Castings (Lecture).

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—A. W. Purchas: Theory and Practice in the Engine and Boiler Rooms.

MONDAY, MARCH 5.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. H. G. Cannon: On the Feeding Mechanism of the Shrimp, *Chirocephalus diaphanus*.—Dr. C. H. O'Donoghue and Miss Eileen (Bulman) Abbott: The Blood Vascular System of the Spiny Dogfish, *Squalus acanthias*, Linné, and *Squalus sucklii*, Gill.—Dr. S. Williams: Sporangial Variation in the Osmundaceæ.—Dr. C. W. Wardlaw: Size in Relation to Internal Morphology. No. 3, The Vascular System of Roots.—J. Caldwell: Translocation.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.—At 5.15.—Prof. E. Schrödinger: Wave Mechanics (I.).

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—G. L. Ensor: Notes on the Single Sleeve-Valve Principle.

INSTITUTE OF METALS (Sheffield Local Section) (jointly with Kindred Societies) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—Dr. S. Z. de Ferranti: Electricity in the Service of Man.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. H. Jack: Ancient Bridges.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Prof. G. T. Morgan, R. Taylor, and T. J. Hedley: Syntheses under High Pressure.

SURVEYORS' INSTITUTION (at Institution of Civil Engineers), at 8.—P. J. Waldram: The Estimation of Damage in Ancient Lights Disputes.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—D. R. G. Cameron: Across the Sahara from Kano to Warghla.

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers' Club, Coventry Street, W.1).—L. J. Lambourn: Methods used for Determining Abrasion with Particular Reference to the Relation between Road Performance and Laboratory Results.

TUESDAY, MARCH 6.

ELECTRICAL ASSOCIATION FOR WOMEN (at Oxford Circus House, 245 Oxford Street, W.1), at 3.—M. A. Hussey: The Home Electric Laundry.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. A. E. Crew: Individual, Familial, and Racial Differences in respect of Immunities and Disease Resistance (Milroy Lectures) (II.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: The Behaviour of Animals (III.).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. Harold Scott: (*a*) Report on the Deaths occurring in the Society's Gardens during the year 1927; (*b*) Carcinoma of the Tonsil in a Common Wolf (*Canis lupus*).—Major M. Connolly: On a Collection of Land and Freshwater Mollusca from Southern Abyssinia.—Enid K. Sikes: The External Morphology and Life-history of the Coccid Bug *Othezia urticæ* Linn.

INSTITUTION OF CIVIL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—J. C. Robbins: Hibernation of Insects.—R. W. Hale: Beaks and Bills of British Birds.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—D. S. Munro: Modern Electric Wiring, particularly as applied to Small Houses.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—E. C. McKinnon: Storage Batteries in relation to Modern Supply of Electric Lighting and Power.

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

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—A. E. Collins: The Problem of Selling Cars.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Annual General Meeting and Exhibition of Metallurgical Preparations and Products.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—C. H. Cooke: Lubrication.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—Dr. F. W. Lanchester: Automobile Steering Gear—Problems and Mechanism.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—H. Platt and others: Discussion on The Treatment of Acute Osteomyelitis.

INSTITUTION OF THE RUBBER INDUSTRY (Liverpool Section) (in Common Hall, Dale Street, Liverpool).—R. M. Fitzpatrick: Rubber Footwear Manufacture.

WEDNESDAY, MARCH 7.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—Presidential Address.—S. Beckinsale and H. Waterhouse: The Deterioration of Lead Cable Sheathing by Cracking, and its Prevention.—Dr. M. Haas: The Dilatometric Study of Light Metals.—Dr. Ezer Griffiths and F. H. Schofield: The

Thermal and Electrical Conductivity of Some Aluminium Alloys and Bronzes.—R. Chadwick: The Constitution of the Alloys of Magnesium and Zinc.

At 2.—H. O'Neill: Historical Note on Density Changes caused by Cold-working of Metals.—Major F. S. Grimston: Season-Cracking of Small Arms Cartridge Cases during Manufacture.—F. Hargreaves: The Ball Hardness and the Cold-working of Soft Metals and Eutectics.—W. L. Kent: The Behaviour of Metals and Alloys during Hot-Forging.—W. A. Cowan: Minute Shrinkage Cavities in Some Cast Alloys of Heterogeneous Structure.—W. A. Cowan: Note on the Composition of Old Roman Lead.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. R. Hutchison: A Biographical Note on Sir James Wylie, Bart., M.D., a Medical Adventurer.—F. Prescott: Louis Pasteur and Fermentation.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. E. Schrödinger: Wave Mechanics (II.).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Hilda K. Cargill, Dr. L. Hawkes, and Julia A. Ledeboer: The Major Intrusions of South-Eastern Iceland.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—G. W. N. Cobbold and A. E. Underdown: Some Practical Applications of Quartz Resonators.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—W. MacLaren: The Principles of Coal Cleaning.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—D. S. Munro: Modern Electric Wiring, particularly as applied to Small Houses.—A. J. Milne and R. H. Rawll: The Domestic Applications of Electricity.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—D. T. Smout: Electric Welding.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (Annual Meeting) (at Glasgow University), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall, Westminster), at 7.—H. R. Hiscott: The Manufacture of Malleable Iron Pipe Fittings.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section), at 7.30.—F. S. Sinnatt: The Formation and Structure of Cenospheres; a Study of the Carbonisation of Coal in the Form of Particles.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting and Ordinary Meeting) (at Chemical Society), at 8.—Presidential Address.—Prof. T. P. Hilditch: Composition of the Fatty Acids present as Glycerides in Elasmobranch Oils.—R. T. Thomson: Behaviour of Indicators in the Titration of Ammonia, Sodium and Calcium Phosphates, the Methylamines, Pyridine Bases and Boric Acid.—H. R. Jensen: Cacao Tannin.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—J. H. Jarman: General Building Materials (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Dr. J. H. Jeans: Some Wider Problems of Cosmogony (Trueman Wood Lecture).

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Dr. T. de Martel and others: Discussion on Colectomy.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, MARCH 8.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—G. L. Bailey: The Influence of Dissolved Gases on the Soundness of 70 : 30 Brass Ingots.—Dr. A. L. Norbury: The Effect of Quenching and Tempering on the Mechanical Properties of Standard Silver.—Dr. J. N. Friend and W. E. Thorneycroft: An Example of Roman Copper 'Soldering' and Welding from Uriconium.—Dr. J. N. Friend: The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part I. The Results of Four Years' Exposure in the Bristol Channel.—Dr. T. E. Allibone and C. Sykes: The Alloys of Zirconium. I.—Dr. T. Matsuda: On the Quenching and Tempering of Brass, Bronze and Aluminium-Bronze.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. A. E. H. Love: Biharmonic Analysis, especially in a Rectangle, and its Applications to the Theory of Elasticity (Lecture).

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. F. Fox and others: Discussion on The Value of Marine Health Resorts, with a Special Reference to Children.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. F. A. E. Crew: Individual, Familial, and Racial Differences in respect of Immunities and Disease Resistance (Milroy Lectures) (III.).

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at Royal Society of Arts), at 5.15.—Investigators of the Institute: The Attitude of Employees towards the Institute's Investigations.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. J. Fox: Optics and Chemistry (I.).

BRITISH PSYCHOLOGICAL SOCIETY (Education Section), at 6.—R. R. Dobson: Report of an Inquiry into the Attitude of Local Authorities towards Mental Tests.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group) (Annual Meeting), at 7.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at University College, Nottingham), at 7.30.—O. Mitchell: Further Work with Vat Dyes.

OPTICAL SOCIETY (at Imperial College of Science) (Annual General Meeting), at 7.30.—Dr. R. S. Clay: The Stereoscope, Illustrated by Demonstrations and Exhibits of Early Apparatus and Slides (Presidential Address).

INSTILUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—Dr. S. Z. de Ferranti: Electricity in the Service of Man (Faraday Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Cardiff Branch).—W. K. V. Phillips: Engineering in the Cement Industry.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 30 Russell Square, W.C.1)—E. W. J. Mardles: Notes on Aeronautical Paints and Varnishes.

FRIDAY, MARCH 9.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Col. I. A. E. Edwards: The Air Routes of India.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Sir J. J. Thomson: On Electrodeless Discharge through Gases (Guthrie Lecture).

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—J. S. Brown: Measurement of Power.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—E. S. Huntingford: Air Compressors.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—W. R. Barclay: Special Alloys in relation to the Corrosion Problem.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Deansgate, Manchester), at 7.30.—Dr. J. N. Friend: Researches on the Preservation of Iron and Steel with Paint.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. A. Milne: The Sun's Outer Atmosphere.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Midland Centres of Institutions of Civil and Mechanical Engineers) (at Birmingham).

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch) (jointly with Manchester Association of Engineers).—N. Greenhalgh: Examples of Modern Tool Room Practice.

SATURDAY, MARCH 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Transformation of Matter (I.).

PUBLIC LECTURES.

SATURDAY, MARCH 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: A Naturalist at Land's End.

MONDAY, MARCH 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. E. Schrödinger: Wave Mechanics. (Succeeding Lectures on Mar. 7, 12, and 14.)

UNIVERSITY OF LEEDS, at 5.15.—Sir John Russell: Science and Food Production.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Principal W. A. Stewart: The Production of Baby Beef.

TUESDAY, MARCH 6.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. B. Poulton: Recent Discoveries throwing New Light on some of the Commonest Insects.

UNIVERSITY COLLEGE, at 5.15.—J. Ramsbottom: The Evolution and Classification of Fungi. (Succeeding Lectures on Mar. 13 and 20.)

UNIVERSITY OF LEEDS, at 8.—Prof. P. C. Buck: The Meaning of Progress in Music.

WEDNESDAY, MARCH 7.

MEDICAL SCHOOL, LEEDS, at 3.30.—Sir Berkeley Moynihan: Introduction to a Series of Lectures on Cancer.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30.—Dr. G. R. Lynch: Some Problems in Medico-Legal Practice.

KING'S COLLEGE, at 5.30.—Sir R. A. Sampson: In what Degree is Science True?

UNIVERSITY COLLEGE, at 5.30.—Dr. A. Mansbridge: The Citizen and the Librarian.

THURSDAY, MARCH 8.

STUART HALL, ST. ANDREW'S HALL PLAIN, NORWICH, at 8.—F. W. Alexander: The Value of Sunlight (Chadwick Lecture).

FRIDAY, MARCH 9.

ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE, at 6.—Prof. R. Robinson: The Relation of Some Plant Products to the Simple Sugars and the Amino Acids (Bedson Lecture).

SATURDAY, MARCH 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. Darrell Forde: The First Metal-Workers.

CONFERENCES.

MARCH 5 AND 6.

GERMAN SOCIETY FOR RESEARCHES ON THE CIRCULATION (at Cologne).

MARCH 8 AND 9.

INSTITUTION OF CHEMICAL ENGINEERS (at New Princes' Restaurant, S.W.1).

Thursday, March 8.

At 5.—Prof. B. W. Holman: The Theory of Magnetic Separation.

At 8.—Dr. B. Moore: The Combustion of Powdered Coal.

Friday, March 9.

At 11.30 A.M.—Sixth Annual Corporate Meeting.

At 12 NOON.—President's Address: The Economics of Power as Applied to Chemical Engineering.

At 2.15—Dr. O. Spengler: The Treatment of Effluents from Beet Sugar Factories.

MARCH 28 TO 31.

GERMAN BALNEOLOGICAL CONGRESS (at Baden, near Vienna).