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Science and History.[1]

"WHAT is the use of historical knowledge?" asked the late Frederic Harrison when beginning a lecture on the use of history, delivered in London some seventy years ago. "Is an acquaintance with the events, the men, the ideas of the past of any real use in these days?" To such questions, he remarked that two very different answers might be given, one by the Gradgrinds who would say that it was of no use at all, and the other by the literary gossip who would say history had fifty uses. With neither of these did Harrison agree, but running through his lecture was the thought that "the proper study of mankind is man". No matter whether it be politics, religion, law, literature, science, or art, whatever our system of education included, whilst man was wanting all the rest remained vague and incomplete, and aimless. "But the moment we learn the influence which some great discovery has had on the destinies of man: the moment we note how all human thought was lighted up when Galileo said that the sun, and not the earth, was the centre of the world, the moment we feel that the demonstrations of Euclid are things in which all human minds must agree—indeed, are almost the only things in which all do agree—that moment the science has a meaning, and a clue and a plan."

It may perhaps be considered not a little surprising to find Harrison so long ago emphasising his view by a reference to science, for although, as Dr. Singer recently reminded us, during the last few centuries no event has wrought so fundamental a change as the advent of the scientific way of thinking, there are yet professional historians who are content to tell the political history of the last three hundred years without reference to scientific discovery, scientific method, or the application of science to life and thought, showing a lamentable separation of humanistic from scientific studies. This divorcement is no doubt partly due to the comparatively recent growth and spread of the scientific spirit and also to the highly technical character of scientific studies. It may be, too, that teachers of science have made no greater attempt to connect science with the humanities than teachers of history to allow for the influences of science.

However this may be, whether or no teachers should regard it a duty to connect scientific and historical studies, there can be no question that

[1] A History of Physics in its Elementary Branches: including the Evolution of Physical Laboratories. By Prof. Florian Cajori. Revised and enlarged edition. Pp. xiii+424. (New York: The Macmillan Co., 1929.) 15*s*. net.

students of science should be familiar with the great pioneers as well as with their discoveries. In the past there have been histories of mathematics, astronomy, electricity, and chemistry, and the names of Bossut, Montucla, Bailly, Priestley, Whewell, Grant, Clerke, and Thorpe recall some of the best known of historians of science, among whom Prof. Florian Cajori of California holds a distinguished place. His "History of Physics" has for long been familiar, and the new edition supplies the need of an up-to-date review of the subject. First published in 1898, the book now runs to more than four hundred pages, and in these are surveyed the science of the ancients and the Renaissance and of the succeeding centuries. In the review of the work of the twentieth century are sections devoted to radioactivity and the evolution of physical laboratories.

"This is essentially an age", said Sir Ernest Rutherford recently, "of pioneer activity based on the four great discoveries of X-rays, radioactivity, the electron and the quantum theory", and it is just these things Prof. Cajori deals with in the new section of his book.

If the first steps towards the revival of scientific studies were taken in the fifteenth and sixteenth centuries, experimental science, thanks to the work of Gilbert, Galileo, Huygens, Newton, and others, made its first great onward stride in the seventeenth century. It then passed through what has been called the materialistic age of the eighteenth century to the nineteenth, which brought with it law and order. Last century Prof. Cajori calls a century of correlation, the present is an age of fundamentalism.

"The nineteenth century physicist was like the explorer who, reaching Niagara Falls, contemplated with intellectual satisfaction the grand display of natural phenomena before him. The twentieth century physicist is like the explorer who, going further, arrived at Yellowstone Park and was perplexed by the endeavour to reconcile the fact that in that region not only does water *fall*, but also *rises* and shoots on high, not steadily but in intermittent streams."

All the hypotheses, all the mysteries of to-day, however, we like to believe will eventually lead "to harmonious co-ordination, to the old Pythagorean ideal of the 'harmony of the spheres'". The story Prof. Cajori unfolds recalls some of the greatest achievements of the human intellect. With profound speculation have been joined brilliant efforts of the imagination, patient study of facts, striking examples of manipulative dexterity, and a love of truth. The unravelling of the secrets of Nature has been almost entirely the work of the peoples of western Europe, but the benefits are available for the whole world. Modern communication and transport, the multiplication of industries and manufactures, the enlargement of the opportunities, and the amelioration of the lot of untold millions, what are they but the material gains due to the attempts to read some of the riddles of the universe? The greatest good derived from them, however, has been the emancipation of the spirit of man from credulity and superstition. That is one of the lessons of history.

Mathematical Notation.

A History of Mathematical Notations. By Prof. Florian Cajori. Vol. 2: *Notations Mainly in Higher Mathematics.* Pp. xvii+367. (London and Chicago: The Open Court Co., 1929.) 25*s.* net.

THE first volume of this invaluable work was noticed in our columns on July 6, 1929, p. 4. The vast quantity of material which had to be digested constrained the author to divide it into two volumes, the first of which dealt with notations in elementary mathematics. Had it been possible for one man to set forth the rest of the subject down to the present time on the same scale as the part of it included in the first volume, it would have required more volumes still. The author has therefore limited himself to "the endeavor to present in the two volumes of this history a fairly complete list of the symbols of mathematics down to the beginning of the nineteenth century, and a fairly representative selection of the symbols occuring in recent literature in pure mathematics". As it is, Prof. Cajori has accomplished a great work, for which mathematicians cannot be too grateful to him.

The present volume is in four main sections: 1. Topical survey of symbols in arithmetic and algebra (advanced part); 2. Symbols in modern analysis; 3. Symbols in geometry (advanced part); 4. The teachings of history. The first section treats of letters representing magnitudes, the letters π and e, the evolution of the dollar sign, signs in the theory of numbers, signs for infinity and transfinite numbers, continued fractions and infinite series, signs in the theory of combinations, signs for determinants and logarithms, signs in theoretical arithmetic, and symbolism for imaginaries and vector analysis. The second section deals with trigonometrical notations, symbols used in the differential and integral calculus, finite differences, the theory of functions, and finally in mathematical logic down to White-

head and Russell. Section 3 covers the recent geometry of the triangle and circle, and projective and analytical geometry. Section 4 may be said to contain the moral of the story. It comprises quotations giving the individual judgments of eminent mathematicians, such as De Morgan, Maclaurin, Babbage, Mach, P. G. Tait, Glaisher, Whitehead, and H. F. Baker, on the interpretation of the history of the subject. Next come empirical generalisations by the author himself on the growth of mathematical notations, followed by suggestions for international co-operation as the only hope for the establishment of uniformity of notations.

When there is such a wealth of interest in the volume before us, it is difficult to make a selection of topics suitable for mention in a notice of this kind. One thing that stands out is the leading part played by Leibniz in the development of mathematical notations. Recognising the supreme importance of satisfactory symbols, Leibniz made a prolonged study of matters of notation, and, unlike others, for example, Oughtred and Hérigone, who launched 'off their own bat' a vast quantity of new signs, he first experimented with symbols for some thirty years, corresponded with mathematicians on the subject, and tried to ascertain their preferences, in order to secure, if possible, an agreed system. He was never better inspired than when he put forward his dx and dy in differential calculus and his sign $\int$ for integration. Yet he withheld the former from print for about ten years, and consulted in the meantime with Oldenburgh and Tschirnhausen. He discussed with Johann Bernoulli both the name and the principal symbol of the integral calculus. Leibniz himself favoured the name "calculus summatorius" and the symbol $\int$, Bernoulli the name "calculus integralis" and the capital letter I for the sign. The result was the happy compromise of adopting Bernoulli's name and Leibniz's symbol.

Nothing better attests the success of Leibniz's careful method of preliminary experimentation and consultation than the fact that no other mathematician has advanced so many symbols which have retained their place to the present day as did Leibniz. The tables which Prof. Cajori gives of the symbols used by Leibniz from time to time in his MSS. and printed papers occupy about nine pages. Leibniz's ideals for mathematical notation were part of his broader scheme of mathematical logic, which, however, was rather a programme than an actual accomplishment. He came to regard logic as "like a universal mathematics", and advocated a "universal language" or "calculus". "This true method", he said, "should furnish us with an Ariadne's thread, that is to say, with a certain sensible and palpable medium, which will guide the mind as do the lines drawn in geometry and the formulas for operations which are laid down for the learner in arithmetic". He prophesied the triumphant success of researches in this field in the famous sentence: "I dare say that this is the last effort of the human mind, and, when this project shall have been carried out, all that men will have to do will be to be happy, since they will have an instrument that will serve to exalt the intellect not less than the telescope serves to perfect their vision."

Two interesting details may be added. The sign π for the ratio of the length of the circumference of a circle to that of its diameter was first used by William Jones in his "Synopsis palmariorum matheseos" (1706), without any advertisement, or any idea that he was doing anything noteworthy. William Oughtred had so early as 1647 used π/δ for the ratio, where π clearly stood for periphery ($\pi\epsilon\rho\iota\phi\acute{\epsilon}\rho\epsilon\iota\alpha$). Similarly, Jones, on p. 243, wrote "Periphery (π)"; but twenty pages later he quotes an infinite series given to him by John Machin and adds simply "$=3{\cdot}14159$, etc. $=\pi$".

The old sign for 'factorial-n' (two lines forming a right angle), which was used by Todhunter and others in algebraical text-books, was due to the Rev. Thomas Jarrett (1805–1882), of St. Catherine's College, Cambridge, who must have been a remarkable man. Seventh Classic and thirty-fourth Wrangler in 1827, Jarrett made an extensive study of algebraic notation, which he discussed in an article of 1830 and much more fully (1831) in "An Essay on Algebraic Development containing the Principal Expansions in Common Algebra, in the Differential and Integral Calculus and in the Calculus of Finite Differences"; he was professor of Arabic in the University of Cambridge from 1831 until 1854 and Regius professor of Hebrew from 1854 until 1882, while in 1875 he edited the Sanskrit text of the Tale of Nala with vocabulary.

It is amusing to find De Morgan condemning the present sign for 'factorial-n' in the "Penny Encyclopædia": "Among the worst of barbarisms is that of introducing symbols which are quite new in mathematical, but perfectly understood in common, language. Writers have borrowed from the Germans the abbreviation '$n!$' to signify $1 \cdot 2 \cdot 3 \ldots (n-1)n$, which gives their pages the appearance of expressing surprise that 2, 3, 4, etc., should be found in mathematical results"!

T. L. H.

Bacteriology in Medicine and Public Health.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 3. By W. Bulloch, P. Fildes, A. T. Glenny, H. Henry, R. T. Hewlett, R. A. O'Brien, S. G. Paine, G. F. Petrie, Muriel Robertson, R. St. John-Brooks, W. G. Savage, A. C. Thaysen, H. G. Thornton, R. L. Vollum. Pp. 413. (London: H.M. Stationery Office, 1929.) 21*s.* net.

THIS "System of Bacteriology" aims at giving a comprehensive survey of our present knowledge of bacteriology, specially in its relation to medical work. The first volume of the series to be published gives promise of a very valuable contribution to scientific literature. A book of this kind can only be undertaken by a series of authors, and the reviewer is placed in a rather difficult position. He can have only a superficial knowledge of many of the articles, and his judgment of the whole work must, to a certain extent, be influenced by the quality of those papers with which he has an intimate knowledge. Of the various papers, the three outstanding ones are those of Chaps. viii., ix., and x. In Chap. viii. there is a short history of plague by W. Bulloch, but the main part of the chapter by G. F. Petrie is obviously written by a man of wide experience, and a real authority on the subject. It deals with all aspects of plague infection—the characters of the bacillus, the problems in plague immunity, the transmission by the rat-flea, the natural disease in rodents, and the various forms of plague in man with reference to its pathology, its diagnosis, and treatment. It is a very valuable contribution and must be regarded as a standard work on the subject.

Chap. ix., on the organisms of gas gangrene, by Muriel Robertson, will commend itself to all who have worked on this subject. Miss Robertson deals very fully with the characters of the bacteria and their classification, with their pathogenic action in man and in the lower animals, and with their toxins. We may not agree with all Miss Robertson's conclusions, but she has done an extremely valuable piece of work, and has brought some order out of what has been practical chaos. The part of this chapter on the preparation and testing of toxins and antitoxins, coming with the authority of R. A. O'Brien, is an addition of considerable value.

It is appropriate that Chap. x., on *B. tetani*, should maintain the standard set by Miss Robertson. Fildes, with Bulloch, O'Brien, and Glenny, have given to scientific bacteriologists and medical men in general a very worthy contribution on this important pathogen. We commend these two chapters to all workers with the pathogenic anaerobes as the best summarised work which has yet been published on this subject.

Of the merits of some of the other chapters we feel very incompetent to judge. Chap. i., on "The Economic Aspects of Bacteriology", is of considerable interest, and many points of practical importance have been brought out, but some of the descriptions are scrappy and give the impression that there has been very little advance in economic bacteriology. One is surprised that no reference is made to the work of Winogradsky on 'retting', which we think is worthy of rather serious consideration. On 'Baking' surely some reference should have been made to bacterial troubles other than 'Ropy-bread'. These are perhaps minor faults in a work which undoubtedly is both interesting and stimulating.

Chap. ii., "The Bacteriology of Water", is frankly disappointing. The author deals with some factors which influence bacterial counts of water, such as storage, the effects of rain, food supply, temperature, etc., but surely the essential factor in determining the significance of counts is a knowledge of the local conditions of supply, the nature of the gathering ground, the situation of the storage areas, and number and efficiency of the filters. A reservoir near the seaside may be frequented by gulls, and the *B. coli* content there be greater than if the reservoir were in an inland area, but the *coli* contamination would be of little importance. None of these points is even mentioned. Then, we find no mention of the bacterial growth which occurs in pipes and tunnels, which is such a big economic problem to water engineers, or of the contamination so often found in leather and other washers.

In the portion of this chapter dealing with sewage one is surprised to find no reference to the recent work of Wilson and others on the isolation of *B. typhosus* and *B. paratyphosus*. What is given is well done, but the chapter suffers from the sins of omission rather than those of commission.

Chap. iii., "Bacteriological Aspects of the Dairy Industry", is well written and will be warmly welcomed by all those who are dealing with the bacteriological aspect of our milk supply. The subject is not dealt with very fully, but the essential facts are given and are presented by a man who evidently has accurate knowledge of what is needed.

Chap. iv., "The Bacteriology of Foods", is interesting, but this subject very naturally raises the question of how much value is to be attached to the ordinary bacteriological examination of food-stuffs; for example, the standard laid down for the bacteriology of shell-fish is excellent, but the working bacteriologist has to deal with the material as collected from stores and shops where they are being sold many hours, or it may be days, after the removal from the beds. So with other foods; there are so many factors that come in that each case has to be dealt with on its merits, and individual bacteriologists will disagree as to the importance to be attached to examination of eggs, fruit, vegetables, and even canned foods. Public health authorities still lay considerable stress on this work, and Dr. Savage has done the work well.

Chaps. v., vi., and vii. have interested us very much. They are well written, but as we have only touched the surface of these fields we do not feel competent to assess the value of the work. From the authors of these chapters one would expect valuable contributions, and we have little doubt that to workers on these subjects these papers will be welcomed.

Chap. xi., on *Bacillus botulinus*, is written by Dr. Hewlett, with sections by Dr. Bulloch and Dr. O'Brien. Bulloch deals with the history and O'Brien with the large-scale production of anti-toxin, a subject on which no one is more qualified to speak. The general characters of the bacillus, its fermentation reactions, its serology, and the variations in strains and types, are dealt with very fully. The manifestations of botulism in animals, the disease in man, the effects of the toxin and the anti-toxin, are all discussed. Botulism has become more familiar in recent years, but we feel that this paper gives us a very complete and very accurate account not only of the disease, but also of the causal bacillus.

Chap. xii. is simply a collection of material from various authors, with some observations by Dr. Savage. As we are told that the Salmonella group is to be dealt with in Vol. 4, and as botulism has been dealt with in Chap. xi., we think it would have been wiser either to have omitted this chapter altogether or to have treated the subject fully. In its present condition it is not of great value.

Taking the volume as a whole, we cordially congratulate the authors and the editors on the production. The book will prove of enormous value to all bacteriological workers, and we hope that the other volumes will reach the same high standard.

J. M. BEATTIE.

Gauges and Fine Measurements.

Gauges and Fine Measurements. By F. H. Rolt. Edited by Sir R. T. Glazebrook. Vol. 1: *Standards of Length, Measuring Machines, Comparators.* Pp. xv + 366. Vol. 2: *Limit Gauges, Measuring Instruments, General Methods of Measurement.* Pp. viii + 357. (London: Macmillan and Co., Ltd., 1929.) 42*s.* net.

IT is questionable if any section of engineering has hitherto suffered so much as the metrological from the want of a standard text-book, and now, with the advent of this work, it is just as questionable if any section is better equipped with a really sound and comprehensive treatise. The copious references at the end of each chapter show that much of a specialised nature has been written on metrology, but very few indeed of the many engaged on, or interested in, this branch of engineering have more than a fragmentary knowledge of the subject, and the number of persons who could deal with the whole field with the intimate knowledge of the expert is probably exceedingly small. It is therefore fortunate that one of the few has produced this treatise.

The history of the subject, as revealed more or less incidentally in the two volumes before us, shows that gauge construction and fine measurement was developing so continuously during the last twenty years that probably no particular time during that period would appear appropriate for writing a comprehensive book on the subject. During the period 1840–80, Sir Joseph Whitworth introduced his famous system of end gauges, the first end-measuring machine, and his system of producing truly flat surfaces by lapping a set of three plates. The next important improvement was the introduction of the now common system of 'go' and 'not go' gauges. With the exception of Michelson's classical experiment in 1892–93 on the determination of the length of the standard metre in wave-lengths of monochromatic light, no further notable contribution to the art appears to have been made until the Johannsson (Swedish) Company introduced its block gauge and slip gauge system in 1908. This appears to have been the starting-point of the great advances made since then. These gauges opened a new field in the art of mechanical measurement, but, in the workshop, they were regarded as an expensive novelty and tardily adopted until, in 1917, a system of manufacturing gauges of this type was evolved in Great Britain, since when they have been produced in bulk for use in the tool room. The degree of

accuracy attained in block gauges is exceedingly high, and the Johannsson gauges are supplied in four grades, respectively accurate to 2, 4, 8, and 12 parts in a million on the length of the gauge.

The commencing point in the production of accurate length gauges is the legal standard of length, which is the distance between two parallel lines engraved on a metal bar. Comparison between line standards is made with a pair of microscopes, under which the bars are placed in turn and the longitudinal position of the microscopes adjusted by a micrometer to bring them over the lines. The adjustment necessary between the settings is a measure of the difference between the standards. Yard or metre bars having well-defined lines can be compared in this manner to an accuracy of one part in ten million, about 0·000,004 in.

Comparing the absolute length of an end gauge with a line standard involves the problem of transference of size from lines to transverse faces. A method of wringing on each end of the gauge a short auxiliary block, with a transverse line engraved on it, has enabled this to be effected to an absolute accuracy of one part in two million. An end gauge of the standard yard or metre having been obtained, the gauges of shorter lengths are produced by a system of subdivision, making sets of gauges of equal length which together equal the standard. In producing these sets a comparator is used which detects a difference of one millionth of an inch. The accuracy of the finished gauges is checked by comparing various combinations giving nominally equal lengths, taking into account the thicknesses of the wringing films.

The methods of measuring absolute length and making comparisons between end gauges by optical interference methods are exceedingly interesting, and the accuracy attainable is of the order of a fraction of a millionth of an inch. The optical interference method is also adopted for testing the flatness of surfaces and for determining coefficients of expansion, but for measuring long gauges it is doubtful if it is more accurate than the mechanical method. A further method which will give a natural control on standards of length in terms of time is being developed at the National Physical Laboratory.

It is not to be gathered that attention is confined in Mr. Rolt's work to these highly sensitive methods of measurement. As an example, a system of sets of gauges is described for workshop, inspection, check and standard use, and, in the order given, each is ten times as accurate as the preceding set. But these very accurate measurements of standards, etc., are the bedrock on which most of the many developments are based. So much ground is covered that it is impracticable to refer in particular to the many instruments, machines, methods, etc., which are described, but it seems certain that nothing of value has escaped attention, and all are treated with the same thoroughness.

In practical worth to those concerned in its subject, this work is a most valuable contribution to engineering literature. It is very regrettable that circumstances have postponed the publication of the third volume dealing with screw threads, and its appearance will be looked forward to by all readers of the present two volumes.

L. M. D.

The Extinct Dwarf Elephants of Sicily and Malta.

Les éléphants nains des îles méditerranéennes et la question des isthmes pléistocènes. Par Raymond Vaufrey. (Archives de l'Institut de Paléontologie humaine, Mémoire 6.) Pp. ii + 220 + 9 planches. (Paris : Masson et Cie, 1929.) 160 francs.

IT may seem strange to find a memoir on extinct dwarf elephants among the publications of the Institute of Human Palæontology. These elephants, however, lived on several islands in the Mediterranean during part of the period when Palæolithic man ranged over both western Europe and northern Africa. They were especially abundant in Sicily and Malta, where they are commonly supposed to have been stranded when a neck of land which connected Italy with Tunis became submerged, except in the fragments which those islands represent. The proper understanding of them, therefore, has an important bearing on the geography of the Mediterranean region in Pleistocene times when early human migrations were taking place.

Dr. Raymond Vaufrey has studied the subject as thoroughly as possible, both by examining the collections of remains of dwarf elephants which have already been made, and by visiting the various caves and rock-fissures in Sicily and Malta in which these fossils occur. He himself has also made an important contribution to knowledge by providing new material to distinguish precisely the smallest form of dwarf elephant, commonly known as *Elephas falconeri*, from the somewhat larger form, *E. melitensis*. In the cave of Luparello, near Palermo, he found two superposed deposits, the upper containing only *E. falconeri*, the

lower only *E. melitensis*, so that there could be no confusion of the teeth and bones of the two forms. He showed at the same time what had long been suspected, that the smaller form was of later date than the larger form.

The technical descriptions of the teeth and bones are illustrated both by diagrammatic text-figures and by several plates of most beautiful photographs. The results are then summarised, and it seems clear that the dwarf elephants both of Malta and Sicily represent three distinct races of the well-known European Pleistocene *Elephas antiquus*, as already recognised by Pohlig, with no relationship to the modern African elephant. They must all have had a comparatively large head, for the size of the molar teeth is less reduced than that of the limb bones. The largest members of the race *falconeri* would be less than a metre in height; those of the race *melitensis* would stand about 1·40 m. high, and those of the race *mnaidriensis* about 1·90 m. high. As teeth of *E. antiquus* of normal size have already been found in the oldest Pleistocene deposits of Sicily, and as the deposits in the caves are evidently of later date, the dwarfing must have occurred after the beginning of the Pleistocene period.

To determine the exact date of the dwarfing of the elephants, Dr. Vaufrey has made many important geological observations, and has searched especially for evidence of associated man. He has not found any implements in the same deposits as the teeth and bones, and he is satisfied that the two human teeth discovered some years ago in the Har Dalam cave of Malta are neither Mousterian (as often claimed) nor from the elephant-bearing layer. He has found stone implements of very late Palæolithic type only in certain caves in Sicily well above the deposits containing remains of dwarf elephants. He therefore concludes that Palæolithic man did not reach the Sicily-Malta land area until after the elephants had become extinct. They probably flourished in Mousterian times.

In conclusion, Dr. Vaufrey compares the Sicilian and Maltese fossils with the corresponding remains of dwarf elephants found by Miss Dorothea Bate in Cyprus and Crete, and by Dr. Forsyth Major in Sardinia. He considers that the remains from Cyprus belong to the races named *falconeri* and *melitensis*, while all those from Crete and Sardinia represent the race *melitensis*. As Cyprus, Crete, and Sardinia can scarcely have been continuous with Sicily and Malta after the early part of the Pleistocene period, similar dwarf races must have arisen independently from *Elephas antiquus* in at least four areas.

The dwarf elephants of the Mediterranean islands, therefore, must be regarded as the stranded descendants of a well-known early Pleistocene European species which roamed over the Mediterranean lands before parts were broken up into islands. As no distinctively African animals are represented by fossils in the same deposits as their remains, and as the dwarf elephants are not closely related to the modern African elephant, the Sicily-Malta land area cannot ever have extended to Tunis. During Pleistocene times, indeed, there was no land bridge in this region which man could traverse between the European and African continents. A. S. W.

Our Bookshelf.

Surveying: as Practised by Civil Engineers and Surveyors; including the Setting-Out of Works for Construction and Surveys Abroad, with Examples taken from Actual Practice; intended as a Handbook for Field and Office Use, also as a Text-Book for Students. By John Whitelaw, Jun. Eighth edition, thoroughly revised and enlarged by Col. Sir Gordon Risley Hearn. Pp. xvi+578. (London: Crosby Lockwood and Son, 1929.) 16*s*. net.

HAVING achieved in the past the distinction of appearing in seven editions, Whitelaw's "Surveying" has now, in the capable hands of Col. Sir G. R. Hearn, been thoroughly revised and enlarged in accordance with the most recent developments in modern practice and issued in its eighth form. Originally designed as a compact handbook, it has now become somewhat too bulky literally to fulfil such a function, but as a desk manual and a comprehensive text-book for students it will command an even wider range of utility and service.

In the new edition prominence is rightly given to developments in the field of tacheometry or stadia surveying, and to other means of rapid measurement required in modern prospective work and for kindred purposes, in which the plane table and aneroid barometer also find a field of usefulness. Photographic and aerial surveying similarly receive notice. Attention, moreover, is directed to modern instruments of precision, and a description is given of the micrometer microscope.

To those who are not familiar with the scope of the work, especially in its enlarged form, the following summary of the contents of the successive chapters may be useful: surveying by means of the chain only; surveying with the aid of angular instruments; levelling operations; adjustment of instruments; railway and road surveys; tacheometric surveying; tunnel work; water supply surveys; hydrographical surveying; astronomical observations connected with surveying; surveys abroad in jungle, desert, and

unmapped open country; and trigonometrical or geodetic surveys. An appendix adds a number of useful details on various points, including plan preparation and photographic reproduction. There is a serviceable index. B. C.

Bahnbestimmung der Planeten und Kometen. Von Prof. Dr. G. Stracke. Pp. viii + 365. (Berlin: Julius Springer, 1929.) 26 gold marks.

THIS is a volume of convenient size, and gives in a compact form all the details of orbit computation. Dr. Stracke has great experience in such computations from his extensive work on minor planet orbits for the Berlin Rechen-Institut. The first chapter gives a description of undisturbed motion about the sun, and the relation of the geocentric to the heliocentric places. The next gives the various reductions that the observed positions need before commencing the orbit computation. The third chapter is the fundamental one; it describes three different methods of deducing an elliptical orbit from three observations, and two of doing so from four observations; then follow two methods for a circular orbit, and two for a parabolic one; it is to be regretted that Leuschner's method is not included, as many computers prefer it to any other, and it is very effectively employed in America. The next chapter explains the calculation of ephemerides, including all the refinements necessary when exact ones are required.

The chapter on perturbations describes the methods of Cowell and Numerow, in which the co-ordinates x, y, z are determined by mechanical quadratures; also that of Encke, in which the perturbations of x, y, z are thus calculated. Lastly, there is a chapter on the improvement of orbits by the inclusion of later observations.

There are numerous examples; the elliptical orbit of planet No. 996 is worked out from an arc of 50 days, and a parabolic orbit is found for Orkisz's comet from an arc of a month. There is a collection of tables at the end of the volume and also an extensive list of books and pamphlets relating to the subject. The very useful X, Y tables of Innes, published since the list was prepared, should be added to it. A. C. D. C.

Ur of the Chaldees: a Record of Seven Years of Excavation. By C. Leonard Woolley. Pp. 210 + 16 plates. (London: Ernest Benn, Ltd., 1929.) 7*s.* 6*d.* net.

MR. WOOLLEY'S brief but compendious account of the excavations at Ur during the seven seasons in which he has been in charge of the joint expedition of the British Museum and the Museum of the University of Pennsylvania, is both timely and convenient. Periodical reports and newspaper articles freely contributed to the Press by Mr. Woolley have kept his public informed of the progress of the work in each season, but everyone will be glad to have at hand this convenient summary of the results as a whole.

Reading through Mr. Woolley's narrative in this connected form, and surveying his material as it is possible to do here, only serves to bring home with telling force the importance of this work for the history of civilisation. During the past two seasons, apart from the evidence for a flood of unexpected dimensions, of which the interest will vary according as it is taken to bear upon Biblical narrative, the excavation of the Royal and 'private' tombs, with their rich treasure and elaborate offerings of human and animal victims, has thrown an entirely new light upon ritual and culture in Sumeria at this early stage. It has given us a new view of the artistic achievements of the early Sumerians for which even the discoveries of previous seasons at El Ubaid and Ur itself had not prepared us. By the side of these achievements, the excavation of the great temple at Ur seems to pale in interest; but Mr. Woolley's account of this remarkable piece of work will serve to restore something of a sense of proportion.

Physical Chemistry. By Dr. J. B. Firth. Pp. iv + 292. (London: University Tutorial Press, Ltd., 1929.) 5*s.* 6*d.*

DR. FIRTH has undertaken a difficult task in attempting to outline the modern doctrines of physical chemistry in a book of less than 300 pages. This task has been rendered more difficult by the inclusion of an introductory chapter on the atomic and molecular theories and a final chapter on atomic structure. The author has therefore summarised the subject matter of the usual elementary course of physical chemistry within the narrow limits of about 240 pages, but has done his work so well that no important omissions appear to have been made. Of up-to-date topics the use of the parachor is briefly but adequately described, but the modern theory of complete ionisation of strong electrolytes is only referred to in a footnote which states that "the assumption . . . that the speed of the ions remains unaltered on dilution . . . holds for weak electrolytes but not for strong electrolytes". The text includes some 50 figures and a collection of 106 problems and test questions.

The Rise of Modern Physics: a Popular Sketch. By Prof. Henry Crew. Pp. xv + 356 + 24 plates. (London: Baillière, Tindall and Cox, 1928.)

FOR many years Prof. Crew has been lecturing to students of Northwestern University (in Evanston, a suburb of Chicago) on the history of science. He has now put his lecture notes into book form, so that they may benefit a wider circle. His book is not intended to be a serious critical study of the history of physics, but rather an outline that will enable the modern student to appreciate the labours of the pioneers of the science. This object it achieves admirably. It may occasion surprise to find that Galileo receives much more attention than does Newton, but this is probably due to the fact that the author had previously made and published an intensive study of the life of Galileo.

The book is lucidly written and may be perused with profit by all students of physics, and indeed by all whose interest is in the domain of science. L. J. C.

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.*]

Loss of Ultra-Violet Transparency in Glasses.

IN a recent issue of NATURE (Sept. 21, 1929, p. 441) Messrs. Wood and Leathwood described some experimental work on the ageing or solarisation of ultra-violet transparent glasses, from the results of which they arrived at two conclusions: (1) that complete degeneration by a mercury arc lamp results in a greater loss of ultra-violet transparency than does natural solarisation, and (2) that natural solarisation of U.V. glasses is complete after only a few days' exposure to the sun.

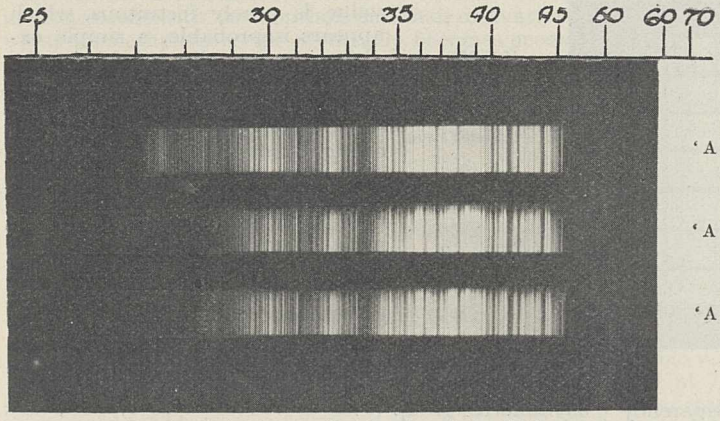

FIG. 1.—Natural and artificial ageing of glass 'A'.

The first of these conclusions is a confirmation of observations published by me in a paper in *Glass* (September 1928) in which it was shown that only eight hours' treatment with a mercury arc lamp was sufficient to reduce the ultra-violet transparency of four different types of glass to the same extent as six months' exposure to the sun and a practically complete hemisphere of sky. Throughout the whole of the comparisons of natural and artificial ageing described in that paper, a standard period of eight hours' arc treatment was adopted, although prior to that date all the test reports given by the National Physical Laboratory and by the Reichsanstalt of which I was cognisant, showed that artificial ageing had been carried out by mercury arc lamps for periods of twenty-four hours. The similarity of the effect of six months' natural solarisation and eight hours' artificial ageing on one particular glass (glass 'A') is clearly shown in Fig. 1.

Among the data given by Wood and Leathwood an interesting fact is given but not emphasised, namely, that all glasses are not equally susceptible to this loss of ultra-violet transparency. This can best be brought out by photographs taken, developed, and printed under identical conditions, rather than by quoting figures. Pieces of two glasses ('A' and 'H') of similar thickness but different manufacture were cut into three sections. One section of each was preserved in the 'new' condition, the other two were simultaneously subjected respectively to five hours' and ten hours' artificial ageing, six inches below a quartz mercury lamp. Afterwards, photospectrographs of the transmission of each of the six sections were taken on one plate, using an iron arc and giving a uniform twenty seconds' exposure in each case.

The results, reproduced in Fig. 2, clearly show that even this severe treatment barely affects the glass 'H', but, on the other hand, the glass 'A' suffers a serious reduction in ultra-violet transparency when judged either by the extent of the transmission or by the brightness in the important zone between 2950 A. and 3200 A. These observations have recently been confirmed by National Physical Laboratory tests on a sample of the glass 'H' (independently selected by a well-known London architect) and on a piece of the glass 'A' bought in the ordinary way of business. These tests show that at 3050 A. the glass 'H' has an initial transparency of 68 per cent, falling to 53 per cent on arc ageing, while the glass 'A' has an initial transparency of 64 per cent, falling to 45 per cent on arc ageing. Natural solarisation shows up the difference between these two glasses even more clearly.

Turning now to the second conclusion arrived at by Wood and Leathwood, namely, that natural solarisation is complete in comparatively few days.

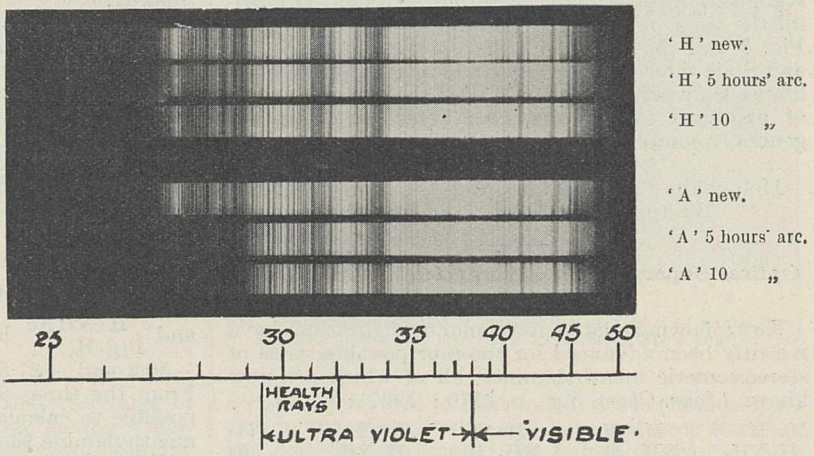

FIG. 2.—Comparative artificial ageing of glasses 'H' and 'A'.

This is contrary to my experience and to that of independent investigators who have made a detailed study of the subject, as shown by the following data. At the beginning of last January I took pieces of five types of ultra-violet glass, each cut into a number of sections. One section of each was preserved in its new condition, the others were exposed in a horizontal roof for periods of 1, 2, 3, 6, and 10 months, after which period, photographs of their transmissions were taken. Since a glass 'S' shows this solarisation effect better than most of the others and much more pronouncedly than the glass 'H', its transmission photograph is reproduced to illustrate

the results (Fig. 3). This photograph clearly shows that, though the first month's exposure is most effective, the loss of transparency proceeds to a marked extent during the second and third months, and at a slower rate even up to six months. There appears to be no appreciable change after the lapse of six months—as shown by the transmission of the samples exposed for six and ten months. In considering these results it must be remembered that the first three months of exposure were comparatively sunless winter months, while the later months were particularly bright and sunny.

Coblentz and Stair, in a recent paper from the Bureau of Standards, show that a sample of an ultra-violet glass, exposed at Washington from October

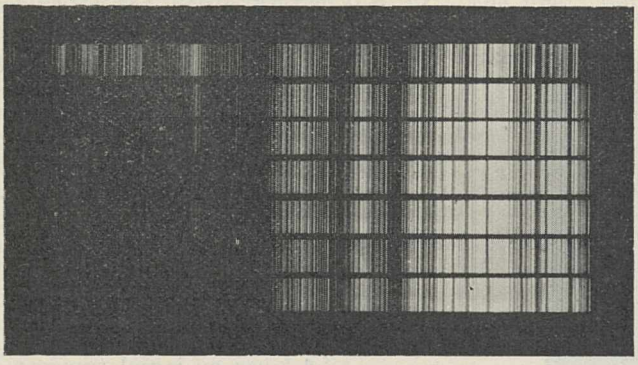

FIG. 3.—Natural solarisation of glass 'S'.

1927 to June 1928, suffered a reduction of transparency from an initial value of 55 per cent at 3020 A. to 48 per cent after one month, to 47 per cent after three months, to 45 per cent after six months, and to 43 per cent after nine months. They express the opinion that this photochemical change may require several years' exposure to the sun before a state of perfect stabilisation is reached. Whether this is a too pessimistic view or not, the photograph reproduced in Fig. 3 and the general results obtained by Coblentz and Stair show conclusively that, though the greatest loss of transparency occurs during the first few weeks of exposure to the sun, this deterioration is not generally complete until after the lapse of six months.

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Optical Superposition among Menthylamines and Menthols.

THE following relative molecular configurations have recently been advanced for the four possible series of stereoisomeric menthylamines, all of which are now known (*Jour. Chem. Soc.*, p. 2170; 1927):

Me|H	Me|H	Me|H	Me|H	. . (1)
H|NH_2	NH_2|H	NH_2|H	H|NH_2	. . (3)
H|Prβ	H|Prβ	Prβ|H	Prβ|H	. . (4)
l-Menthylamine.	*d-neo-*	*d-iso-*	*d-neoiso-*	

The respective values of $[\alpha]_D$ (in chloroform) for the acetyl-derivatives are $-81{\cdot}7°$, $+53{\cdot}0°$, $+30{\cdot}7°$, and $-2{\cdot}6°$. The sum of any two of these values is approximately equal in magnitude and opposite in sign to the sum of the other two; and from a series of observations which we have just concluded upon 14 other derivatives of each base we find that this curious relationship holds generally for menthylamine derivatives of the type $R{\cdot}CH_2{\cdot}CO{\cdot}NH{\cdot}R'$, and for the free bases; it obtains, moreover, for $[\alpha]_{5461}$, as well as for $[\alpha]_D$. When R is phenyl and the adjacent methylene group is simultaneously eliminated, the relationship fails; nor is it evident in derivatives of the type $R{\cdot}CH:NR'$.

Upon selecting a suitable derivative, for example, the acetyl derivative, and superposing the four configurations shown above, it is found that the algebraic sum of the four values of $[\alpha]_D$ approximates to zero. In the process of superposition, the optical effects of the asymmetric groups (3) and (4) would appear to undergo a mutual neutralisation, owing to the opposed spatial dispositions of these groups in the various molecules. The possibility of such an annulment is not immediately obvious, however, for the asymmetric group (1), which has the same spatial disposition (that is, Me|H) in all four configurations. Unless the approach to a zero value is purely fortuitous, which appears improbable, a simple explanation may be sought in the assumption that the asymmetric group (1) exerts a numerically constant rotational effect in all four configurations, the positive or negative sense of which is determined by the nature of the attached complex group (*vide infra*). If, in two of the four instances, the effect is negative, and in the other two positive, the origin of the zero value is explained.

By taking the mean optical rotation of the *l*- and *d-iso*-acetyl derivatives, the rotational effect of the asymmetric group (1) is evaluated at 25·5 units, and the mean optical rotation of the *d-neo*- and *d-neoiso*-acetyl derivatives gives the almost identical result, 25·2 units: the average value is thus 25·4 units. Similarly, the average value for the combined rotational effect of the remaining asymmetric centres, (3) and (4), is 56·2 units for *cis*-H and 27·8 units for *trans*-H.

Proceeding now to a generalisation, it seems that in each of the eight stereoisomeric acetylmenthylamines the asymmetric group (1) has a constant value of 25·4 units of specific rotational power (in chloroform solution, for sodium light). When the configuration Me|H is attached to $\begin{matrix}H\\H\end{matrix}\Big|\begin{matrix}NHAc\\Pr\beta\end{matrix}$ or to $\begin{matrix}NHAc\\Pr\beta\end{matrix}\Big|\begin{matrix}H\\H\end{matrix}$ it exerts a lævo-rotatory effect; but when the same configuration is attached to $\begin{matrix}H\\Pr\beta\end{matrix}\Big|\begin{matrix}NHAc\\H\end{matrix}$ or to $\begin{matrix}NHAc\\H\end{matrix}\Big|\begin{matrix}H\\Pr\beta\end{matrix}$ its effect, although equal in magnitude, is dextro-rotatory. Further, the complex asymmetric groups $\begin{matrix}H\\H\end{matrix}\Big|\begin{matrix}NHAc\\Pr\beta\end{matrix}$ and $\begin{matrix}H\\Pr\beta\end{matrix}\Big|\begin{matrix}NHAc\\H\end{matrix}$ have respective constant values of $-56{\cdot}2$ and $-27{\cdot}8$ units of specific rotational power. From the three constants, 25·4, 56·2, and 27·8, it is possible to calculate the value of $[\alpha]_D$ for any acetylmenthylamine the relative molecular configuration of which is known. A similar statement applies to any menthylamine derivative of the type $R{\cdot}CH_2{\cdot}CO{\cdot}NHR'$ which we have examined up to the present. As an illustrative example, the configuration of acetyl-*d*-menthylamine may be selected: $\begin{matrix}H\\NHAc\\Pr\beta\end{matrix}\Big|\begin{matrix}Me\\H.\\H\end{matrix}$ The complex configurational unit $\begin{matrix}NHAc\\Pr\beta\end{matrix}\Big|\begin{matrix}H\\H\end{matrix}$ has the value $+56{\cdot}2$; Me|H attached to it has the value $-25{\cdot}4$, so that obviously the value for H|Me is $+25{\cdot}4$. Thus, $[\alpha]_D$ for acetyl-*d*-menthylamine is $56{\cdot}2+25{\cdot}4=+81{\cdot}6$.

It appears, then, that the magnitude of the optical

effect of the asymmetric group (1) is retained throughout the various stereoisomeric forms, independently of the other two asymmetric groups which are present. No corresponding constancy can be postulated, however, for either of the asymmetric groups (3) or (4), taken separately. A marked discrepancy is noticed when the rotational effect of either of them is calculated in two ways. Thus, the optical effects of the asymmetric groups (3) and (4) appear to undergo striking fluctuations, determined by their immediate environment in the molecule. The apparent constancy of the optical effect of the asymmetric group (1) may perhaps be correlated with the fact that there is no alteration in its immediate environment when it is rotated through an angle of 180°.

It will be of particular interest to conduct similar investigations with the menthols and their derivatives, when the complete series eventually becomes accessible. Meanwhile, a close parallelism is discernible between the optical rotations of the menthylamines and the corresponding menthols, so far as the latter are known. The following comparison of values of $[\alpha]_D$ is instructive :

	l-	*d-neo-*	*d-iso-*	*d-neoiso-*
Menthylamine (no solvent)	−43·2°	+15·1°	+28·8°	+0·3°
Menthol (no solvent)	−49·9	+19·6	—	—
Menthol (in alcohol)	−49·1	—	+27·0	?

Unfortunately, the specific rotatory powers of the *neo*menthols appear not to have been observed in alcohol; but from the data available for *l*-menthol (Gildemeister, "Die Ätherischen Öle", Leipzig, I., 469, 1928), the value may be accepted provisionally as being practically identical with that of the liquid substance. Applying, then, to the specific rotatory powers of the three known series of menthols processes similar to those developed above for the analogous menthylamines, the appended specific rotational values are calculable for the three fundamental asymmetric groups :

SPECIFIC ROTATIONAL VALUES FOR ASYMMETRIC GROUPS IN THE MENTHOLS—$[\alpha]_D$ IN ALCOHOL.

Me | H	H | OH H | Prβ	H | OH Prβ | H
±11·1	−38·0	−8·5

CORRESPONDING VALUES FOR THE MENTHYLAMINES—NO SOLVENT.

±7·5	−36·0	−7·4

The prediction may now be made that the value of $[\alpha]_D$ for the unknown *d-neoiso*menthol, having a configuration similar to that of *d-neoiso*menthylamine above (*Chemistry and Industry*, p. 873, 1927), will be $-8·5+11·1=+2·6°$.

It is possible in this place to give only a brief outline of the relationships concerned, and details will be published elsewhere. Further studies of this kind may be expected to throw a good deal of new light upon the so-called principle of optical superposition. The main obstacle to such work lies in the great difficulty of gaining access to complete stereoisomeric series of suitable substances.

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Structural Variation in the Chromosomes of *Campanula persicifolia*.

CHROMOSOME behaviour at meiosis has been described in *Campanula persicifolia* to show the relationships of diploid, triploid, and tetraploid forms.[1] The haploid number is eight. In the diploid, as a rule the chromosomes are associated at both ends forming rings, but occasionally association at one end gives a rod. In the tetraploid, the majority of the chromosomes still associate in pairs, but this is varied by the formation of rings and chains of four as well as by failure of pairing. In the triploid the third chromosome is occasionally associated with its homologues in a chain, but more usually free. The end-to-end association always found at metaphase follows terminalisation of from two to five interstitial chiasmata found at a diplotene stage characteristic of parasynapsis. This terminalisation accounts for the failure of quadrivalents by the cancellation of chiasmata.[2] We may therefore speak of the chromosomes as being joined at metaphase by terminal chiasmata with an approximate average of two to each chromosome.

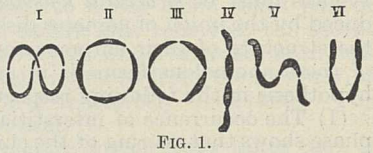

FIG. 1.

In plants from two sources, anomalous chromosome behaviour has been found at meiosis : (i) a white double variety in cultivation; (ii) a type form found wild at Gmunden, Austria (two seedlings). These have, instead of eight rings of two at metaphase, six rings of two and one group of four which takes the forms shown in Figs. 1 and 2.

The types are given in order of frequency. The last three, in which one of the four chiasmata necessary for a ring may be said to have failed, are in small proportion in the white double and have not been found in the Austrian seedlings. The failure of two or three chiasmata, giving two pairs or actually unpaired chromosomes instead of the ring of four, has been observed occasionally in both forms.

FIG. 2.—Microphotographs of metaphase × *ca.* 1500 : *a*, normal type; *b-d*, structural hybrid type; *a*, 8 bivalents; *b*, type I. ring; *c*, type III. ring; *d*, type IV. chain.

Specific properties of ring formation are inherited. Twenty-nine plants were raised from the cross white double by the seedling from Murols (Puy de Dôme). Of four that were examined, three had the ring of four as in the female parent, one had simple pairing (8 bivalents).

The somatic complement has been examined in several stocks (Fig. 3). Some (for example, Murols and Varna) have all chromosomes medianly con-

[1] Gairdner, *Jour. Genet.*, **16**; 1926.
[2] Darlington, *Jour. Genet.*, **21**, iii.; 1929.

stricted; others (for example, Gmunden) have five of the eight pairs with subterminal constrictions. Other more complex structural changes are still under investigation.

It has been suggested that the parasynapsis (side-by-side conjugation) of homologous parts of chromosomes is a universal condition of meiosis [3] and that therefore the association of more than two chromosomes in a diploid must always be due to the interchange of segments between non-homologous chromosomes in the complement of one parent (an explanation already proposed in the case of *Datura* [4]). Such diploid zygotes must be *structural hybrids*, for they are produced by the union of gametes dissimilar in respect of the structure of their chromosomes. The behaviour of these anomalous forms is in agreement with this hypothesis in the following respects:

(1) The occurrence of interstitial chiasmata at prophase shows that pairing of the chromosomes in *Campanula* is by parasynapsis. The end-to-end pairing is a secondary condition of known origin.

(2) The ring of chromosomes (here, as in *Pisum* [5]) may be represented as consisting of four segments *A*, *B*, *C*, and *D* occurring as chromosomes *AB* and *CD* in the complement derived from one parent, *BC* and *DA*

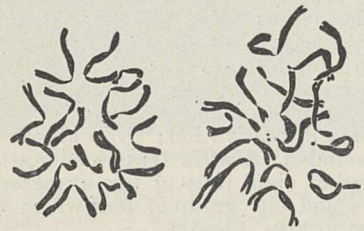

FIG. 3.—×2000.

in the complement derived from the other. Then, since each of the segments has the specific property of pairing with an identical segment, the only configuration possible will be (i) the ring, and (ii) chains derived from the ring by failure of one or more chiasmata in the ring. Configurations of the *X* and *Y* shapes found in tetraploids and depending on the formation of multiple chiasmata between the ends of several segments do not occur.

(3) The orientation of the ring when formed is in no way different from that found in *Œnothera* or *Rhœo*.[2] That is to say, apart from the usual segregation of pairing chromosomes to opposite poles, non-disjunction may occur (type III.). These variations occur equally in tetraploid *Tradescantia* [2] and *Primula sinensis* (unpublished).

(4) As in the tetraploid form,[1] so with four associated chromosomes in the diploid, failure of pairing sometimes occurs. The regularity of pairing should depend on the length of the segment of chromosome exchanged.[2]

(5) The ring of four in the diploid is more constant than in the tetraploid, because in the absence of competition there can be no cancellation of chiasmata.

(6) As in *Œnothera*, *Rhœo*, and *Datura*, the specific pairing properties of the chromosomes are inherited unchanged.

(7) Different races of *C. persicifolia* have visible structural differences in their chromosomes. Structural variation is a necessary antecedent of structural hybridity, but has not previously been demonstrable in the somatic chromosomes except in a tetraploid, *Tradescantia virginiana*.[2]

[3] Darlington, *Jour. Genet.*, **20**, iii. and **21**, i. and ii.; 1929.
[4] Belling and Blakeslee, *Proc. Nat. Acad. Sci.*, **12**; 1926.
[5] Richardson, *Nature*, **124**, Oct. 12, 1929.

On these grounds we conclude that the present observations show in *Campanula persicifolia* the incipient stages of structural hybridity. They provide another valuable link connecting the complex permanent structural hybrids in *Œnothera* and *Rhœo* with everyday homozygous organisms, and thus enable us to regard all types of diploid ring formation as due to a modification of the results of ordinary parasynapsis produced by this condition of structural hybridity.

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Optical Anisotropy and Theoretical Intensities of Raman Lines in Diatomic Gases.

WE wish to consider the scattering bound with the vibrational transitions $|\Delta v| = 1, 2\ldots$(Raman lines) and $\Delta v = 0$ (Rayleigh lines). In each case there is a well-known [1] selection rule for the rotational transitions $\Delta j = 0, \pm 2$. The plus sign gives rise to a double *R*-branch, the minus sign to a double *P*-branch, and $\Delta j = 0$ to a *Q*-branch. Initial and final states correspond to an electronic ground level $^1\Sigma$.

In the case $\Delta v = 0$, a discussion of the Kramers-Heisenberg dispersion formula leads to the following values for the scattering moment; $M(\pi)$ and $M(\sigma)$ are respectively the components parallel and perpendicular to the electric field E of the plane polarised monochromatic incident light wave: *R*-and *P*-branch, $\Delta v = 0$, $j \longrightarrow j \pm 2$:

$$M^2(\pi) = E^2\gamma^2 . 2/15 . J(j \pm 1) \quad M^2(\sigma) = E^2\gamma^2 . 1/10 . J(j \pm 1)$$

Q-branch, $\Delta v = 0$, $j \longrightarrow j$:

$$M^2(\pi) = E^2\zeta^2(2j+1) + E^2\gamma^2 I(j) \quad M^2(\sigma) = E^2\gamma^2 . 1/15 . J(j)$$

where $J(j) = j(j+1)/(2j+1) . I(j)$ is a rational function of j which reduces to $2j/45$ for large values of j. ζ and γ are defined as

$$\zeta = (\alpha + 2\beta)/3 \qquad \gamma = \alpha - \beta$$

where, as seen below, the constants α and β represent the influence of the electronic levels only on the intensity of the scattered lines. The relations are sums taken over the $(2j+1)$ degenerate rotational states.

In the case $v - 1 \rightleftarrows v$, similar expressions are obtained, with the difference, however, that α and β are replaced by $\kappa\alpha'\sqrt{v/2}$ and $\kappa\beta'\sqrt{v/2}$, where $\kappa^2 = \nu_{rot}/\nu_{osc}$ ($\kappa = 1/10$ to $1/50$; $\nu_{rot} = h/4\pi^2 I$, I moment of inertia; ν_{osc} = frequency of oscillation in the ground level). If $|\Delta v| = n$, the scattering moment is proportional to κ^n and to $\alpha^{(n)}$ or $\beta^{(n)}$.

Denoting by $\alpha(R)$ the electronic polarisability of the molecule along its axis of symmetry, the nuclei being a fixed distance R apart, the following connexion is found for the α's

$$\alpha(R) = \alpha + \alpha'(R - R_0)/R_0 + \ldots \quad \alpha^{(n)}[(R - R_0)/R_0]^n \ldots$$

where R_0 is the nuclear distance in the position of equilibrium of the ground level. Similarly, $\beta(R)$ means the polarisability along any direction perpendicular to the axis. Only matrix elements of electronic transitions from the ground level Σ to any Σ level enter into the expression for α, and to any Π level for β. Both α and β vary slowly with the incident frequency, except in the neighbourhood of an electronic frequency of absorption.

An apparently good check on the formulæ was obtained on comparing with the photographs for gaseous hydrogen made by Rasetti.[2] The formulæ still show that the depolarisation of any line in the

[1] E.C. Kemble and E. Hill, *Proc. N. A. S.*, **15**, 387; 1929. F. Rasetti, *ibid.* **15**, 515; 1929.
[2] F. Rasetti, *Phys. Rev.*, **34**, 367; 1929.

P- or R-branch, that is, the ratio of its σ to π components, observed in a direction perpendicular to E, *should be the same and equal to 3/4* for *all diatomic molecules*, irrespective of the incident frequency and the temperature.

The total intensity of each *unresolved* branch can be calculated. For temperatures not too much below the room temperature, the intensity of the Q-branch remains nearly constant, whereas there is a *dissymmetry* in the intensities of the P- and R-branches, the R-branch, on the low frequency side, being the stronger the more the temperature is decreased. Thus, the total unresolved P-Q-R-line should be *diffuse*, with a slight apparent shift of the centre of gravity of the line towards the red. This dissymmetry should usually be more pronounced for the σ- than for the π-component. The effect, which seems to exist in vapours,[3] is, however, insufficient to account for the large frequency shift of the scattered lines towards the red, observed in such liquids as ammonia and hydrogen chloride.[4]

Finally, the intensities in the P- and R-branches are proportional to the factor of *optical anisotropy* $\gamma^2 = (\alpha - \beta)^2$, for the intensities vanish when $\alpha = \beta$, that is, when the electronic polarisation is the same in every direction. A connexion between diffuseness of the lines and optical anisotropy has been noticed experimentally by Raman.[5] A slight dependence on the incident frequency is also to be expected for the anisotropy.

The relative scattering intensities of a Rayleigh and the related Raman lines corresponding to transitions from the same vibration level are in the ratios $\epsilon^2 : (\epsilon')^2\kappa^2 : (\epsilon'')^2\kappa^4$ where $\epsilon^{(n)}$ means a quantity of the order of magnitude of $\alpha^{(n)}$ and $\beta^{(n)}$. As has been emphasised elsewhere,[6] the presence of the factor κ^2 explains why harmonic Raman lines, when they can be detected, are so faint. One must, however, take into consideration the additional influence of the electronic levels, as marked by the ϵ's, which may modify somewhat the expected intensity ratios. Moreover, the dependence on the frequency may also not be the same for the different ϵ's, although the trend of variation remains. Thus it can be explained why it is that the ratio of intensities of the Raman and Rayleigh lines has not been found to be rigorously independent of the incident frequency.[5]

Although the theory has been developed for diatomic molecules, it seems that some of the preceding conclusions can be extended to polyatomic molecules. The only assumption made in deducing the above results is that the molecule is stable in the ground state. The rapidity of convergence of the expansion for $\alpha(R)$ is immaterial.

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Intermetallic Compounds in Mercury.

ATTENTION has not previously been directed to the possibility of formation of intermetallic compounds (other than with mercury) in liquid mercury. It is expected *a priori* that if such compounds are formed they would be unstable. With Mr. P. V. F. Cazalet I am investigating this problem and our preliminary results are given below.

Pairs of metals more reactive than mercury have been obtained in mercury either by direct solution or by electrolysis. These mixed amalgams have been subjected to the action of potassium permanganate or other oxidising agents in sulphuric acid solution and the resultant solution of sulphates quantitatively analysed. So far, in none of the reactions investigated does mercury itself take part. The reactions occurring may be classed under three heads, namely:

(1) The more reactive metal is completely removed from the amalgam before the second takes part in the reaction. This occurs with cadmium and copper, cadmium and iron, lead and copper, lead and iron, the first-named in each case acting as the more reactive metal.

(2) The more reactive metal alone takes part in the reaction, then, before it is removed, the second metal begins to take a part which increases until both metals are completely removed from the mercury, at which stage the first is scarcely detectable. This occurs with tin and iron.

(3) The more reactive metal alone takes part in the reaction until its concentration (in atoms), relative to that of the second metal in the amalgam, is represented by a simple ratio. Then, and until both metals are completely removed by the oxidising agent from the amalgam, does the atomic ratio of the metals taking part in the reaction remain simple and constant. This occurs with tin and copper, zinc and copper, zinc and iron, copper and iron.

These 'constant-reducing' mixtures of metals behave in each case like an amalgam containing the less reactive metal, and certainly markedly different from an amalgam of the more reactive metal as regards solubility in mercury, action on acids, and action on certain oxidising agents. For example, whereas zinc is soluble in mercury to the extent of about 1 per cent, the zinc-copper complex is totally insoluble; whereas zinc in mercury reduces quinquevalent vanadium to the divalent state without difficulty, the zinc-copper complex reduces it only to the quadrivalent state. Again, whereas tin in mercury (as in the free state), when oxidised by ferric sulphate, pauses in the stannous condition before being oxidised gradually to the stannic condition, the tin-copper complex may be shown to be oxidised directly to the stannic condition.

The complexes examined tend on standing to dissociate into the more reactive metal, and either the less reactive metal or a similar complex richer in the less reactive metal. Vigorous shaking prevents the dissociation or restores the association. The empirical formulæ of the complexes so far obtained are $SnCu_2$, $SnCu_3$, $SnCu_4$, ZnCu, ZnFe, $ZnFe_3$, and CuFe. The second and fourth of these are known to metallurgists, and the third may possibly be the known compound Sn_8Cu_{31}. Whether these complexes are true compounds, however, must depend upon how accurately their analysis gives a simple ratio of atoms and upon their examination after removal from suspension in mercury.

A. S. RUSSELL.

Dr. Lee's Laboratory,
Christ Church, Oxford,
Dec. 21, 1929.

Some Bands of the Carbon Molecule.

IN a recent communication (NATURE, Jan. 11), Dieke and Holtgreven have given details of a new system of the C_2 molecule. The band heads (degraded to the ultra-violet) have long been known from the work of Deslandres and D'Azambuja (*vide* Kayser's "Handbuch", vol. 5, p. 234), while in 1916, Raffety (*Phil. Mag.*, vol. 32, p. 546) recorded four of the strongest bands as associated with the Swan bands under his experimental conditions. Vibrational and fine structure analysis have now been made for the first time by

[3] J. Cabannes and P. Daure, *C. R.*, **186**, 1533; 1928. A shift of 0·01 A. for butane vapour at normal pressure.
[4] P. Daure, Thèse, Paris, 1928. Shift of 100 cm.$^{-1}$ for the 'missing' line in liquid hydrogen chloride and of 20 cm.$^{-1}$ for the Q-branch at 3μ in liquid ammonia.
[5] C. V. Raman and K. S. Krishnan, *Proc. Roy. Soc.*, A, **122**, 23; 1928.
[6] *Naturwiss.*, **17**, 364; 1929. Also J. H. van Vleck, *Proc. N. A. S.*, **15**, 754; 1929.

Dieke and Holtgreven, making this the third known system of the C_2 molecule.

I had also recently made a vibrational analysis and a partial rotational analysis of this system, and my conclusions are in substantial agreement with these workers. Although there is no state in common with the three known ($^3\Pi$) states of this molecule, there is ample evidence both from experimental conditions and fine structure analysis that the emitter is C_2. The characteristic 'staggering' of the structure lines due to σ-type doubling, combined with alternate missing levels due to symmetry of the molecule is very evident, and the transition $^1\Pi \rightarrow {}^1\Pi$ is without doubt correct. I have obtained plates of these bands in the first order of a 21-ft. grating, and wave-lengths of the heads are given in the accompanying table:

Int.	Wave-Length (Heads).	ν (in Vacuo).	n'.	n''.
5	3398·12	29419·6	3	1
5	3399·73	29405·7	2	0
7	3587·65	27865·5	3	2
7	3592·9	27824·8	2	1
8	3607·3	27713·7	1	0
5	3825·65	26132·0	1	1
10	3852·2	25951·9	0	0
1	4026·92	24825·9	3	4
3	4041·80	24734·5	2	3
6	4068·14	24574·3	1	2
9	4102·28	24369·8	0	1

In view of the higher resolving power used by Dieke and Holtgreven, it is unnecessary to enter into further detail of fine structure analysis. It may be mentioned that the system appears well in a tube containing carbon electrodes and a little hydrogen together with 30-40 mm. pressure of argon, and it has also been produced under high temperature conditions in the carbon arc in hydrogen.

The data suggest that one (or more) of the initial vibrational levels is considerably perturbed, although it is not possible to specify precisely which, on the evidence at present available.

In conclusion, it may be mentioned that it seems just possible that the strong (0, 1) sequence of this system may be contributory to the strong condensation in cometary spectra which centres about the wave-length λ4050 (*vide Monthly Notices R.A.S.*, vol. 87, p. 625, 1927).

R. C. JOHNSON.

King's College,
Strand, W.C.2.

Crystalline 'Menformon'.

FOUR years ago we gave the name 'menformon' to a female sexual hormone, which name, as distinct from other denominations, included in its definition a certain degree of purity of the product. The biological and chemical properties of the substance were described in detail in various communications, to which one about its influence upon the plumage of the fowl was added recently.[1]

About a year and a half ago we reached a degree of purity of 10,000,000 units per gram[2] by means of methods described by us.[3]

In August last Doisy presented a communication to the Physiological Congress in Boston, according to which he has obtained crystals containing 8,000,000 units per gram. Recently Butenandt described crystals again of the same degree of purity.[4] Since this substance is not purer than that previously described by us, the giving of a special name to the crystalline hormone, 'progynon', seems unnecessary.

Recently Dr. J. R. Katz was kind enough to control our own preparations by means of X-ray spectrography and found the structure undoubtedly to be crystalline. Since last June we have obtained more of the substance partially purified by methods based on the idea that menformon is acidic in character. With these larger quantities we have now succeeded in obtaining macro-crystals in the form of colourless platelets, similar to those described by Doisy and by Butenandt and have been able to demonstrate that these crystals yield the same X-ray spectrum as our earlier preparations of the same degree of purity. They could be repeatedly recrystallised out of 70 per cent alcohol.

While in our earlier experiments with less pure material in a vacuum of about 0·4 mm. at a temperature of 200° C., we were unable to obtain trustworthy information concerning the possibility of distillation, we have now succeeded, like Butenandt, in subliming the material at a pressure of about 0·01 mm. and 130°-150° C. It is uncertain whether any further purification was obtained thereby. The analyses so far carried out have yielded results similar to those of Butenandt, that is, 78·61 per cent carbon, 8·25 per cent hydrogen. As we were able to show several years ago on less purified preparations, the crystals are free from nitrogen, sulphur, and phosphorus. Experiments of Dr. Katz on the spreading of the substance in a monomolecular layer on water yielded very delicate films. The degree of spreading suggests that the substance under investigation contains not more than 25 carbon atoms.

We may mention that during the purification of the raw material obtained from the urine of pregnant women, other crystals are also encountered, which through all the initial phases were associated with the active substance (melting point, 235° C.; carbon, 78·1 per cent; hydrogen, 11·5 per cent). The X-ray spectrum of these crystals is different from that of menformon. This substance contains an OH group, because it may be acetylated and the acetyl derivative saponified. Crystals of this description have been recently found by Marrian[5] and characterised as an alcohol of a formula C_{19} – C_{20}.

Whether crystalline menformon of the above mentioned purity (8-10 million units per gram) really constitutes the pure hormone, is not quite certain, in which respect we agree with the cautious expression of Doisy[6] at the Congress. In spite of careful recrystallisation, adsorption of the active substance on the crystals cannot be excluded. The objective reason for our doubt is that we have succeeded in three cases up to the present in producing a substance of an activity of 14,000,000 units per gram.

E. LAQUEUR.
E. DINGEMANSE.
S. KOBER.

Pharmaco-therapeutic Laboratory of the University of Amsterdam and the Chemical Research Laboratory of the Organon Oss. Co., Ltd.
Dec. 13, 1929.

Preparation of Œstrin.

RECENT work from several laboratories strongly suggests that the œstrus-producing hormone is a substance possessing weakly acidic properties. If this is so, the methods in general use for the preparation and purification of the hormone, involving as they do numerous extractions with fat solvents from neutral or alkaline aqueous media, must result in great losses of

[1] *Proc. Roy. Acad. Amsterdam*, **32**, 1929.
[2] *Jour. Pharmacol. and Exp. Therapeut.*, **36**, No. 1, 1929.
[3] *Lancet*, May 28, 1927.
[4] *Naturwissenschaften*, **17**, p. 379; 1929.
[5] *Biochemical Jour.*, **23**, No. 5; 1929.
[6] *Nederl. Vereen. voor Bioch.*, Nov., *Chem. Weekbl.*, 1929.

the active material. This is borne out by the observation of Miss M. Hill, privately communicated to me, that urine extracted as many as twelve times with ether may still contain large amounts of œstrin.

If the urine is acidified before ether extraction, the yields of œstrin obtainable can be very greatly increased. Three successive batches of fifty litres of urine treated in this manner yielded 2,069,000, 980,000, 1,000,000 mouse units, tested by the method recently described in the *Journal of Physiology* by Dr. A. S. Parkes and myself. The error in this method is little, if any, more than ± 10 per cent.

Saponification and subsequent ether extraction of such crude ether-soluble material, although effecting considerable purification, results in the loss of a great part of the total activity. This loss can be minimised by saturating the saponified mixture with carbon dioxide before ether extraction (paper in press). The material obtained in this way can be further purified by extraction with ice-cold acetone, extraction with ice-cold 50 per cent alcohol, and finally extraction from ethereal solution with aqueous potash. The active material may be extracted from this alkaline solution with ether after acidification. The total loss of activity throughout the whole process of purification has been found to be approximately 40 per cent. As the following table shows, practically the whole of this loss occurs in the initial saponification.

	Wt. (gm.).	No. M.U.	Wt. 1 M.U. (mgm.).	Yield M.U. per litre.	Loss per cent.
Total ether sol. material from 501 of urine . .	22	2,069,000	0·0106	41,380	..
Unsap. matter (after CO_2 treatment) .	2·845	1,278,000	0·00223	25,560	38
Acetone sol. .	2·456	1,236,000	0·00199	24,720	40
50 per cent alcohol sol. .	0·742	1,236,000	0·000600	24,720	40
Alkali sol. .	0·364	1,208,000	0·000301	24,160	41·5

Similar results have been obtained with several other batches of urine.

The most potent preparation of œstrin obtained by me by these methods had an activity of 8 million mouse units per gram. This is of the same order of activity as the pure crystalline hormone described by Dr. A. Butenandt, of Göttingen, in a preliminary communication. The latter, however, injects his material dissolved in oil in a single dose. It is therefore somewhat difficult to compare the activity of the crystalline hormone with my obviously impure preparations.

G. F. MARRIAN.
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University College, London,
Dec. 23, 1929.

The Product of the Radioactive Disintegration of Potassium.

DIE obige Mitteilung der Herren Frost (NATURE, Jan. 11), deren Korrekturbogen mir durch die Freundlichkeit des Editor der NATURE zur Einsichtnahme vorgelegt wurden, interessiert mich in ganz besonderem Masse, da ich derzeit mit dem Studium der gleichen Frage beschäftigt bin.

Zu den Atomgewichtsbestimmungen der beiden Autoren möchte ich mir die Bemerkung erlauben, dass es mir zu gewagt erscheint aus den mitgeteilten Analysenresultaten weitgehende Schlüsse in der so wichtigen Frage nach der Existenz eines durch radioaktive Umwandlung des Kaliums entstandenen Calciumisotops zu ziehen.

Um Atomgewichts-Unterschiede der Isotope experimentell festzustellen, muss man zunächst über eine zuverlässige Bestimmungsmethode, die genügende Genauigkeit garantiert, verfügen. Die von den beiden Autoren angewandte Methode, Umwandlung des $CaCl_2$ in $CaBr_2$, arbeitet zwar bei richtiger Ausführung, wie ich mich bei meiner Atomgewichtsbestimmung des Radiums überzeugen konnte, sehr gut und sicher, dennoch lieferte sie hier recht unsichere Werte. Beträgt doch die maximale Differenz der drei mit gewöhnlichem Calcium ausgeführten Vergleichsbestimmungen 0,1 Einheiten des Atomgewichtes, ist also fast ebenso gross wie die festgestellte Differenz der Mittelwerte der Atomgewichte der beiden Calciumproben, die nur 0,12 Einheiten erreicht.

Ferner muss es nach den bisherigen Mitteilungen fraglich erscheinen, ob die beiden Calciumproben in Bezug auf chemische Reinheit vergleichbar waren, da der spektroskopische Nachweis für die Abwesenheit der schweren Calciumhomologen, Strontium und Barium, fehlt. Die von den Autoren angewandte Reinigungsmethode, wiederholte Fällung des Calciumsulfats und Oxalats, habe ich bei der Herstellung meiner atomgewichtsreinen Calciumpräparate, die auch gerade jetzt in meinem Laboratorium durchgeführt wird, niemals versucht, da ich sie von vornherein für nicht ausreichend erachten muss.

Bevor man zu der grundlegenden Frage nach der Existenz des aus Kalium entstandenen Calcium-Isotops Stellung nehmen kann, wird man die angekündigten weiteren Versuche der beiden Autoren abwarten müssen, die mit grösseren Materialmengen ausgeführt hoffentlich zuverlässigere Atomgewichtswerte liefern werden.

O. HÖNIGSCHMID.
München.

Preparations of Protozoa and Algæ.

WISHING to get some permanent preparations of the Protozoa of West African forest pools, I have adopted a simple little technique which if not known is worth publication. Two clean cover glasses are tied together back to back with thread, one end being left long. They are suspended in the water with the lower edge just touching the bottom and sloping somewhat. They are left for several days and then lifted out and immersed at once in alcoholic Bouin's fixative. Afterwards I stain with Erlich's acid hæmatoxylin, 1 in 20 or 30 per cent alcohol, 3 hours, differentiate in 1 per cent acetic acid in 70 per cent alcohol, 1-3 hours, no counterstain being needed. The cover slips may be kept tied together if desired up to the stage of dehydration. Most, if not all, of the species of Protozoa and Algæ which may be seen in the fresh sample can be found excellently fixed and stained in the mounted specimen.

LL. LLOYD.
Azare, N.P., Nigeria,
Nov. 3.

THE plan adopted by Dr. Lloyd is excellent, providing always that it is not frustrated by (*a*) wind and rain, (*b*) fish, or (*c*) hungry marauders. We adopted a similar plan in my tanks at Selsey when we were studying the bionomics of *Verneuilina polystropha* and *Massilina secans*. We hung cover slips (*a*) vertically, and (*b*) horizontally close against the sides of the tanks, and they collected satisfactory gatherings of 'primordials' and very young tests. I do not think it was an original operation, for I seem to remember having got the idea from something I had read.

EDWARD HERON-ALLEN.

The 'Wave Band' Theory of Wireless Transmission.

By Sir AMBROSE FLEMING, F.R.S.

IN scientific history we meet with many examples of scientific theories or explanations which have been widely adopted and employed, not because they can be proved to be true but because they provide a simple, easily grasped, plausible explanation of certain scientific phenomena. The majority of persons are not able to see their way through complicated phenomena and so thankfully adopt any short-cut to a supposed comprehension of them without objection.

Ease of comprehension is not, however, a primary quality of Nature, and it does not follow that because we can imagine a mechanism capable of explaining some natural phenomenon it is therefore accomplished in that way. There is a widely diffused belief in a certain theory of wireless telephonic transmission, and also of television, that for securing good effects it is necessary to restrict or include operations within a certain width of 'wave band'. But although this view has been very much adopted there is good reason to think that it is merely a kind of mathematical fiction and does not correspond to any reality in Nature.

Let us consider how it has arisen. We send out from all wireless telephone transmitters an electromagnetic radiation of a certain definite and constant frequency expressed in kilocycles. Thus 2LO London broadcasts on 842 kilocycles. This means that it sends out 842,000 electric vibrations or waves per second. Every broadcasting station has allotted to it a certain frequency of oscillation and it is not allowed to depart from it.

It is like a lighthouse which sends out rays of light of one pure colour or an organ which emits a single pure musical note. For most broadcasting stations this peculiar and individual frequency lies somewhere between a million and half a million per second, though for the long wave stations like Daventry it is so low as 193,000 or 193 kilocycles.

When we speak or sing or cause music to affect the microphone at a broadcasting studio the result is to cause the emitted vibrations, which are called the *carrier waves*, to fluctuate in height or wave amplitude, but does not alter the number of waves sent out per second. It is like altering the height or size of the waves on the surface of the sea without altering the distance from crest to crest which is called the wave-length.

Suppose the broadcasting station emits a carrier wave of frequency n and let $p = 2\pi n$. Then we may express the amplitude a of this wave at any time t by the function $a = A \sin pt$ where A is the maximum amplitude. If on this we impose a low frequency oscillation due to a musical note of frequency m and let $2\pi m = q$, then we can express the modulated vibration by the function

$$a = A \cos qt \sin pt.$$

But by a well-known trigonometrical theorem this is equal to

$$\frac{A}{2}\left\{\sin (p+q)t + \sin (p-q)t\right\},$$

and thence may be supposed to be equivalent to the simultaneous emission of two carrier waves of frequency $n+m$ and $n-m$.

If the imposed note or acoustic vibration is very complex in form, then in virtue of Fourier's theorem it may be resolved into the sum of a number of simple harmonic terms of form $\cos qt$, and each of these may be considered to be equivalent to a pair of co-existent carrier waves. Hence the complex modulation of a single frequency carrier wave might be imitated by the emission of a whole spectrum or multitude of simultaneous carrier waves of frequencies ranging between the limits $n+N$ and $n-N$, where n is the fundamental carrier frequency and N is the maximum acoustic frequency occurring and $2N$ is the width of the wave band. This, however, is a purely mathematical analysis, and this band of multiple frequencies does not exist, but only a carrier wave of one single frequency which is modulated in amplitude regularly or irregularly.

If the sounds made to the microphone at the broadcasting station are very complex, such as those due to instrumental music or speech, then in virtue of this mathematical theorem the very irregular fluctuations in amplitude of the single carrier wave can be imitated if we suppose the station to send out simultaneously a vast number of carrier waves of various frequencies lying between certain limits called the "width of the wave band".

This, however, is merely a mathematical artifice similar to that employed when we resolve a single force or velocity in imagination into two or more component forces. Thus, if we consider a ball rolling down an inclined plane and desire to know how far it will roll in one second, we can resolve the single vertical gravitational force on the ball into two components, one along the plane and one perpendicular to it. But this is merely an ideal division for convenience of solution of the problem; the actual force is one single force acting vertically downwards. Similar reasoning is true with regard to wireless telephony. What happens, as a matter of fact, is that the carrier wave of one single constant frequency suffers a variation in amplitude according to a certain regular or irregular law. There are no multiple wave-lengths or wave bands at all.

The receiver absorbs this radiation of fluctuating amplitude and causes the direct current through the loud speaker to vary in accordance with the fluctuations of amplitude of the carrier wave; the carrier wave vibrations being rectified by the detector valve.

The same thing takes place in the case of wireless transmission in television. The scanning spot passes over the object and the reflected light falls on the photoelectric cells and creates in them a direct current which varies exactly in proportion to the intensity of the reflected light. This photoelectric current is employed to modulate the amplitude of a carrier wave, and the neon lamp at the receiving end translates back these variations of carrier wave

amplitude into variations in the cathode light of the neon tube.

There is neither in wireless telephony nor in television any question of various bands of wave-length. There is nothing but a carrier wave of one single frequency which experiences change of amplitude. The whole question at issue then is, What range in amplitude is admissible ?

In the case of television it is usual for critics of present achievements to say that good or satisfactory television cannot be achieved within the limits of the nine kilocycle band allowed. But there is in reality no wave band involved at all. It is merely a question of what change in amplitude in a given carrier wave can be permitted without creating a nuisance.

It is something like the question : How loud can you whisper to your next neighbour at a concert or theatre without being considered to be a nuisance ? People do whisper in this way, and provided not too loudly, it is passed over. But if anyone is so ill-mannered as to speak too loudly he is quickly called to order, or turned out.

It is, however, not an easy thing to define a limit to wave amplitudes. They are measured in micro-volts per metre and are difficult to measure. But a wave-length is easy to define in kilocycles or in metres, and hence the method has been adopted of limiting emission to an imaginary band of wave-lengths which, however, do not exist.

The definition is imperfect or elusive. It is something like the old-fashioned definition of metaphysics as " a blind man in a dark room groping for a black cat which isn't there ". Similarly, the supposed wave band is not there. All that is there is a change, gradual or sudden, in the amplitude of the carrier wave. It is clear, then, that sooner or later we shall have to modify our code of wireless laws.

We have no reason for limiting the output of our broadcasting stations to some imaginary wave band of a certain width, say nine kilocycles or whatever may be the limiting width, but we have reason for limiting the range of amplitude of the carrier waves sent out.

Some easily applied method will have to be found of defining and measuring the maximum permissible amplitude of the carrier waves as affected by the microphone or other variational appliance. It may perhaps be thought that an unnecessary fuss is here being made on what may be regarded as simply a way of explaining things, but experience in other arts shows how invention may be greatly retarded by unessential official restrictions. Consider, for example, the manner in which mechanical traction was retarded in Great Britain for years by ridiculous regulations limiting the speed of such vehicles on highway roads. The only restrictions that should be imposed are those absolutely necessary in the interests of public safety or convenience, and all else tend to throttle and retard invention and progress.

The Growth of Education in India.[1]

IN 1928 the Indian Statutory Commission appointed an Auxiliary Committee to inquire into the growth of education. The Committee's views are now made public as an Interim Report of the Simon Commission. The Committee consisted of six members, of whom three are Indians. The minute of their appointment indicated that the Commission is primarily concerned with education in British India as bearing upon political and constitutional conditions and potentialities of progress. The Committee realised the limitations thus laid upon it, but had difficulty in confining itself to a consideration of the subject in this aspect only. So far, however, as this aspect is concerned, the result of the Committee's investigations, regarded as an index of administrative progress under the reformed constitution, is sufficiently disturbing.

" Throughout the whole educational system ", runs the Committee's Report, " there is waste and ineffectiveness. In the primary system, which from our point of view should be designed to produce literacy and the capacity to exercise an intelligent vote, the waste is appalling. So far as we can judge, the vast increase in numbers in primary schools produces no commensurate increase in literacy, for only a small proportion of those who are at the primary stage reach Class IV. in which the attainment of literacy may be expected. . . . The wastage in the case of girls is even more serious than in the case of boys."

Out of the meagre percentage (4·26) of the total population who are receiving instruction in recognised institutions, how many will retain any traces of literacy in after-life ? Nor is this all. The average pay of a primary school teacher in Bengal is about thirteen shillings a month ; in only two provinces are more than half of the primary teachers trained ; and, despite the increased number of institutions, the inspecting staff has in recent years been reduced. In the light of these facts, the Committee's approval of a policy of consolidation and improvement rather than of diffusion is less surprising than the declaration that the adoption of compulsion is important and urgent as an effective means of checking the wastefulness of the present system.

The Committee views the condition of secondary education with greater complacency—a complacency which is not shared by one of its members, Sir Amherst Selby-Bigge. The average annual cost of a pupil in a secondary school in Bengal is forty-five shillings. In the same province only twenty per cent of the secondary teachers are trained. The curriculum is narrow and, together with the teaching, is dominated by the matriculation

[1] Indian Statutory Commission. Interim Report of the Indian Statutory Commission (Review of Growth of Education in British India by the Auxiliary Committee appointed by the Commission), September 1929. (Cmd. 3407.) Pp. xxxiii+401. (London: H.M. Stationery Office, 1929.) 4*s*. net.

examination. From Bombay (where such schools are maintained at a far higher cost than in Bengal) it is reported that "with every increase in the numbers of those taking secondary education there is a fall in the standard of efficiency, owing chiefly to the fact that lower and lower strata are being tapped, and the majority of those who pass the school-leaving examination are altogether unfit for higher studies". The Committee endorses this last criticism when it comments adversely on the inadequate qualifications of high school students who enter upon university courses; "a low standard of university work means a low standard of school work". It admits that there are grave defects in the organisation of secondary education. It considers that there has been an advance in some respects; but the reader is tempted to ask from what level, and by what gauge, the progress is to be measured.

On the subject of higher work in the universities, the Report says that lists of original study recently published by university teachers and students and by institutions like the Indian Institute of Science at Bangalore, the Jagadis Bose Institute, and the Government Research Departments, show that a considerable advance has been made. The research carried out, both in arts and in science, at the University of Dacca is specially mentioned. The growth of honours schools and of post-graduate courses in the universities generally is regarded as a welcome sign. But it is inevitable that an inquiry into education as a factor in the creation of good citizens should deal mainly with the qualifications of the average product of the universities. "There are unmistakable indications", says the Report, "that the standards in some of the universities are not satisfactory." Indeed, signs of deterioration are observed. "There is no evidence of any improvement in entrance standards between 1918–19 and 1924–25, yet the number of passes at the B.A. and B.Sc. degree examinations rose in those years from 50 per cent. to over 70 per cent." Some of the witnesses asserted that "the student of the present day is not equal, either in the width of his information or in the range of his interests, to the student of an older generation." It is interesting to find this view borne out by the "Ninth Quinquennial Review of Indian Education", the appearance of which synchronised with that of the Committee's Report. This review, commenting on the subordination of teaching to examination, says that "it is still rare to find in any candidate, however proficient he may be in the subjects which he offers for examination, any evidence of that background of wider interest which can only be acquired by general reading and observation outside his prescribed course of study". In confirmation of this, answers are quoted which were given by fifty-five graduates of one of the universities to questions asked in a simple paper on general knowledge. Among the astonishing results, fifteen of these graduates recommended charms and incantations as a cure for snake-bite.

Defective teaching in secondary schools, easy admission to colleges and the tyranny of examinations are obvious causes of this state of affairs. The remedy is less obvious. The Commission (known as the Sadler Commission) which was appointed in 1917 to inquire into the affairs of the University of Calcutta, made two admirable suggestions. One was the relegation of the first two years of college instruction (called the Intermediate stage) to separate institutions organised less on collegiate than on school lines. The other was the creation of a new type of unitary teaching and residential university. In Calcutta itself these proposals fell on deaf ears. Elsewhere (notably in the United Provinces) attempts have been made to give effect to them in a greater or less degree. The "Quinquennial Review" says that but little has been accomplished in respect of the former of these recommendations—the establishment of Intermediate Colleges—and that the experiments are not on the whole very hopeful. The Committee accounts for this failure by the fact that in many cases these institutions have not been established under the conditions recommended by the Sadler Commission. The second suggestion is in part responsible for the large increase in the number of universities of British India—from five in 1915 to fifteen to-day. But of these fifteen only five are unitary; and the "Quinquennial Review" points out that the two universities created during the last quinquennium have reverted to the affiliating type and that the University of Rangoon also has assumed affiliating functions.

The Committee justly remarks that the affiliating university is likely to remain for many years to come; and it may be noted as a sign of grace that it now generally participates in the work of higher teaching. But it might have been hoped that the establishment of unitary universities, with their greater concentration of teaching effort and of social amenities, would gradually reduce the number of scattered colleges (often ill-staffed and ill-equipped) which prepare the majority of students for the examinations of an affiliating centre. Instead of this, there has been a new growth of these affiliating and examining centres, with the danger, as the Committee more than hints, of unwholesome competition; and the number of affiliated arts colleges has actually risen from 152 in 1922 to 232 in 1927. The task of university reform in India is Sisyphean. Well may the Committee ask whether "the time has not come when all efforts should be concentrated on improving university work, on confining the university to its proper function of giving good advanced education to students who are fit to receive it, and, in fact, to making the university a more fruitful and less disappointing agency in the life of the community".

Other points in this Report are no less disquieting. The Central Advisory Committee and the Bureau of Education, which constituted practically the last links between the Government of India and educational problems, have been abolished. The Committee regrets their disappearance; for, though the reforms have favoured expansion,

" much of that expansion has been on ill-considered lines and neglectful of the proposals made by the Government of India previously to the reforms ". Education, as a transferred subject, is now in the hands of ministers in the provinces. A tribute is paid to the zeal and ability which these ministers bring to bear upon their task. But the position of a minister is unstable. He cannot easily escape from adverse influences. It was represented to the Committee that in some provinces he had exercised pressure on the Director of Public Instruction in the matter of appointments and promotions on political and irrelevant personal grounds. Moreover, he has to work through various agencies, such as local bodies, which, the report notes as a distressing feature, " have in many instances gravely abused their powers for political and other purposes ". He is likewise largely dependent on the services which deal directly with education. The Indian Educational Service, " with its fine traditions of integrity and devotion to duty ", is moribund. The Committee declares that its progressive extinction, accompanied by the failure to reconstitute the provincial Services, " has been disastrous to the organisation of Indian education ". " The number of fully qualified men and women, competent to hold the higher posts in the Department, has become totally inadequate in every province."

The attitude of the Committee has clearly been sympathetic. But the studied restraint of the report serves to emphasise some of the conclusions into which facts have forced its members. If literacy is a desirable qualification in the voter, an expansion of mass education which is (in the words of the report) " so largely ineffective as scarcely to influence the advance of literacy at all in the sense of increasing the proportion of literates to the population " cannot result in the formation of a competent electorate. Nor, however brilliant may be the exceptional scholar, does a top-heavy superstructure of higher education, coupled with relaxation of the standards of admission and too often with unemployment after completion of the course, promise well for the production of sound representatives and officials. Above all, this narrative of educational work during the past few years indicates a fatal tendency to loosen the framework on which the whole fabric depends for support.

H. SHARP.

Bochart de Saron, 1730–1794.

WHEN Herschel, in April 1781, announced the appearance of a new body in the heavens, nowhere did the news create greater interest than in France, where Lalande, Mechain, Lemonnier, Laplace, and Bochart de Saron attempted to discover the orbit in which the body moved. Based on the supposition that it was a comet, the investigations all failed until Bochart de Saron, on May 8, 1781, announced that the so-called comet was in reality much farther from the sun than had been thought. This was the first glimmering of light on the perplexing subject which eventually led to the discovery that Herschel's ' comet ' was a new planet, to which he assigned the name Georgium Sidus, but was afterwards designated Uranus.

Jean-Baptiste-Gaspard Bochart de Saron, born on Jan. 16, 1730, two hundred years ago, was as distinguished in law as in science. He served as president of the Parliament of Paris, and at his seat in Champagne had an observatory partly furnished by Ramsden. It is said, also, that a duplicate of Ramsden's dividing machine was introduced into France by him, concealed in the pedestal of a table. Especially interested in comets, he became a member of the Paris Academy of Sciences, and it was he who paid for the printing, in 1784, of Laplace's " Théorie du mouvement et de la figure des planètes ". But, ten years later, neither his eminence as an astronomer or as a lawyer could save him from the fury of the Terror, and he perished beneath the guillotine.

The king had fallen in January 1793, Marie Antoinette in October ; the academies had all been suppressed, the scaffold had alike claimed Bailly, Madame Roland, and Danton, and executions could be counted by the hundred. On April 13, 1794, nineteen were condemned, on April 18 a further seventeen, mostly of the nobility, and on April 20, Bochart de Saron and twenty-four of his fellow ex-presidents and counsellors of the Parliaments of Paris and Toulouse suffered. It was to see this ' batch ' tried that the Auvergnat carpenter, Trinchard, wrote the invitation, " If you are not alone and the journeyman is working, you can, my dear wife, come to the court to see twenty-four gentlemen, all of them former presidents or counsellors . . . passed in judgment. I advise you to get something to eat before coming, as we shall not have finished before three o'clock."

There was never any doubt of the finding of the court, and while it was still sitting Fouquier was ordering the tumbrils and the escort. Presiding over the court which condemned Bochart de Saron was the notorious Coffinhal, who a few days later, when trying the Farmers-General, immortalised himself by replying to the great Lavoisier, who had asked for a delay in order to allow him to conclude an experiment, " The Republic requires neither savants nor chemists ; the course of justice cannot be suspended ". For three months longer the guillotine continued to rob France of some of her greatest minds. With the fall of Robespierre on July 28, the nation breathed again, and the year which saw the death of Condorcet, Bochart de Saron, and Lavoisier, also saw the foundation of the great institutions, the École Normale, the École Polytechnique, and the Conservatoire des Arts et Métiers, while the year 1795 saw the inauguration of the famous Institut de France.

Obituary.

DR. SAMUEL RIDEAL.

SAMUEL RIDEAL was born in London in 1863. His father was John Rideal. He obtained a scholarship at Dulwich College, 1875–1878. For a short time he studied at the Royal School of Mines, but afterwards went to University College, London, where, in 1883, he became assistant to Dr. A. W. Williamson. He retained this post for a year or two under Sir William Ramsay, but in 1889 became lecturer on chemistry at St. George's Hospital Medical School. He was a brilliant student, and in 1884 took the degree of bachelor of science at the University of London, with first class honours, and a University scholarship in chemistry. Two years later he received the degree of doctor of science, his subject being inorganic chemistry. In 1888 he was elected a fellow of University College, London. Already in 1878 he had become a fellow of the Institute of Chemistry, upon the council of which he served during the years 1899–1902.

About the year 1890, Rideal became public analyst for Chelsea, and was also, for a short time, public analyst for Lewisham. He set up a consulting practice at 28 Victoria Street, S.W., and retained an active interest in the work for thirty-five years. He married Lilla, daughter of the late Samuel Keightley, of Bangor, Co. Down, and sister of Sir Samuel Keightley, barrister and novelist. Dr. Rideal's son, Eric K. Rideal, is Humphrey Owen Jones lecturer in physical chemistry at Cambridge, and fellow of Trinity Hall. He has taken up his father's work in conjunction with Mr. A. Sciver.

While at University College, Rideal published several researches in pure chemistry, such as the action of ammonia on chromyl dichloride, on tungsten compounds, and on the halogen compounds of boron. A new volumetric method for the estimation of nitrous acid depending upon the conversion of an acid solution of aniline into diazobenzene was published by Arthur G. Green and S. Rideal in 1884.

Dr. Rideal became a recognised authority on the disposal and disinfection of sewage, the purification of water and sanitation generally. His book on "Sewage and the Bacterial Purification of Sewage" went through three editions, while that on "Water and its Purification" published in 1897, had a new edition in 1901. With his son, Dr. Eric Rideal, he published "Public Water Supplies" in 1914. The Rideal-Walker method for determining the antiseptic value of disinfectants is widely used. Rideal also studied carefully the use of electrolytic chlorine and of ozone in the purification of sewage. He was well known as an expert witness in the courts and gave evidence in a large number of Parliamentary inquiries.

Rideal's indefatigable energy in overcoming difficulties and his frank manner gained the confidence of those who had to work with him. To the great sorrow of his many friends, his health gave way, so that he had to take a prolonged rest. He died at Hartley, in Southern Rhodesia, on Nov. 13 last, at the age of sixty-six years.

DR. A. N. A. NALEPA.

DR. AUGUST NEMESIUS ALFRED NALEPA, the well-known acarologist, of Baden, near Vienna, died after a short illness on Dec. 11 last. Nalepa was born at Versecy, in Hungary, on Dec. 15, 1856. He was educated at the University of Vienna and later joined the staff and became assistant zoologist at the University.

Nalepa commenced to study the gall-mites (Eriophyidæ) in 1880, and seven years later he published his fundamental and unique work entitled "The Anatomy of the Phytoptera". The gall mites are considered to be the most primitive animals of the order Acarina; they are all microscopic in size and are entirely herbivorous in their habits. Nalepa studied them mainly from a systematic point of view, and as a result of his researches more than four hundred new species have been described. He was a prolific writer, and his publications in relation to gall mites number about one hundred. Of these, his works entitled "Eriophyidæ", in "Das Tierreich" (Berlin, 1898), and "Eriophyiden, Gallenmilben", *Zoologica*, **61** (Stuttgart, 1910), are widely known, and are still recognised as the standard works on the subject.

For prominent services rendered to education and scientific research Nalepa was honoured with the Emperor Franz Joseph Order and also the title of State Councillor. He was very generous, and delighted in assisting and advising other students engaged in research on the Eriophyidæ, and his immense knowledge of the group, together with sound criticism, always proved of great value to those who had the pleasure of corresponding with him.

Nalepa took an active interest in gall mites until the last, and was about to publish a new paper in collaboration with the present writer on "The Habits of Gall Mites" at the time of his death. He possessed a magnificent collection of gall mites contained in small glass vials. This collection is unique, and will in all probability be presented to the trustees of the Vienna Museum of Zoology.

A. M. MASSEE.

DR. WILHELM MAYBACH.

THE death of Dr. Wilhelm Maybach at Stuttgart on Dec. 29 removes the last of the four great German pioneers whose names will always be associated with the perfection of the internal combustion engine and its application to road transport. Nicolas Otto, who died on Jan. 26, 1891; Gottlieb Daimler, who died on Mar. 6, 1900; Karl Benz, who passed away in April last; and Maybach, all made important contributions to this subject; and to their names might be added that of Eugen Langen, 1833–1895. Just as Maybach for many years was connected with Daimler, so seventy years ago Otto had found in Langen a most able collaborator and partner.

Otto began his long struggle with gas engine difficulties in 1854; with Langen in 1867 achieved partial success, and then ten years later, on Aug. 4, 1877, took out his great patent for the four-stroke

engine so widely used to-day. Moreover, in 1872, the partners founded the Gasmotorenfabrik Deutz Aktiengesellschaft, near Cologne, in which both Daimler and Maybach worked.

The partnership of Daimler and Maybach dates from the 'eighties, and Daimler in 1884 invented the light high speed spirit engine which the following year was applied to road carrriages by Karl Benz. The first motor-car imported into England, as also the first imported into the United States, was a Benz. In the subsequent improvements of the 'nineties, Daimler and Maybach both had a large share, and the Mercedes car exhibited by Maybach at the Paris Exhibition in 1900 was named after Daimler's daughter.

Daimler dying in 1900, Maybach took over the direction of the Daimler works, retiring in 1907. His son's work for Count Zeppelin, however, led to his taking up active work again, and for many years he has been engaged with the management of the Maybach Motorenbau G.m.b.H. at Friedrichshaven, the first subsidiary company of the Zeppelin works. A fine example of a Maybach airship engine is to be seen in the Science Museum at South Kensington, and it may be recalled that the 530 h.p. engines with which the airship *Graf Zeppelin* is equipped were supplied by the firm. Maybach was born at Heilbron on Feb. 9, 1846, and was thus in his eighty-fourth year.

WE regret to announce the following deaths:

Major P. G. Craigie, C.B., formerly assistant secretary to the Board of Agriculture and Fisheries, who was president of the Royal Statistical Society in 1902 and president of Section F (Economic Science and Statistics) at the Bradford meeting (1900) of the British Association and of the Sub-Section of Agriculture at the Winnipeg meeting (1909), on Jan. 10, aged eighty-six years.

Dr. S. Z. de Ferranti, F.R.S., president in 1910 and 1911 of the Institution of Electrical Engineers, on Jan. 13, aged sixty-five years.

Prof. Henry D. Hooker, associate professor of horticulture at the University of Missouri, known for his work on the chemical composition of fruit plants and on plant reactions, on Oct. 26, aged thirty-seven years.

Mr. Maxmillian Mannaberg, well known in the iron and steel industry, who was one of the founders of the British Engineering Standards Association and also of the Institute of Fuel, on Dec. 18, aged seventy-two years.

Sir Thomas Matthews, formerly engineer-in-chief to Trinity House, who was well known in connexion with the design and equipment of lighthouses, on Jan. 13, aged eighty years.

Mr. Henry Nehrling, collaborator in the Bureau of Plant Industry of the U.S. Department of Agriculture, known for his work in horticulture and ornithology, on Nov. 22, aged seventy-six years.

Mr. E. A. Pinchin, public analyst to City of London and the Boroughs of Camberwell and Islington, on Dec. 23, aged fifty-five years.

News and Views.

REPORTS appeared in the daily Press last week announcing the recent death of Prof. A. A. Michelson, the distinguished physicist of the University of Chicago. We are happy to be able to state, on the authority of a cablegram from Science Service, of Washington, D.C., in reply to an inquiry by us, that these reports are incorrect and that Prof. Michelson is on his way to enjoy a holiday in Bermuda after his recent illness. A detailed account of Prof. Michelson's work was given by Sir Oliver Lodge in NATURE of Jan. 2, 1926, when Prof. Michelson was added to our series of Scientific Worthies. It is stated in *Science* of Dec. 27, 1929, that he has resigned his position in the University of Chicago as head of the department of physics, and that, after his visit to Bermuda, he intends to go to Pasadena, California, to carry out further work on the velocity of light. We are sure that scientific workers throughout the world will join with us in congratulating Prof. Michelson that he has survived his obituary notice, and also in wishing him many years of health and strength to add to those fundamental measurements for which the world is already indebted to him.

SUGGESTIONS have recently appeared in the Press to the effect that the Middlesex County Council is contemplating acquiring Syon Park, which is situated on the banks of the Thames immediately opposite the Royal Botanic Gardens, Kew, for the development of a sewage disposal scheme. Local opposition was quickly aroused, while on Jan. 9, at a well-attended meeting, the Linnean Society of London passed the resolution "That the Society views with the utmost concern and regret the reported proposal in regard to the grounds of Syon House". The meeting requested the president and secretaries to make public this resolution and to express at greater length the sentiments evidenced in the decision. The Society deplores the proposal to acquire Syon Park for sewage disposal and earnestly hopes that nothing will be done to mar the singular beauty of the Syon reach of the River Thames. It considers that Syon Park should be safeguarded from any form of spoliation or 'improvement' such as a riverside embankment which would be inimical to the wild river life for which this is one of the few remaining localities near London, and in which lovers of Nature find their interest and their duty.

IT is now just over a century since Lamarck died (see NATURE, Dec. 14, 1929, p. 922), and his remains lie in an anonymous grave in Montparnasse cemetery, Paris. The only memorial which France had of him was the house where he was born, the home of his ancestors, at Bazentin, a small village of the Somme, not far from Albert. For four years, Bazentin was in the zone of the Somme fighting, and the locality is well known to many who served in the British Army on the Western Front. Of Lamarck's house, only a few scattered bricks and blackened stones are now left. The Société Linnéenne du Nord de la France has therefore decided to raise a fund with the view of erecting, on the site of the old house, a memorial worthy of Darwin's precursor. This memorial will

stand in the middle of a garden, in which the plants grown will be the botanical species especially studied by Lamarck or named after him by other botanists. Lamarck belongs not to Picardy or to France but to the whole world; his work on classification made possible noteworthy advances in biology, and his views on evolution are still the subject of debate. A memorial to him is an object in which scientific workers of all nationalities may fittingly co-operate. Remittances should be directed to Banque de France, succursale d'Amiens (Somme) au Compte Société Linnéenne souscription Lamarck—No. 2433. All correspondence should be sent by May 15 next to M. le Secrétaire Général du Comité Lamarck, 81 Rue Lemerchier à Amiens (Somme).

THE problems which face the introducer of foreign species of animals to a new country are as difficult to solve in advance as they are many. The subject came before the Linnean Society recently in connexion with the proposed introduction of black buck into Ceylon, and a resolution was passed and communicated to the Colonial Office deprecating the introduction and naturalisation of wild animals or plants into new countries except after thorough study of the local conditions and possible results. But even when a creature has made good in the land of its naturalisation there may still be acute differences of opinion about the economic success of the venture. The introduction of the musk-rat (*Fiber zibethicus*) to Europe for the sake of its fur is a case in point. Dr. Hjalmar Broch showed (in *Naturen*, No. 1, 1929) that this species, introduced into Bohemia, has overrun much of southern Europe, and has become a pest against which strong measures have been taken (see NATURE, May 18, 1929, p. 775).

DR. BROCH'S article, and particularly his statement that the experience of southern Europe should prevent any relaxation of the law prohibiting the importation of live musk-rats to Norway, has been met by a spirited protest from Ludv. Munsterhjelm (*Naturen*, p. 120, 1929). This author cites the experience of Finland, where the musk-rat was liberated on several small estates in two districts some years ago. From neither area have reports of damage to crops been received, nor has there been any undue tendency of the creature to spread beyond its proper domain. The difference appears to be traceable to topographical and climatic conditions. In the warmer plains of southern Europe all the conditions favoured abundant food-supply and rapid breeding, whereas the mountains of Finland, with their unsettled weather, imposed a natural check upon multiplication and dispersal. Munsterhjelm considers that there is no probability of the spread of the musk-rat overland to Norway, and holds that in Norway itself the musk-rat might well be bred profitably and without incurring risk of damage to crops or property.

ATTENTION is being directed to the possibilities of the transference of diseases, human, animal, and plant, by air routes. Owing to the rapidity of air transit, an individual in the incubation stage of cholera might board an air liner in China, land at Los Angeles within two or three days, and develop the disease a day or two later, with the risk of spreading cholera far and wide. Another serious event would be the introduction of yellow fever into Asia by this means. When travel is slower, as by steamship, there is usually time for the disease to develop en route before the next large community is reached. Aerial boarding stations for quarantine officers have already been envisaged by public health authorities, and we learn from a radio-talk issued by Science Service, of Washington, D.C., that the U.S. Public Health Service has detailed quarantine officers expressly for the inspection of air-craft at the landing fields before the passengers or crew disembark.

ON Jan. 14, 1830, appeared the first number of *Das chemische Zentralblatt*, which at that time was also designated *Das pharmaceutische Centralblatt*. The centenary of this well-known reference work was marked by the delivery of an address to the German Chemical Society by Dr. Maximilian Pflücke on Nov. 11, 1929. The address, which is published at length in the December issue of the *Berichte der Deutschen Chemischen Gesellschaft*, deals with the early history and subsequent development of the journal. The original purpose of the undertaking was to provide pharmacists with an accurate survey of the new and important facts of interest to them which were being discovered not only in Germany but also in France, England, Holland, and Italy. At first the issue was fortnightly, but ever since September of the first year of publication it has appeared weekly in spite of the enormous difficulties arising from the War. The extraordinary growth of the work can be gauged from the fact that the number of abstracts in the first volume amounts to about one per cent of those now appearing annually, and many of the original sources are now obsolete. The first editor, Herr Gustav Theodor Fechner, was able to undertake the whole survey himself. One of his earliest problems was apparently connected with nomenclature, and he decided to be guided by the system of Berzelius. After several changes, the editorship passed into the hands of Prof. Rudolf Arendt in 1862, who guided its destiny for about forty years. So successful was the work under his direction that in 1895 the German Chemical Society decided to take over the management, and shortly after Arendt's death in 1902 the headquarters were moved from Leipzig to the newly established Hofmann-Haus in Berlin.

Two replicas of 'Les Bisons d'Argile' of the Tuc d'Auduobert Cave of the Ariège district are on their way to Canada: one, ordered by Dr. Ami, the director of the Canadian School of Prehistory in France, for Ottawa; the other, ordered by Prof. W. A. Parks, of the Geological Department of the University of Toronto, Canada. It is well that Canada should possess replicas of that wonderful piece of Magdalenian art, modelled some twenty thousand years ago when the bison dwelt in south-western France in large numbers. The bison to-day is a typical Canadian animal, and it is not yet extinct, nor does the Canadian Government, if we understand aright, mean the race to pass out. The *bisons* represented on the clay mass

—beautifully carved and sculptured—measure as a piece of art more than two metres in length, and form a most impressive spectacle from every point of view. The magic in art is well exemplified there, and it is to be regretted that, so far, no specimen of the few replicas being prepared for university or prehistoric museums is to be seen in Great Britain. These replicas are being prepared under the supervision of Count Begouën of the University of Toulouse, France.

MISS SYLVIA SEELEY, of the Canadian School of Prehistory in France, whose able presentation of Count Begouën's views on "The Magic Origin of Prehistoric Art" appeared in the March number of *Antiquity*, has recently been co-operating with him in the University of Toulouse, in the preparation of a comprehensive statement of the subject. So much new material has of late been, and is every week being, discovered by different members of the Begouën family, and by others working in the Ariège (Pyrenees) caves, that unless someone brings together every once in a while the results obtained in synthetic form and interprets the facts obtained in the light of prehistoric science and art, much time is lost and progress retarded. The work undertaken by Miss Seeley, in collaboration with Count Begouën, promises to open new vistas in the hidden treasures of those Pyrenean caves. The discovery of the grasshopper, of the owls, of the rare engravings and paintings in the Grotte des Trois Frères, near Pryòl, Ariège, are absorbing their attention, and will mark an interesting phase of prehistoric art in the light of what those discoveries themselves teach.

THE University of St. Andrews has planned an ambitious and admirable series of lectures under the adult education scheme for Fife and Stirlingshire. The title of the course and of the 60-page 'Synopsis' published by the University Press of St. Andrews, "Man and his World in the Light of Emergent Evolution," suggests the general scope of the series, but it gives no idea of the care with which the lectures have been devised and arranged to give a connected story, from the evolution of matter and the universe by way of the evolution of living things to the emergence of mind and its products. It endeavours to place in their due relationships and to give unity to the discoveries of the sciences and the developments of civilisation. Each of the twenty lectures has been written by an expert, generally the professor of the particular subject at the University, and in spite of the contraction of an hour's lecture into an average of two pages, the synopsis still carries the theme through with a swing. It is a pity that so excellent a course should be introduced by a preface the intellectual sufficiency of which would damp the ardour of many a modest inquirer after knowledge.

A REGULAR public service of picture telegraphy between London and Berlin is now in operation. The Siemens-Carolus system has been adopted and some of the pictures we have seen transmitted in this way are extremely good; with the exception of a slight tendency to exaggerate the blacks and the whites, the results are admirable. It is expected that the newspapers will be the largest users of this service. It will probably be used whenever it is necessary to send architects' plans and engineering drawings as quickly as possible. Cheques and legal documents with the signatures in facsimile can also be sent usefully in this way. Scotland Yard will doubtless make use of it to send the photographs of 'wanted' persons to seaports so as to prevent them leaving the country. Similar services already exist between Berlin and Copenhagen, Berlin and Vienna, and Berlin and Stockholm.

THIS year the picture telegraphy service will be extended to Munich and other German towns and to Holland and Belgium. The London to Berlin circuit is about a thousand miles long and consists of cable throughout. During the experimental stage, considerable trouble was experienced owing to inductive interference with other circuits, but this source of trouble has now been eliminated. The charge for sending picture telegrams from Great Britain is at the rate of $2\frac{1}{2}d.$ a square centimetre, which is equivalent to about a pound for fifteen square inches. There is a minimum charge of one pound. Some success has been achieved in radio picture telegraphy between Berlin and Buenos Ayres. From the commercial point of view, the services do not seem to be attractive, but they may nevertheless serve a useful function.

NOW that it is possible to communicate with nearly ninety per cent of the world's telephone stations from any one of the 1,900,000 subscribers' stations of the British Post Office, a vast amount of work has to be done in maintenance. In addition, as last year there were 125,000 new subscribers, thousands of miles of new cable had to be laid. In the *Electrician* for Dec. 27, P. E. Erikson says that the rate of progress is such that one new public exchange and 1000 new telephones (including replacements) are installed for each working day of the year. Fifteen new large automatic stations were completed in London last year. Of the twelve next largest towns in Great Britain, five are completely converted and four are well under way. An important development put into operation last year is the installation of rural automatic exchanges. Ninety exchanges have been installed providing day and night service to outlying subscribers, who would otherwise have only a limited day working. When a minimum of eight subscribers is forthcoming, rural automatic exchanges are being installed. Many new districts have been added in countries in which communication was already established. In Italy, for example, a recent installation of a carrier system provides three additional channels over an existing wire line and has greatly increased the service. The new hand set which is being introduced as an alternative to the familiar pedestal pattern telephone is excellently designed. Hand set telephones have been in use on the Continent for many years, but the speech transmission characteristics of these have been markedly inferior to the pedestal sets; the new hand sets have, on the other hand, superior characteristics. Successful ship-to-shore conversations between New York and the *Berengaria* up to distances of about a thousand miles were carried out during last year.

A CONFERENCE arranged by the National Institute of Agricultural Botany, with the assistance of the Royal Agricultural Society of England and the National Farmers' Union, was held on Jan. 8 to discuss the question of cereal synonyms and means of eliminating them. Representatives of the Agricultural Seed Trade Association and of the National Association of Corn and Agricultural Merchants also took part in the conference. It was agreed that it is undesirable in the interests alike of agriculturists, plant-breeders, and the seed trade that stocks of wheat, barley, and oats sold for seed which are of identical origin and character should be sold under different names. The name under which such stocks are sold should be that given by the original producer, with the addition of words indicating that further selection has taken place where this has been done. It was also resolved that a standing committee of reference, consisting of one representative of each of the five associations and of the Cambridge University Plant Breeding Institute should be formed to investigate and report on infringements of the recommendations of the conference. The secretary of the National Institute of Agricultural Botany is to act as convener of the committee of reference.

THE Geological Society of London has this year made the following awards of medals and funds: The Wollaston Medal to Prof. A. C. Seward, master of Downing College and professor of botany in the University of Cambridge, in recognition of the value of his researches in stratigraphy and palæobotany; the Murchison Medal to Mr. A. L. Hall, of the Geological Survey of South Africa, for his researches on the stratigraphy and economic geology of South Africa; a Lyell Medal to Mr. F. Chapman, palæontologist to the Federal Government of Australia, in recognition of his work in palæontology (especially on the Foraminifera), and of his researches on the tertiary rocks of Australia; a second Lyell Medal to Mr. H. B. Maufe, Director of the Geological Survey of Southern Rhodesia, for his work on the geology and mineral resources of that Colony; the Wollaston Donation Fund to Mr. E. G. Radley, of H.M. Geological Survey, in consideration of his work on the chemical analysis of rocks and minerals; the Murchison Geological Fund to Mr. John Smith of Dalry, in recognition of his contributions to the geology and palæontology of western Scotland; the Lyell Geological Fund to Miss H. M. Muir-Wood, in recognition of her work on the palæontology of the Brachiopoda.

THE Harrison Memorial Prize Selection Committee, consisting of the presidents of the Chemical Society, Institute of Chemistry of Great Britain and Ireland, Society of Chemical Industry, and Pharmaceutical Society, has awarded the Harrison Memorial Prize for 1929 to Dr. R. P. Linstead. The prize is given for conspicuously meritorious work in any branch of chemistry, pure or applied, and is to be regarded as an exceptional distinction to be conferred upon a chemist less than thirty years of age who in the opinion of those best qualified to judge had made a notable addition to our knowledge of chemistry. The presentation of the prize will be made at the annual general meeting of the Chemical Society on Mar. 27.

THE Darwin Medal awarded by the Royal Society in 1928 to Dr. L. Cockayne was presented to him on Aug. 7 last at a special meeting of the Canterbury Branch of the Philosophical Institute of New Zealand, held in the Hall of the Canterbury University College, Christchurch, New Zealand, by Dr. C. C. Farr, professor of physics in the Canterbury University College and president of the Philosophical Institute of New Zealand. In the course of an address on "Darwin and After Darwin", Dr. F. W. Hilgendorf of the Agricultural College, Lincoln, Canterbury, dwelt upon the great value and significance of the recent researches by Dr. Cockayne into hybridism in the native flora of New Zealand, which have proved clearly that Nature is selecting among the members of the hybrid swarms. In presenting the medal, Dr. Farr remarked that Dr. Cockayne is the first to gain a Royal Society Medal by work done entirely in New Zealand. Dr. Cockayne, in his reply, spoke of his early interest in the plants of his native Yorkshire, and told how the late Mr. Robert Brown, the well-known bryologist of Christchurch, had advised him, when he first began to work upon the flora of New Zealand, "to leave the authorities alone and go to the plants themselves". Outlining his own work, Dr. Cockayne said that he had published 155 botanical papers, all of which touch upon and illustrate variation in plants. Only a few years ago, our knowledge of hybrids in New Zealand was quite meagre, whereas now there are known to exist no less than 360 'hybrid swarms'. In his opinion, the flora of New Zealand offers a magnificent laboratory for the study of evolution, and he expressed the hope that its problems will ultimately be solved by some worker born and bred in New Zealand itself. On behalf of the Philosophical Institute of Canterbury, Mr. R. M. Laing congratulated its only honorary member, Dr. L. Cockayne, on the award of the Darwin medal. He said that Dr. Cockayne's work, apart altogether from its scientific value, has resulted in much knowledge of value to horticulture, agronomy, and forestry.

IN a further despatch to the *Times*, Sir Hubert Wilkins has added some details about his flight to Charcot Island. The most easterly point of the island is in long. 73° W., and the latitude of the north coast is five miles south of its charted position. The flight evidently confirms the existence of Stefansson Strait between Graham Land and Hearst Land and extends the islands of the Finley group to long. 70° W. No further information is available regarding Hearst Land and its relation to the Antarctic continent. It appears, however, to be Sir Hubert Wilkins' intention to travel by steamer along the pack-ice to about long. 100° W., making flights to the coast at various points. He believes that he may be unable to make his contemplated flight to the Ross Sea owing to the lack of a suitable taking-off field in the far south.

THE seventh annual meeting of British zoologists was held on Jan. 11 in the rooms of the Zoological Society of London, by kind permission of the council of the Society. Prof. Stanley Gardiner opened a dis-

cussion on the possibility of rendering the zoological experts of one university available for special instruction to the advanced students of another university. The committee presented a report on the syllabus of biology in schools, urging the importance of a grounding in animal biology as a preparation for citizenship. Mr. James Gray recounted the difficulties of importing scientific cinema films and scientific apparatus; it was decided to appoint a subcommittee to consider the hindrances offered to scientific research by the present Customs regulations. On the motion of Lord Rothschild, the meeting expressed disapproval of any proposal to convert the existing nature reserves in Great Britain into national parks. Dr. C. M. Yonge reported the proceedings of the Barrier Reef Expedition and was congratulated on his success.

WE have received Parts 71-72 (combined) of "Type Ammonites", which bring to a conclusion this work started by the late Mr. S. S. Buckman (as "Yorkshire Type Ammonites") a little more than twenty years ago. The whole work includes more than 1000 plates, figuring very nearly 800 species of Jurassic ammonites. No plates appear in the final part, which, except for the completion of the author's text on the opening page, consists entirely of tables and notes compiled by the editor, Dr. A. Morley Davies. Chief among these is a complete list of the figured species arranged in order of geological sequence according to the detailed hemeral scheme proposed by the author. There are also indexes of generic and specific names, bibliographic details, etc. This final part is published by the executors of the late S. S. Buckman, at Southfield, Thame, England (price £1). We understand that a limited number of complete copies of the whole work (Vols. 1-7) are still available (price £36), and that incomplete sets can be completed provided they include Vol. 3.

IN the *Times* of Jan. 11 was the account of the sale by auction of the famous mountain landmark in south-eastern France, the Puy-de-Dôme, famous as the scene of Pascal's great experiment with the barometer. It was a month after Torricelli's death that Pascal first proposed the experiment of carrying a barometric tube up a mountain and noting the variation. Being himself in the north of France, he wrote to his brother-in-law, Périer, in November 1647, but the experiment was not carried out until Sept. 9, 1648, when Périer and his companions found that while at the base of the mountain the mercury stood at 26 in., at the summit it had fallen to 23 in. The Puy-de-Dôme was also one of the heights ascended by Guettard and Malesherbes prior to the former reading his paper on "Certain Mountains in France which have once been Volcanoes" to the Paris Academy of Sciences on May 10, 1752. Last year a syndicate attempted to buy the summit to make it a tourist resort, but the peasant proprietors defeated the attempt, and they have now apparently by a bid of 122,000 francs outbid the Department, hoping thereby to enhance its value still further.

SIR RICHARD GLAZEBROOK, formerly Director of the National Physical Laboratory, has been elected an honorary member of the Institution of Electrical Engineers.

LORD BLEDISLOE, whose appointment as Governor-General of New Zealand was referred to in our issue of Dec. 7, 1929, p. 887, has been made Knight Grand Cross of the Most Noble Order of St. Michael and St. George (G.C.M.G.).

A MEMORIAL plaque to the late Sir William Glyn-Jones, formerly secretary of the Pharmaceutical Society of Great Britain, who died on Sept. 9, 1927, will be unveiled in the Society's examination hall by the Right Hon. Christopher Addison, on Wednesday, Feb. 5, at 3 P.M.

THE Secretary of State for the Colonies has appointed Dr. Drummond Shiels, M.P., Parliamentary Under-Secretary of State for the Colonies, to succeed Mr. William Lunn, M.P., as chairman of the Advisory Committee on Education in the Colonies and of the Colonial Advisory Council of Agriculture and Animal Health, and also as chairman of the Colonial Medical Research Committee.

THE Henry Saxon Snell prize of the Royal Sanitary Institute was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the Council of the Institute at intervals of three years. The prize in the year 1930 will consist of fifty guineas and the medal of the Institute, and is offered for an essay on "Improvements in the Sanitary Provisions of Schools". Essays should not be longer than 5000 words and typewritten, must be delivered on or before Aug. 30 next, addressed to the Secretary of the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1, from whom further particulars may be obtained.

As already announced, the meeting of the British Association this year will be held in Bristol on Sept. 3–10, when Sir Thomas Holland will be succeeded in the presidential chair by Prof. F. O. Bower. The presidents and recorders of the Sections will be as follows: A. (Mathematical and Physical Sciences): Dr. F. E. Smith; Mr. W. M. H. Greaves, Royal Observatory, S.E.10. B. (Chemistry): Prof. G. T. Morgan; Prof. C. S. Gibson, Chemical Department, Guy's Hospital Medical School, S.E.1. C. (Geology): Prof. O. T. Jones; Mr. I. S. Double, Department of Geology, University, Liverpool. D. (Zoology): Dr. W. T. Calman; Mr. G. Leslie Purser, University, Aberdeen. E. (Geography): Prof. P. M. Roxby; Mr. R. H. Kinvig, 36 Oakfield Road, Selly Park, Birmingham. F. (Economics): Prof. T. E. Gregory; Mr. R. B. Forrester, Inverey, Somerset Road, New Barnet, Herts. G. (Engineering): Sir Ernest Moir; Mr. J. S. Wilson, 49-50 Parliament Street, S.W.1. H. (Anthropology): Dr. H. S. Harrison; Miss R. M. Fleming, Marine Terrace, Aberystwyth. I. (Physiology): Prof. H. S. Raper; Dr. M. H. MacKeith, Magdalen College, Oxford. J. (Psychology): Prof. C. W. Valentine; Dr. Shepherd Dawson, Hazel Bank, Thorn Road, Bearsden, Dumbartonshire. K. (Botany): Dr. A. W. Hill; Prof. W. Robinson, Botanical Department, University College, Aberyst-

wyth. L. (Education): Right Hon. Lord Eustace Percy, P.C.; Mr. G. D. Dunkerley, 29 Gordon Square, W.C.1. M. (Agriculture): Dr. P. J. du Toit; Prof. G. Scott Robertson, Ministry of Agriculture, Wellington Place, Belfast.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. A. G. G. Hill, botanist, Nigeria, to be plant breeding officer (senior geneticist), Mauritius; Mr. N. Humphrey, to be agricultural officer, Kenya; Mr. L. R. Doughty, to be geneticist, East African Agricultural Research Station, Amani, Tanganyika Territory; Mr. J. P. Mead, personal assistant to the conservator of forests, Malaya, to be director of forestry, Malaya; Mr. J. N. Oliphant, conservator of forests, British Honduras, to be deputy director of forestry, Malaya.

THE afternoon lectures at the Royal Institution will be resumed on Jan. 21 at 5.15, when Dr. F. W. Aston will begin a course of three lectures on Tuesday afternoons on isotopes; on succeeding Tuesdays there will be four lectures by Sir William Bragg on X-ray determination of the structure of cellulose and similar substances, and four by Dr. Charles Singer on the passage from medieval to modern science. On Thursday afternoons, beginning on Jan. 23 at the same hour, there are to be two lectures by Dr. H. A. Harris on the growth of children in health and disease, one on Feb. 6 by Dr. R. L. Smith-Rose on radio direction finding by transmission and reception, and two by Mr. T. A. Joyce on architecture and the industrial arts of Pre-Spanish America. The Saturday afternoon lectures at three o'clock will include four by Sir Ernest Rutherford on atomic nuclei and their structure. Sir William Bragg will give the first Friday evening discourse on Jan. 24, on cellulose in the light of the X-rays. Succeeding discourses will probably be given by Lord Rayleigh, Dr. Leonard Hill, Prof. A. F. Pollard, Prof. G. I. Taylor, Mr. C. Tate Regan, Prof. G. Elliot Smith, Mr. Seton Gordon, Sir Ernest Rutherford, and others.

MOVEMENTS attributed to an earthquake reported to have been felt in Brittany were recorded at Kew Observatory on Jan. 9. The first onset was at 19 hr. 39 min. 49 sec. and oscillation lasted about three minutes. The disturbance was less than that produced by the earthquake in Jersey on July 30, 1926.

THE Royal Institute of Public Health will hold its annual congress at Portsmouth on June 4–9. The scientific work of the Congress will be conducted in five sections dealing respectively with State medicine and municipal hygiene, health in the naval, military, and air services (including tropical diseases), industrial hygiene, women and children and public health, and tuberculosis.

BY kind permission of the president and council of the Royal College of Surgeons of England, the human skeletal material collected by the East African Archæological Expedition during the season 1926–27 and 1928–29, will be on view to the public in the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, for one week from Monday next, Jan. 20, during the hours 10-5, and on Saturday, 10-1. A type series of the associated stone implements will also be exhibited.

THE annual report and statement of accounts for the year 1928–29 of Livingstone College, Leyton, have reached us. The College provides instruction in the elements of medicine for those engaged in work in the mission field. During the year, 83 students attended the various courses of instruction. The College has paid its working expenses during the year and also reduced the deficit of £933 by £117, but additional donations and subscriptions are required to extend the work.

THE Rockefeller Foundation, New York, has issued the fifteenth series of "Methods and Problems of Medical Education". This contains a description of the departments and courses of instruction of the Albany Medical College of the Union University and of the Albany Hospital, Albany, New York, with numerous plans and illustrations. It is of interest that Dr. Sautter, the professor of contagious diseases, expresses the opinion that the cubicle system of treating infectious diseases is satisfactory only if fully trained nurses are employed, and while cheaper than the ward system, the latter, from the humanitarian view point, has great advantages.

THE annual report of the South African Institute for Medical Research contains an account of the routine and research work carried out in the Institute during 1929. Trials made of a bacteriophage active against the plague bacillus as a prophylactic or a therapeutic agent have been unsuccessful. Dr. Pirrie has found that the plague bacillus is dissociable into two variants, corresponding to the normal or 'S' forms and the 'R' forms of other micro-organisms. Tuberculosis of South African natives appears to be caused by the human type of tubercle bacillus, as 100 strains of the bacillus isolated were all of this type, and bovine sources of infection play little part, therefore, in the causation of tuberculosis among South African natives.

THE Medical Research Council has issued a report entitled "Medical Uses of Radium: Summary of Reports from Research Centres for 1928 (*Special Rep. Series*, No. 144. London: H.M. Stationery Office, price 1*s.* net). This has been compiled by the Radiology Committee of the Council, which allocated the radium salt entrusted to it by H.M. Government to various institutions named. As in previous years, the reports are grouped under the headings of regions of the body. It may be stated in general that the results so far obtained indicate that while the use of radium as an agent for the treatment of localised cancer has considerable chance of success, once the disease has become generalised the use of radium is mainly palliative. The Committee emphasises the fact that

radium therapy is a highly specialised type of work to be undertaken only by properly trained persons.

A NOTICE appeared in NATURE of Dec. 21, 1929, p. 944, of "A Challenge to Neurasthenia", by Miss D. M. Armitage. The price given, namely 5*s*. net, is incorrect; the booklet is available at 2*s*. 6*d*., or 1*s*. in paper covers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecture assistant in the department of chemistry of the University College of Swansea—The Registrar, University College, Swansea (Jan. 20). A mathematical master at the Royal Naval College, Dartmouth—The Headmaster, Royal Naval College, Dartmouth (Jan. 20). A science master at the Huddersfield College, for Physics and Chemistry—The Director of Education, Education Offices, Peel Street, Huddersfield (Jan. 22). A secretary and director of education under the Wigan Education Committee—The Town Clerk and Clerk to the Local Education Authority, Municipal Offices, Library Street, Wigan (Jan. 22). An engineering assistant at the Building Research Station of the Department of Scientific and Industrial Research, for work in connexion with investigations on Structural Steelwork—The Director, Building Research Station, Garston, Watford, Herts. (Jan. 23). A lecturer in physiology at St. Thomas's Hospital Medical School—The Dean of the Medical School, St. Thomas's Hospital, S.E.1 (Feb. 14). A professor of electrical engineering at King's College, London—The Academic Registrar, University of London, S.W.7 (Feb. 21). A senior research assistant at the National Institute of Poultry Husbandry—The Director, National Institute of Poultry Husbandry, Newport, Shropshire. Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1. A full-time lecturer at the Portsmouth Municipal College, for the Training of Wireless Operators for the Postmaster-General's certificate—The Secretary, Municipal College, Portsmouth. A resident research fellow at Lady Margaret Hall, Oxford—The Hall Secretary, Lady Margaret Hall, Oxford. A part-time laboratory assistant in the department of hygiene and bacteriology of King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W.8. A laboratory assistant in the physics department of the Cancer Hospital—The Secretary, The Cancer Hospital, Fulham Road, S.W.3.

Our Astronomical Column.

Rotation of the Galaxy.—A *Daily Science News Bulletin* of Jan. 1, issued by Science Service, Washington, D.C., gives a summary of a lecture given by Dr. J. S. Plaskett at Des Moines, Iowa, during the meeting of the American Association for the Advancement of Science. It had been found by several observers that the stars of *B*-type show on the average an outward motion from our system of about 5 km./sec. Dr. Plaskett showed that this could be explained in large measure by combining the effect of galactic rotation with the fact that a special group of *B*-stars in Scorpio and Centaurus show an unusually high speed for stars of this type. He gives 9 km./sec. as the mean speed of the more luminous *B*-stars, and 12 km./sec. for the less luminous ones.

It may be noted that Dr. Plaskett has just been awarded the Gold Medal of the Royal Astronomical Society for his brilliant researches in stellar spectroscopy.

Comet Schwassmann-Wachmann (1).—*Beob.-Zirk.*, No. 44, contains an interesting note by Dr. W. Baade of Bergedorf Observatory on this comet. It will be remembered that its perihelion passage occurred in May 1925, more than four and a half years ago. On Nov. 6 last, Dr. Baade failed to photograph it, and concludes that it must have been fainter than mag. 17. But on Dec. 2 its magnitude had risen to 13·5, and it presented the appearance of a planetary nebula some 18″ in diameter. It was again photographed on Dec. 5, when its nucleus was of mag. 14·3, eccentrically placed in a faint nebulosity. The sudden change of brightness recalls the remarkable outburst of Holmes's comet in November 1892, repeated on a smaller scale some two months later. D'Arrest's comet in 1923 also exhibited an unexpected increase of brightness from mag. 14 to mag. 11, although the calculated brightness was diminishing. But the change in the present case is still more mysterious, owing to the great distance of the comet from the sun. It is now not very far inside the orbit of Saturn, where the solar exciting effect must be very weak. It would appear that there is some unknown source of energy in the comets themselves to explain these sudden outbursts.

Orientation of the Planes of Binary Stars.—There have been many attempts to find whether there is any law governing the orientation of the planes of revolution of the binary stars. The conclusions have been curiously inconsistent, some observers finding a concentration of the poles of the planes in the plane of the galaxy, others in the pole of the galaxy, others in positions related to the ecliptic or the solar apex. Such discordance is not surprising when we note that when the orbits of binaries are determined simply from measures of position angle and distance, there are two possible positions of the orbit plane, one nearer to us on the north side, the other nearer on the south. The investigators tried to avoid the difficulty in different manners, but Mr. Y. C. Chang notes in *Astr. Jour.*, No. 932, that it can only be eliminated in the case of those binaries for which radial velocities have been obtained with the spectroscope over a sufficient arc of the orbit. He was able to collect the necessary observations for twelve binaries, and has added four more from results obtained at the Yerkes and Lick observatories. The resulting poles are deduced and plotted on two diagrams, referred respectively to the terrestrial equator and to the galactic plane. Neither diagram shows any evidence of concentration. The distribution appears to be a random one.

Mr. Chang draws the conclusion that the evidence favours the fission theory of generation of double stars, rather than those of stellar appulse, or adjacent nuclei in a primitive nebula. These would be likely to show grouping related either to the direction of the streams of stellar motion, or to the plane of the galaxy.

Research Items.

Archæology of the San Joaquin Valley, California.—A further study of the archæology of the San Joaquin Valley, in this case covering the northern section, has been published by the University of California in the *Publications relating to American Archæology and Ethnology*, Vol. 26, No. 4. The authors, W. E. Schenck and Elmer J. Dawson, have examined a number of mounds in this section as well as specimens obtained by other collectors, especially the late Mr. H. H. Barr. The mounds, the evidence indicates, were not used exclusively for burial, though these occur throughout the strata and in some cases in the substratum. Although some of the human bones were scorched, this was probably due to the burial fire, and cremation was not practised. Artefacts were burned at the grave. Of those associated with the skeletal remains, which were found in large numbers, pipes, pestles, and obsidian blades were sometimes broken or 'killed'. Shell ornaments and beads were the objects most frequently found. Though pottery was extremely rare, the large number of objects of clay was one of the unique features of the site. Baked clay balls were found in profusion. These were probably a local invention, as they are not known elsewhere. Their use is obscure. Their number is perhaps due to the lack of stone in the area, and they may have been used for some such purpose as fire-stones. The age of the mounds in some instances may be put at 1800 A.D., as is shown by Caucasian objects associated with the finds; but the oldest mound is calculated to be probably not more than fifteen hundred years earlier.

Effects of Environment on Twins.—Many studies are now being made of identical twins. It is well known that such twins show great similarity not only in appearance but also in such details as finger and palm prints. The *American Weekly* of Dec. 29 last describes recent studies by Prof. H. H. Newman, of the rare cases in which identical twins have been separated in early life, and have grown up in different environments. A pair of twin girls born in London were separated at the age of 18 months, one (Olive) growing up in a poor part of Chelsea and the other in an Ontario town under better conditions. They differ in height by only an eight of an inch, but Olive weighed nearly ten pounds more than her sister when the latter joined her in Canada. Among numerous other similarities they have the same dental peculiarities. Mental tests showed marked superiority of the Canadian girl, partly accounted for by her superior schooling and better health in childhood, but her head is also slightly larger. Another pair of identical twins grew up, one in Chicago and the other in a small town in Illinois. These young men showed the usual marked resemblances. The city boy was better educated and held his facial muscles differently, which made him better-looking, but both showed the same intelligence. That a tendency to criminality is inherited appears to be shown by observations of Prof. Lange in Germany. He examined the brothers of 428 criminals. Where the twin of a convict was of the ordinary fraternal type, he turned out to be criminal only once in 16 pairs, which is about the ratio for ordinary brothers. But in 10 out of 13 cases of identical twins both were criminals, and the three exceptions each had an explanation.

Micro-Organisms in Candies and Chocolate.—A microbiological investigation of these articles has been undertaken at the Institute of Hygiene, Masaryk University, Czechoslovakia (K. Driml, *Publications de la Faculté de Médecine*, Brno, Tchécoslovaquie, 1929, T. 7, p. 45). It is found that humidity and desiccation are the factors which respectively tend to conserve and to destroy the viability of bacteria upon the surface of confectionery. It follows, therefore, that the number of bacteria on confectionery kept in sealed glass or tin-plate containers, and also on chocolates wrapped in tin-foil, remains stationary for long periods. On the other hand, the packing of confectionery in transparent paper or cellulose bags does not hinder the sterilising influence of desiccation and sunlight while affording sufficient protection from contamination after packing. It was found that in samples artificially infected, the typhoid and paratyphoid organisms may remain alive for 2-5 weeks, particularly in chocolates packed in tin-foil. The need for eliminating all chance of infection during manufacture is emphasised, and transparent or translucent cellulose containers are considered to be the best for packing.

Fresh-Water Mollusca of Wisconsin.—Two substantial volumes, comprising 1000 pages in all, are devoted to the enumeration and description of the fresh-water Mollusca of Wisconsin by F. C. Baker (*Wisconsin Geol. and Nat. Hist. Survey Bull.*, 70), published under the auspices of the Wisconsin Academy of Sciences, Arts, and Letters. The contents of many collections, public and private, were studied and special expeditions were made to different parts of the State by the author, but nevertheless there are some districts yet unexplored that might possibly yield additional species. Altogether 327 species and varieties are recognised in this monograph, of which 40 are considered new. This is a considerable fauna, as may be realised when it is recollected that the British Isles, with double the area, can only show a hundred aquatic species, or, if allowance be made for those trifling varieties so dear to some collector's hearts, a total of some two hundred forms. The descriptive text is full, and copious notes are given as to distribution, ecology, etc., while the nomenclature is on the latest approved American pattern. The plates, which number 105, are half-tone figures from photographs, and quite satisfactory save in the case of those of the smaller species of bivalves. There are plentiful and good text figures illustrating anatomical and other details. Each volume has its index, while to the whole work is appended a very full bibliography and a glossary, some of the definitions in which, after the manner of such productions, are distinctly quaint.

The California Jack Smelt.—Mr. Francis N. Clark describes the life-history of the California jack smelt, *Atherinopsis californiensis*, in Contribution No. 77 from the California State Fisheries Laboratory (January 1929, *Fish Bulletin*, No. 16. Division of Fish and Game of California). He begins by describing the commercial catch statistics (this being one of the minor fisheries of the State) and fishing gear, then proceeds to length measurements, scale studies, and ova measurements, spawning, age, and rate of growth. The fish apparently spawn more than once during a spawning season, which occurs from October to March, and individuals are spawning at all times during the breeding season. The largest fish was 33·4 cm. in length and was probably nine or ten years old. Very few attain 30 cm., and the fish are mature at 18-20 cm. at about the end of the second year.

Pendulum Observations at Sea.—In a recent publication ("Theory and Practice of Pendulum Observations at Sea". J. Waltman, Jr., Delft), Dr. Vening Meinesz describes the later modifications made by

him in the construction at de Bilt of a new recording apparatus to be used for the determination of gravity at sea. Meinesz's method, which reduces the time required to compute an observation from several days to a few hours, was first introduced in 1923, and after his first voyage the apparatus was modified. It was tested again in 1925 on a voyage to Port Said, and during the spring of 1926 a further improvement was made by suspending the apparatus in gimbals, and it is hoped that the final results of the voyage to Java during the latter part of that year will be published shortly. An additional modification has since been introduced, and the improved recording apparatus in its present form is described in the present publication.

Latitude Variations in India.—As the result of an inquiry from Prof. Wegener, the values of astronomical latitudes of stations in India at which observations have been taken several times at considerable intervals were recently scrutinised to see if they gave any evidence of the crustal movements suggested in the Wegener hypothesis. The results are published in the *Geodetic Report*, vol. 3, 1926–27, of the Survey of India. Observations at fourteen stations were examined. At some of these the earliest records were more than a century ago. Variations range between $-1{\cdot}56''$ and $+0{\cdot}90''$. Five sets of observations at four stations cover intervals of less than a year, and nevertheless show changes only slightly smaller than other sets covering a much longer period. Of the other ten stations, several appear to show increases of latitude between 1800 and 1870, and others show increases only between 1870 and 1927. The figures from two adjacent stations are directly contradictory. The only conclusions that can be derived from these data is that the apparent changes are due to errors in observations and that they afford no evidence of continental drift. On the other hand, it is pointed out that the figures do not furnish disproof of a drift of the order of fifty feet a century.

New Type of Epidiascope.—The increased use of visual methods in education has been accompanied by progressive improvements in the design and construction of optical projection apparatus, and the modern epidiascope, which is compact and easy to manipulate, is rapidly superseding the projection lantern. A new type of epidiascope embodying several further improvements has recently been put on the market by Messrs. W. Edwards and Co. The apparatus is constructed on the 'unit' principle. The episcope is the basic unit and is so designed that the addition of other units, either as permanent attachments or for temporary use, enables the apparatus to be used for vertical projection, for optical bench work, and for the projection of lantern slides, microscopic slides, or kinematograph pictures. The reflecting mirror for episcopic projection is placed inside the apparatus and is thus protected from dust, and the possibility of accidental damage is diminished. Illumination is provided by means of a 500-watt standard projection lamp. If greater intensity is required a second lamp can be easily introduced. The instrument is fitted with anastigmat projection lenses and good definition is obtained over the whole picture. Demonstrations of the apparatus can be arranged at any time on application being made to Messrs. W. Edwards and Co., 8A Allendale Road, London, S.E.5.

Enumeration of Coincidences.—A neat method for counting coincident discharges in two Geiger α-particle counters is described by Dr. W. Bothe in the first number of the current volume of the *Zeitschrift für Physik*. A four-electrode thermionic tube is set up with its two grids connected one to each of the Geiger counters. The potential impulses set up by the entry of ionising particles into the counters are thus transmitted to the grids, and the latter have in addition a steady negative potential applied to them of sufficient magnitude to prevent the passage of current through the valve to the anode unless the potentials of *both* grids have been momentarily raised. In other words, current pulses are recorded in the anode circuit only when the two counters respond simultaneously to the ionising agency. Dr. Bothe gives some figures to show the very considerable extent to which the labour inherent in the older direct method for detecting coincidences has been reduced by this device, which appears to have an immediate important application in the investigation of the cosmic radiation.

Lead Arsenate Sprays.—In recent years lead arsenate solutions have been extensively used as insecticide sprays, and a leaflet issued by the U.S. Department of Agriculture describes experiments by H. S. Swingle on the effects of such sprays. It was found that, at low concentrations of equivalent arsenic content, arsenious and arsenic acids are equally toxic to peach foliage. At higher concentrations arsenic acid is the more toxic. Arsenic acts as a cumulative poison within peach leaves. The minimum concentration of arsenic acid toxic to peach foliage contains the equivalent of 0·0012 per cent of arsenic pentoxide. Acid lead arsenates containing less than 0·25 per cent of arsenic pentoxide in water-soluble form gave minimum foliage injury. Nothing of practical importance is gained by further reduction in soluble arsenic. Lead arsenate cannot be used upon susceptible plants without the addition of some material to prevent burning.

Proteins in Brewing.—A melancholy interest is attached to a paper recently published in the *Journal of the Institute of Brewing* (35, 532; 1929) under the name of the late Prof. S. B. Schryver. Not only was it intended to serve as an introduction to a series of his researches under the auspices of the Institute of Brewing research scheme on the proteins and their relation to the industry of brewing, but also it was dictated from the sick-bed and read by proxy, and the discussion was never seen by the author even in manuscript. After a discussion of the nature and constitution of the proteins, it is shown that investigation of the large number of unknown factors which determine the rôle of nitrogen in brewing falls under three heads: (1) The variations in nitrogen in barley due to differences in soil, climate, and other conditions; (2) the changes produced in barley proteins during malting; (3) the variations in the nitrogenous constituents of wort and their utilisation by the growing yeast. In connexion with the third problem, great importance is attached to the fact, originally established by Horace Brown twenty years ago, that a relatively large proportion of the protein matter in wort cannot be utilised by the yeast. When in fact these proteins occur in the colloidal state, they may even inhibit growth by settling out with the yeast and choking it. As a result of such researches, it may be possible in the future to choose the barley and regulate the malting process so as to reduce these detrimental colloids to a minimum, or alternatively, the colloidal matter may be partly or wholly removed from the wort or prevented from precipitating during fermentation. It will be seen that Prof. Schryver has provided his successors with a tempting field of possibilities, and it may confidently be anticipated that the seeds he has sown will produce a rich harvest.

The Twentieth Annual Exhibition of the Physical Society and the Optical Society.

THE exhibitions of electrical, optical, and other scientific apparatus arranged by the Physical and Optical Societies have grown steadily in interest and importance year by year, and that held on Jan. 7, 8, and 9 last was decidedly the most successful of all. The exhibition was housed, as usual, in the Imperial College of Science, and although additional accommodation was allotted, the available space was filled to compression with extremely interesting exhibits.

An important new section has been introduced, with the object of encouraging craftsmanship in the scientific instrument trade. Prizes were offered to apprentices and learners for the best examples of craftsmanship and for the best designs, drawings, or tracings. All too little has been done in the past to encourage young instrument-makers to take a pride in their art, and it was gratifying to see the high standard attained. As the competition was the first of its kind, readers of NATURE may be interested to know the results in detail. They were as follows: Class *A*, Craftsmanship: senior grade (18-21 years): (1) J. H. Richards (Creed and Co., Ltd.), perforator punch block; (2) P. D. Betteridge (Griffin and Tatlock, Ltd.), voltmeter movement, and A. Mead (Adam Hilger, Ltd.), micrometer eyepiece; honourable mention: S. W. Angel (Negretti and Zambra), Bourdon tube and spindle, and W. G. Sibley (H. Tinsley and Co.), six-dial resistance box. Junior grade (under 18 years): (1) E. G. Sawyer (Negretti and Zambra), geared movement of quadrant form; (2) R. H. Brockman (Adam Hilger, Ltd.), proof plane of quartz. Class *B*, Draughtsmanship: senior grade: (1) H. Downing (General Electric Co., Ltd.); (2) E. G. Baker (George Kent, Ltd.) and E. Lowings (George Kent, Ltd.); honourable mention, A. G. Haslam (H. W. Sullivan, Ltd.). Junior grade: (1) S. W. Holdstock (George Kent, Ltd.), (2) E. F. Woods (George Kent, Ltd.). Scientific progress depends directly on the skill of the instrument-maker, and the stimulus provided by a competition of this kind should therefore prove decidedly beneficial.

The number of exhibits in the remaining sections was so great that it is out of the question to do justice to them in a short article. A full account of the most interesting will be found in the catalogue, which has been printed in a form suitable for binding up with the proceedings of the participating societies. Here it is possible only to mention briefly a few items which happened to attract the attention of the writer, and a different observer might well have made a different selection.

The section devoted to research and experiment, another feature which has recently been added to the exhibition, is expanding in a satisfactory manner. Group *A* comprised nearly a hundred exhibits illustrating recent research. Those contributed by the National Physical Laboratory included a wireless oscillator for wave-lengths down to 1·5 metres and a direction-finder for wave-lengths of 4-10 metres; a 0·00002-ohm standard resistance for direct current up to 20,000 amperes, consisting of 40 parallel water-cooled manganin tubes joining two copper discs, to the peripheries of which a number of cables are symmetrically connected in parallel, the arrangement being designed to avoid errors arising from variation of current distribution in the end-connexions; and a demonstration of the use of the hot-wire anemometer for detecting turbulent flow. In the latter a hot wire, in circuit with an amplifier feeding a loud-speaker, is situated close to the surface of a stream-lined body in a blast of air. Normally the loud-speaker is silent, but disturbance of the flow by the interposition of a pencil or the like produces loud sounds. Messrs. R. W. Paul and B. S. Cohen showed a series of loud-speaker diaphragms made of balsa wood, an extremely light and stiff material: the response curves actually measured are found to correspond closely with curves predicted on the assumption that the diaphragms are rigid.

In a Kundt's tube excited by a valve-driven diaphragm, demonstrated by Prof. E. N. da C. Andrade and Mr. S. K. Lewer, the dust particles are found to form sharp and accurately measurable rings at the antinodes, the amplitude of vibration of individual particles can be observed directly (the particles being seen as short lines parallel to the axis of the tube), and the tube is sealed to preserve the purity of the gas (see NATURE, Nov. 9, 1929, p. 724). A solution has been provided by the British Thomson-Houston Co., Ltd., of a problem which must have racked the brains of many youthful electricians, namely, the transformation at high efficiency of direct-current supply. For this purpose a mercury vapour rectifier having an oxide-coated hot filament as cathode and a magnetic control is used. This rectifier has several interesting properties and will probably be put to many uses. For the purpose of direct-current transformation, it is made to commutate the low-tension supply, and the resulting alternating voltage, after being stepped up by an ordinary transformer, is rectified to yield a high-tension direct-current output.

A curious experiment on weak suspensions of clay was contributed by the Rothamsted Experimental Station. When the solid matter forms a few per cent of the whole, the suspension behaves as a liquid for ordinary stresses, but as an elastic solid for very small shearing stresses, the critical value of the stress increasing rapidly with concentration. A viscometer of the rotating-cylinder type was demonstrated, the outer cylinder, which contains the clay, being suspended, while the inner revolves. For very slow speeds of rotation the torque increases regularly with speed, but when the shearing stress exceeds the critical value a very large increase in the speed makes little difference to the torque. The Research Laboratories of the Gramophone Co., Ltd. (H.M.V.), and the Marconiphone Co., Ltd., also demonstrated a magnetically controlled mercury vapour relay, and another interesting feature of their stand was a cathode ray oscillograph arranged to show, on a time base, the dying away of a sound picked up by a microphone in the hall, the sound-supply being cut off suddenly after a steady distribution of sound-intensity had been attained. Messrs. C. E. Wynn-Williams and Ward showed apparatus for counting the passage of α-particles based on the usual principles, but having the unusual feature that the impulses initiated by the passage of the particles are applied to a mechanical counter, the number-cylinders of which are seen to move step by step as the particles emerge.

A good deal of ingenuity can be exercised in the devising of lecture-experiments and teaching-apparatus of an inexpensive type, and this year the section of the exhibition devoted to such matters was very well supported. A very fine collection of improvised apparatus was shown by Mr. F. A. Meier, of Rugby, the most striking being, perhaps, that in which a diffraction pattern is formed by means of three steel balls in contact. Talbot's bands were produced by Mr. A. C. G. Beach (Chelsea Polytechnic) by placing between a spectrometer and an observing telescope an additional slit having half its width occupied by

a strip of celluloid film. Paper-clips of the 'bull-dog' type have often featured in apparatus constructed by hard-pressed teachers under the stress of enforced economy, but the usefulness of these factotal objects has been much extended by Mr. D. G. A. Dyson by the addition of brass terminals, which facilitate attachment to the steel rods that figure in improvisations of the kind in question. Mr. J. E. Calthrop, of East London College, has devised a simple hydrometer for measuring surface tension; it consists of a glass vessel made of two cylinders of different diameters having their axes in line. The vessel is loaded with mercury so that it floats vertically with either end uppermost, and the volumes which stand above the surface of the liquid in the two positions differ by an amount which gives the surface-tension in absolute units.

In the trade section the largest share of attention was attracted by those firms—happily a large and increasing number—which enter into the spirit of the exhibition and contrive to make their stalls scientifically interesting. There is still a certain number of firms who are content to set up a kind of shop window full of unedifying boxes with terminals or eyepieces on their outsides, but the more enterprising exhibitors contrived to provide excellent demonstrations or dis-assembled instruments, and even they were far too numerous for individual mention. The Cambridge Instrument Co., Ltd., had, as usual, a very fine display of new apparatus. Among the instruments which attracted our attention was a seismograph for detecting salt domes and for locating geological faults; it was noteworthy for a delicate and effective application of the toggle principle for multiplying movement. The same firm showed a recording colorimeter in which light, after passing through solution the colour-density of which varies with time, affects a photo-electric cell which controls a thread recorder. The current supply is drawn from the mains and ripple is eliminated by an ingenious device; the filament of a triode valve is heated with alternating current, and the anode is supplied through a resistance with rectified current from the same source; fluctuations in the mains vary both the valve impedance and the potential drop in the resistance in such a way that the effects of these variations cancel one another. The Ashdown rotoscope, manufactured by Elliott Bros. (London), Ltd., for observing objects in periodic motion and measuring their periodicity, is a stroboscope with a useful feature for rendering the view of the object instantaneous, while permitting good apparent illumination: the shutters consist of rotating sets of parallel laminæ, so that a good instantaneous view is afforded when the laminæ are horizontal, but a very sharp cut-off is effected as soon as the laminæ have rotated through a small angle. Among Messrs. Hilger's exhibits was a system for spectrographic analysis by Barratt's method. Two spark gaps, one having electrodes of known composition, while the other has electrodes of the substance under test, are connected in series so as to take the same current, and the relative intensities of the same spectral line when derived from each of the two gaps are found by means of a photometer of the polarisation type.

The M.O. Valve Co., Ltd., set an excellent example by installing an automatic grid-making machine, which was seen in action. Nothing is more interesting to visitors than a glimpse of manufacturing processes such as the one thus afforded. It is, however, impossible to do more than pick out, more or less at random, a few plums from the embarrassingly rich fare provided.

Discourses were delivered as follows: on Jan. 7, Lord Rayleigh on "Iridescent Colours in Nature from the Standpoint of Physical Optics"; on Jan. 8, Mr. S. G. Brown on "Gyro-Compasses for Gun-Fire Control"; and on Jan. 9, when the general public was admitted free, Sir Ambrose Fleming on "Television, Present and Future".

Prize Awards of the Paris Academy of Sciences.

AT the annual public meeting of the Paris Academy of Sciences, held on Dec. 16, the prize awards for the year were announced as follows:

Mathematics.—The Francœur prize to Paul Noaillon, for his researches in mathematical analysis and hydrodynamics.

Mechanics.—The Poncelet prize to Alfred Liénard, for his works on the application of the general theories of mechanics to the problems of electrostatics, electrodynamics, and magnetism; the Henry Bazin prize to Charles Camichel, for his experimental study of eddies in liquids with the aid of metallic particles in suspension.

Astronomy.—The Lalande prize to Alexandre Véronnet, for the whole of his astronomical work concerning the figure and constitution of the heavenly bodies; the Damoiseau prize to Gaston Fayet, for his memoir on the eccentricities of cometary orbits; the Valz prize to Louis Dunoyer, for his researches on spirit-levels and photoelectric cells.

Geography.—The Gay prize to Ludovic Gaurier, for his work on the lakes of the Pyrenees; the Tchihatchef foundation to Paul Pollacchi, for his French colonial atlas.

Navigation.—Prize of the Ministry of Marine to (the late) Eugène Émery, for the whole of his work; the Plumey prize to Pierre Clerget, for his improvements in motors for air navigation.

Physics.—The Gaston Planté prize to Charles Féry, for his work on the theory of the lead accumulator; the Hébert prize to Georges Déjardin, for his researches on ionisation potentials and on the classification of spectral lines of various atoms; the Henri de Parville prize to Marcel Pauthenier, for his work on Kerr's electro-optical phenomenon; the Hughes prize to Jean Jacques Trillat, for his researches on molecular orientation made by means of the X-rays; the Clément Félix foundation to René de Mallemann, for his work on rotatory polarisation.

Chemistry.—The Montyon prize (unhealthy trades) to Daniel Florentin, for his work on the hygiene of large towns; the Jecker prize between Richard Fosse, for his work in agricultural, biological, and organic chemistry, and Marcel Sommelet, for the whole of his work in organic chemistry; the Cahours foundation between Henri Moureu, for his researches on the tautomerism of the α-diketones, and Raymond Quélet, for his work on certain derivatives of benzene; the Houzeau prize to André Travers, for his work in inorganic and analytical chemistry.

Mineralogy and Geology.—The Delesse prize to Marius Dalloni, for his geological work on northern Spain and Algeria; the Fontannes prize to Alfred Carpentier, for his work on palæobotany; the Victor Raulin prize to Pierre Bonnet, for his geological work on Armenia.

Botany.—The Desmazières prize to Hubert Bourdot, for his work on the Hymenomycetes of France; the Montagne prize between Pierre Dangeard (1000 francs), for his memoir on *Bangia* and *Porphyra*, and Robert Potier de la Varde (500 francs), for his work in bryology; the Thore prize to Charles Douin, for his work on the

structure of the Muscineæ; the de Coincy prize to Paul Dop, for the whole of his botanical work.

Anatomy and Zoology.—The Cuvier prize to Émile Topsent, for the whole of his work; the Savigny foundation to Henri Gauthier, for his researches on the fauna of the continental waters of Algiers and Tunis.

Medicine and Surgery.—Montyon prizes to Gaston Cotte (2500 francs), David and Jean Olmer (2500 francs), Francis Rathery (2500 francs); Honourable mentions (1500 francs) to Charles Joyeux, Camille Simonin, and Mlle. Suzanne Guéry; the Barbier prize to Prosper Merklen and Maurice Wolf, for their work on the anatomy and pathology of the reticulo-endothelial system; the Bréant prize between Marcel Léger (3000 francs), for the whole of his work relating to plague, and Pierre Lereboullet and Georges Boulanger-Pilet (2000 francs), for their clinical and therapeutical manual of diphtheria; the Godard prize to François Aman-Jean, for his memoir on the thoracic-lumbar region; the Mège prize to René Monceaux, for his memoir on disturbances of the nutritive exchanges in pulmonary tuberculosis; the Bellion prize to Paul Chavigny; the Barron Larrey prize to Joseph Uzac, for his memoir on the medico-surgical organisation in the army; the Argut prize to Robert Leroux-Robert, for his memoir on high frequency in oto-rhino-laryngology.

Physiology.—The Montyon prize to André Strohl, for his work on the electrical conductivity of the human body; the Pourat prize (in equal parts) between Léon Velluz, for his memoir on the biochemical properties of the ethylene linkings, and Henri Bulliard and Antoine Giroud, for the whole of their work on the epidermis; the Philipeaux prize to Louis Genevois, for work in plant biology; the Fanny Emden prize to César Baudi de Vesme, for the whole of his work on the history of experimental spiritualism.

Statistics.—The Montyon prize to Maurice Olivier, for a work on the index numbers of the variation of prices.

History and Philosophy of the Sciences.—The Binoux prize to Prosper Jules Charbonnier, for his work on the history of ballistics; the Henri de Parville prize to Jean Paul Bounhiol, for his work entitled "La Vie".

Medals.—The Berthelot medal to Daniel Florentin, Mlle. Germaine Marchal, André Travers; the Henri Poincaré medal to Louis de Broglie, for his work on wave mechanics.

General Prizes.—The prize founded by the State (Grand prize of the physical sciences) to René Dubrisay, for the whole of his work in physical chemistry; the Bordin prize to Henri Bénard, for his work on vortices; the Lallemand prize to Mlle. Marie Louise Verrier, for her memoir on the eyes and vision of fishes; the Serres prize to Pol. Bouin and Paul Ancel, for their work on the mechanism of the differentiation of secondary sexual characters; the Petit d'Ormoy prize (mathematical sciences) to Paul Montel, for the whole of his work on the theory of functions; the Petit d'Ormoy prize (natural sciences) to Paul Gaubert, for the whole of his mineralogical work; the Jean Jacques Berger prize to (the late) Émile Gérard, for his geological map of the twenty *arrondissements* of Paris; the Saintour prize to Bertrand Gambier, for the whole of his work in infinitesimal geometry; the Lonchampt prize to Pierre Lesage, for his researches on the action of sea salt on the development of plants; the Wilde prize to Léon Brillouin, for his work in physics; the Gustave Roux prize to André Roussel, for his work in mathematical analysis; the Thorlet prize to Adolphe Richard.

Special Foundations.—The Lannelongue foundation between Mmes. Cusco and Rück; the Helbronner-Fould prize to Mme. Louis Gentil.

Prizes of the Grande École.—The Laplace prize to Maurice Borgeaud; the L. E. Rivot prize between Maurice Borgeaud, Alfred Flinois, Paul Moch, and Édouard Beltrémieux.

Foundations for Scientific Research.—The Trémont foundation to Charles Frémont, for his work in applied mechanics; the Gegner foundation to Paul Gautier, for his work in connexion with the Lecoq Museum at Clermont-Ferrand; the Hirn foundation to M. Janvier, for his researches on the Hymenoptera of Chile.

The Loutreuil Foundation.

Out of 27 applications for assistance from this fund, grants were made in the following 21 cases:

(1) *Researches on Specified Subjects.*—2000 francs to François Maignon, for the continuation of his researches on the mechanism of venous sclerosis, of anaphylaxy, the rôle of fats in the utilisation of proteins, the influence of the seasons and of the genital glands on basal metabolism; 3000 francs to Gabriel Marotel, for undertaking researches on Douve's disease and its treatment; 2000 francs to Robert Hamy, for the study of the conditions determining the curdling of milk; 2000 francs to Henri Colin, for the purchase of apparatus for micro-analysis for use in his researches on the carbohydrates; 5000 francs to Henri Cottier, for research into inheritance in crosses of Asiatic and French cattle; 2500 francs to Claude Gautier, for his researches on the evolution of the total albumenoids of the liver under the influence of nutrition by casein peptone, or by a complex mixture of amino-acids; 7000 francs to Edmond Roy-Prémorant, for the construction of his diasthypsometer, a geodesic instrument.

(2) *The Purchase of Material for Researches.*—5000 francs to Émile Demoussy, for the reorganisation of the laboratory of agricultural chemistry at the national agronomic institute; 5000 francs to René Dubrisay, for the laboratory of general chemistry at the Conservatoire national des Arts et Métiers; 10,000 francs to the Museum of Histology of the Hôpital de Saint-Louis for the purchase of projection apparatus; 25,000 francs to the Observatory of Ksara, for the purchase of a seismograph; 10,000 francs to the Colony of Tahiti, and 10,000 francs to the Colony of New Caledonia, as a contribution to the creation of a seismological station in each of these islands.

(3) *The Purchase of Books.*—3500 francs to the National Veterinary School of Toulouse, for completing its French and foreign collection of scientific books and periodicals; 4000 francs to the library of the National Agronomic Institute for the same object; 8000 francs to the library of the École supérieure d'électricité, for the purchase of Wien's treatise on physics (35 volumes); 5000 francs to the society for the encouragement of national industry, for its library.

(4) *Voyages and Explorations.*—5000 francs to Paul Pallary as a contribution to the cost of a zoological expedition in Syria; 3000 francs to Dr. Vellard, to assist his researches in pure and medical zoology in the less known parts of Brazil.

(5) *Publications.*—5000 francs to the Faune des colonies françaises; 3000 francs to Gaston Fayet, for the publication of the *Bulletin de l'Observatoire de Nice.*

The total grants made amount to 128,000 francs.

The Victor Noury foundation between Victor Delahaye (3000 francs), for a book on the physical geography of Indo-China; V. Babet (2000 francs), for his work on the geology of Mayombé, and Mlle. Germaine Marchal, for the whole of her work; the Charles Bouchard foundation to Serge Oberlin, for his work (with Dr. R. Grégoire) on anatomy; the Le Chatelier foundation to Mlle. Jeanne Foret, for her researches in inorganic chemistry; the Roy-Vaucouloux foundation to Eugène Wollman, for his work on life under aseptic conditions.

Annual Meeting of the Mathematical Association.

"GENERAL impressions", said Sir Francis Galton, "are never to be trusted." This general impression (which, if trusted, convicts itself of untrustworthiness) was effectively quoted by Mr. B. L. Gimson in opening the discussion on "Arithmetic of Citizenship" at the annual meeting of the Mathematical Association on Jan. 6 and 7. Though later in the meeting 'general tendencies' or 'laws out of focus' were put forward as governing human life, and therefore to be brought within the mathematician's domain through the study of probability and correlation, yet it may be granted that the mathematician above all others should be dissatisfied with general impressions where quantitative data are available. Mr. Gimson outlined a course of civic arithmetic classified by human interest instead of by arithmetical processes, under such headings as 'Local Finance', 'National Finance', 'Saving, Banking, and Investment', 'Insurance', etc. His experiments, carried on for five or six years with classes of boys and girls of the type commonly called unmathematical, have proved that these children can successfully and with keen interest work upon such real-life data as are to be dug from "Whitaker's Almanack" or the prospectuses of insurance companies.

Those who were inclined to suspect Spherical Harmonic Functions of being excessively abstract found their suspicions agreeably dissipated by Prof. S. Chapman's lecture on their application to mathematical physics. Among the interesting concrete examples which he gave was that of the magnetic field of the earth, expressible as the sum of two convergent series, one of negative powers of the distance from the centre of the earth, giving the part of the field due to extra-terrestrial causes, the other of positive powers, giving the part originating from within. Work begun in 1600 by Gilbert, and carried on later by Gauss, led to the conclusion that this internal part predominates; but it is only by the use of spherical harmonic functions that 94 per cent of the field is now attributed to an internal origin, 3 per cent to causes residing in the lower air, and 3 per cent to the influence of the sun and other bodies outside the earth. In striking contrast to this is the distribution of the responsibility for the diurnal magnetic variation, about 5/7 of which is directly dictated from outside the earth, while the 2/7 which analysis assigns to the inside is probably due, if traced another step towards its source, to internal currents induced by those passing outside. A further deduction from this analysis of the earth's magnetic field is that the earth's electrical conductivity, after changing but little within 200 miles of the surface, increases considerably below that depth.

The principle of a certain celebrated pump was (rather loosely perhaps) described to an inquirer in these words: "You leave out the piston, and compensate for its absence by leaving out the rest of the pump. But it works." This also appears to be the principle on which 'The Dalton Plan' works. You leave out the class-room, the lesson, the chalk, and the teacher: without these hindrances the pupil learns as naturally and inevitably as water flows uphill. Without (or even with) the proved fact that it sometimes does work, one would call it impossible. Mr. G. W. Spriggs, opening the discussion on "Problems of Individual Education, with special reference to Mathematics", gave a most illuminating and well-thought-out account of his own experiments at the Tiffin Boys' Secondary School, first on the Dalton Plan itself, and later on various modifications of it which his own experience suggested. Men of science would feel a certain glow of self-satisfaction, if they were not above such human weakness, at the news that his principal success has been in sweeping away the atmosphere of the mathematical classroom and substituting for it the spirit of the chemical or physical laboratory, where groups collaborate and discuss instead of sitting chained to desks and books. Many will agree that the education of the future may with advantage develop in this direction, as economics may towards communism: if there is value in the analogy it lies in the lesson that communism, though ideal when it appears as a natural growth, is the most disastrous of failures when imposed by authority.

Prof. W. M. Roberts, of the Royal Military Academy, Woolwich, began his lecture on "Gunnery and some of its Mathematical Problems" by some quotations from Tartaglia's "Colloquies", written in 1546. To this Tartaglia is due the solution of the cubic equation for which the charlatan astrologer Cardan appropriated the credit: clearly a conspicuously able mathematician, of an intellectual calibre fit to win distinction in any age. Nothing brings home to us so startlingly the extent of our debt to Galileo and Newton as the pitiable dynamics of this master-mind groping in the darkness of the Aristotelian world. Two guns are placed, equidistant from a given wall, one at the level of the foot of the wall, the other as high as its top. Both fire so as to hit the top of the wall: which hits it harder? "The higher", says the Duke, a practical man, who, like Dr. Watson or a Greek chorus, serves as a foil for the sage's wisdom. "No," says Tartaglia, "The science of weight sayeth contrary. The pellet weigheth less obliquely and therefore flyeth more heavily out of a piece that lyeth level than when it lyeth crooked." Another consideration is that the pellet which started from the lower and more elevated piece would go farther before hitting the ground, if the wall were removed, than would its rival from the higher and less elevated: therefore it contains more force. "You have argued well", said the Duke.

In "the cupping effect", Tartaglia is on surer ground. The rapid cooling of the hot gas after firing causes a low pressure in the barrel, which in "The Bombardier's Story" whuffled an excessively inquisitive dog into the muzzle, where he served as an unwilling piston. "If one shall stick his bare belly against the muzzle, he shall not without great difficulty leave the spot." Members of the Mathematical Association have only themselves to blame if they try this experiment after Tartaglia's and Prof. Roberts's warning.

Gunnery would have been better in the War if officers, or even if only instructors, had understood the theory underlying the practice of the 'long bracket' and 'short bracket' and their connexion with the '50 per cent zone'. On the assumption that four times the 50 per cent zone constitutes a 100 per cent zone containing every shell fired at a given elevation, Prof. Roberts explained the problem, "Given an observer who can only see whether the shell falls beyond the target or short of it, how to bring the Mean Point of Impact as near as possible to the target in the minimum number of rounds". The answer is well known and is taught to gunners as rule-of-thumb: the reason for the answer deserves more attention than it had when most of our artillery officers had never seen Woolwich.

Dr. W. F. Sheppard in his presidential address dealt with "Mathematics for Study of Frequency Statistics". The future, I believe, will criticise the mathematicians of our time more for their backward-

ness in making this subject a part of every mathematician's education than for any of our other defects. If the next generation is less open to this criticism than ours, their thanks will be due to a small body of workers among whom Dr. Sheppard is a notable figure. On this occasion he touched only lightly on frequency-distribution, giving his chief attention to interpolation. What percentage of those who use, and possibly think they can prove, the binomial theorem know that it arose originally from Newton's researches into interpolation? Yet probably an even smaller percentage can attempt for themselves anything beyond 'straight line' or 'first difference' interpolation. Dr. Sheppard's paper showed this simple process as a first approximation to various series employed by Newton, Gregory, Euler, Maclaurin, Whittaker, and others, with special emphasis on those 'central difference' formulæ which avoid the unsymmetrical tendency to take more account of observations on one side of the required point than on the other.

The final discussion on "The Mathematician in Ordinary Intercourse", after being ably opened by Miss Hilda P. Hudson in a speech somewhat critical of her own calling, degenerated into a (fortunately finite) series of addresses on the subject 'Are we remarkably fine fellows?' On this question there was conspicuous unanimity. W. HOPE-JONES.

Annual Conference of the Geographical Association.

THE annual conference of the Geographical Association was held at the London School of Economics on Jan. 2–4, and was attended by between 400 and 500 delegates and members from all parts of Great Britain. The publishers' exhibition included an unusually fine display of wall maps and other maps for teaching purposes. The outstanding feature of this year's conference was the series of lectures by prominent business and professional men, all of them indicating very clearly the position which geography occupies as a key subject in a liberal education and in a preparation for a variety of careers.

Sir Henry Lyons, before handing over the office of president to Mr. B. B. Dickinson (who founded the association thirty-seven years ago), dealt in his address with co-operation between the geographer and surveyor. The surveyor is concerned with the application of accurate physical methods to the measurement of the earth: however much the geographer may use the results, surveying is not a branch of geography. But the interpretation of the surveyor's results, and especially the selection of matter to be incorporated in maps on a reduced scale, calls for accurate geographical knowledge. Col. Cochran-Patrick, of the Aircraft Operating Company, lectured on air survey, and emphasised the fact that aerial photographs record far more than can be incorporated on a topographical map. Many contracts for air survey now stipulate that a finished vertical photograph shall be supplied side by side with the finished map of the same area. The use made by archæologists of aerial photographs is well known, and it is interesting to record that the Aircraft Operating Company now employs a forest officer with a long experience in the tropics to assist in the interpretation of forested country. Sir John Russell, in his lecture on agricultural developments in South Africa, also stressed the importance of such co-operation.

REGIONAL SURVEY.

No less than three meetings were devoted to different aspects of regional survey work, and of outstanding importance was the discussion on the land utilisation map of Northamptonshire. Under the guidance of Mr. E. E. Field, and with the support of Mr. J. L. Holland and the Northamptonshire Education Committee, the whole of Northamptonshire, comprising more than 300 parishes, was surveyed by village school children. On the six-inch maps of the Ordnance Survey was marked the utilisation of each field—whether arable, grass, woodland, or waste—and the maps so obtained were reduced to the one-inch scale and the results published in three sheets by the Ordnance Survey. Provided the necessary funds can be obtained, the Geographical Association, following up the success of this pioneer work, proposes to establish a land utilisation survey of Britain, with a central office in London, which shall act as an organising and collecting centre for work of a similar character. The support of the Ordnance Survey, of various education authorities, and of agricultural authorities has been promised, and inquiries should be addressed to Dr. L. D. Stamp at the London School of Economics.

THE ACTUARY AND THE GEOGRAPHER.

Under the title of "The Mortality of Europeans in Equatorial Africa: A Study of the Effects of Improved Conditions and Mode of Life", an important paper was read by Mr. H. E. Raynes. For life insurance purposes an accurate estimate of probable mortality under tropical conditions is obviously of the greatest importance. The most trustworthy figures available relate to government servants, of all ranks and drawn from all classes, employed in West Africa. In the period 1881–1897 the death-rates per 1000 per annum were 75·8 for the Gold Coast and 53·6 for Lagos. Since that time the improvement has been simply amazing—a consistently rapid decline, interrupted only during the years of the War and immediately after, when many officials were overworked and their leave long overdue. The improvement has been specially marked since 1921, and at all ages the death-rates in 1925–28 were an improvement on those for 1921–24. In the period 1925–28 the rate varied from 6·5 per 1000 at the age of 25 to 12·1 per 1000 at age 45, dropping to 9·3 for age 50 and over. A similar reduction in the 'invaliding rate'—Europeans sent home on sick leave or retired as unfit—is also seen. It is often asserted that the resident from the tropics returns home ruined in health and doomed to an early death. Records of retired officials from West Africa, however, show in 1926–28 a mortality of 14·6 per 1000 per annum, against the normal for Great Britain of 15.

Under modern conditions the European in the tropics has an expectation of life differing almost imperceptibly from that in his native country. Deaths are not due to the climate—the 'poisonous atmosphere' of the tropics is a myth—but to lack of precaution against disease. Nearly all tropical diseases are preventable, because they are either water-borne or insect-borne. There are three essential factors in modern conditions—segregation (because of opportunities of social intercourse amongst Europeans and a resulting high moral standard), sanitation, and personal hygiene. Good, even luxurious, housing and good food are necessities, not luxuries, for the European in the tropics. The comparatively high mortality amongst missionaries emphasises the result of a lower standard of comfort.

BRITISH NATIONAL PARKS.

Dr. Vaughan Cornish entered an eloquent plea for a national coastal park, and for reasons of winter climatic conditions, emphasised the suitability of parts of Pembrokeshire or Cornwall.

THE NORWICH FOLK MUSEUM.

At the conclusion of the London meeting, a party of members visited Norwich at the invitation of the Norwich branch. On the Saturday evening they were received by the Lord Mayor (Councillor H. Harper Smith), who, in a lantern lecture, outlined the growth of the city, and gave the Association some idea of the wisely planned and actively pursued efforts of the Corporation to preserve the ancient monuments in which Norwich is so rich and to develop the amenities of the city in all directions. The reception was held in the Strangers' Hall, a beautiful medieval mansion presented to the city by the late Mr. L. G. Bolingbroke and since utilised for the housing of the first 'Folk Museum' in the country. Of parallel interest is the Bridewell Museum, another medieval mansion, and a magnificent example of squared flint work, which houses a collection illustrating local industries. There are few cities which can boast a comparable collection so well arranged, and it is hoped that its immense educational value will be maintained by keeping the exhibits up-to-date as Norwich industries develop.

On Sunday the party studied the agriculture of Norfolk between Norwich and Cromer, and the coast erosion and geology between Cromer and Sheringham. Monday was devoted to a morning tour of the city, and an afternoon visit to Messrs. Colman's mustard works.

L. DUDLEY STAMP.

Annual Meeting of the Science Masters' Association.

THE full programme of the thirtieth annual meeting of the Science Masters' Association, under the presidency of Prof. J. C. Philip, held at the Imperial College of Science, with evening meetings at King's College for Women, appeared in NATURE of Dec. 28 in the Diary of Societies.

Twelve years ago the membership of the Association was about 200 and the whole exhibition of traders, publishers, and members was confined to one large room in the London Day Training College. To-day the membership is 1560, about 500 of whom attended the recent four days' conference. The members' exhibit alone, consisting of about 70 pieces of apparatus made in school workshops, much of it original and very ingenious, occupied the whole of the large Physical Chemistry Laboratory of the Imperial College, whilst the traders' and publishers' exhibition was most extensive and instructive, occupying two laboratories, one being the largest in the building. This remarkable development of the Association is of course due to the original founders having the vision to throw open the membership to all male teachers of science in secondary schools. The friendly contact and fellowship between men with varying types of teaching experience is probably one cause of the particularly bright and stimulating discussions which were an outstanding feature of this year's conference, and show that teachers of science as a body are keenly alive and that school science is in a healthy condition. This does not mean that teachers of science are satisfied either with the content of their courses or the methods of teaching. They realise that school science is a relatively recent development and as such is of necessity still in the experimental stage—a fact apt to be overlooked by the critics.

Many of the members feel, with the president, that after the school certificate stage the tendency has been to make the courses for science specialists too intensive. On the other hand, others prefer to keep within the narrower limits on the ground of thoroughness. There is room for both types of post-matriculation course according to the natural abilities of the pupils and the qualifications of the teacher.

The need for closer co-operation between university and school is keenly felt by science masters, and during the recent conference the rector of the Imperial College, the president of the Association, and the four professors who initiated the discussion on "Openings for College Trained Men in the Mineral Industry", all made special reference to this.

For years science masters have been much exercised in their minds about the value of practical examinations at the school certificate stage. Some examining bodies demand them, others do not, and it is not surprising that science masters are also divided on the question. But a general feeling prevails that some form of practical examination is desirable at the school certificate stage. This should test the ability to do *practical* work and not *theoretical* work or *mathematics*. The joint discussion with the Physical Society on "Examinations in Practical Physics" was noteworthy, in that a new method of examining practical work was put forward by Dr. L. F. Richardson and Mr. R. S. Maxwell, who call it the 'pantopiric' method. In it a large number of simple experiments are to be done in, say, three hours, the candidates moving round like the members of a family coach every time a bell is rung. Mr. Meier, of Rugby School, mentioned that he had tried this with a class, setting six short experiments to be done in two hours, and he was convinced that this method, combined with a practical examination in which all the candidates answered one and the same question in three hours, gives a trustworthy method of testing practical work.

The discussion on broadcasting which followed the specimen lesson on "Liquids", given by Mr. A. F. Walden and broadcast by the B.B.C. from an adjacent temporary studio, elicited the fact that there is a great divergence of opinion on the value of broadcast lessons in science. It was agreed that broadcasting might be utilised to bring boys and girls into touch with recent developments by enabling them to listen to accounts broadcast by the actual discoverers. A resolution was passed that "This Association suggests that broadcasting is not a suitable medium for the science lesson, but recognises that it might be of use in presenting lectures on general science subjects at a time outside the ordinary school time-table".

The past neglect of the teaching of biology in the schools has been partly owing to the fact that physics and chemistry developed earlier and that these subjects lend themselves more readily to laboratory treatment, partly also to the fact that biology should be first of all an outdoor study, and this raises time-table difficulties seldom appreciated by headmasters. The well-attended discussion on "School Certificate Biology", at which the syllabus printed in last week's NATURE was discussed, directed attention to the fact that teachers of the subject work under very varying conditions in regard to time allowance, laboratory accommodation and assistance, money available, etc., making common agreement on a syllabus difficult. This could be overcome by schools sending their own

syllabuses for approval by the examiners. Resolutions were passed that papers on biology should not include questions in pure chemistry and physics; that there should be no separate practical examination; that in many schools definite field work is at present impossible; that biology should be a subject which ranks for matriculating purposes on the same footing as other subjects; and that the course should be primarily for general education purposes.

The retiring chairman, Mr. W. J. Gale, handled the meetings with his usual skill. In previous years he has rendered the Association excellent service, first as a member of the committee and later as secretary. The chairman for 1930 is Mr. F. Fairbrother, of the Cedars School, Leighton Buzzard, and the new president is Sir Charles Grant Robertson, principal of the University of Birmingham, where the next meeting is to be held.

University and Educational Intelligence.

BRISTOL.—Dr. R. J. Brocklehurst has been appointed to the chair of physiology. Dr. Brocklehurst took first-class Hons. Schools at Oxford, and was assistant in physiology, at first part-time, then whole time, at St. Bartholomew's Medical College in 1925–26. He was awarded a Radcliffe Travelling Fellowship from Oxford, with which he went to America and Germany from 1926 until 1928, returning to take up a post as senior lecturer at University College, London, in August 1928. His new appointment dates from Aug. 1 next.

LEEDS.—Plans have now been approved for the new building to accommodate the Department of Chemistry—Inorganic, Organic, and Physical. This building, stretching, when completed, from the Physics Department to Woodhouse Lane, will, together with the mining block at right angles to it, form the north elevation of the new scheme. The east elevation will run alongside Woodhouse Lane, for a distance of about 180 feet, and at its lower end another wing, containing a number of large laboratories, will reach back a distance of 240 feet towards the physics building and will form the southern side of the rectangle of which the complete building will consist. The erection of certain portions of the chemistry block is being postponed, but even so the building shortly to be started will have a floor space of some 95,000 square feet.

THE Board of Governors of the Hebrew University in Jerusalem has authorised the various science departments and institutes to conduct formal courses in biological sciences. The establishment of a School of Tropical Medicine has also been approved. The School is to be in connexion with the proposed medical centre in Jerusalem, which is being planned jointly with the American Jewish Physicians' Committee and the Hadassah Medical Organisation. Dr. S. Adler has been promoted to be professor of parasitology and director of the Department of Parasitology at the University, and he has been granted twelve months' leave in order to carry out investigations on kala-azar for the Royal Society. Dr. A. Fraenkel, formerly professor of mathematics at the University of Kiel, has been appointed professor of mathematics in the Einstein Institute of Mathematics at the University, and Dr. M. Felete has been made associate professor of mathematics. A special course in advanced bacteriology for graduate students is being given by the Department of Hygiene.

Historic Natural Events.

Jan. 20, 1607. **Severn Floods.**—Stow records that "the waters rose above the tops of the houses", and the event is commemorated by a painted board in the church at Kingston Seymour. The flood came suddenly; many persons were drowned and much cattle and goods lost; the water in the church was five feet high and lay on the ground about ten days. The floods extended along the coast for about 20 miles and reached a depth of 12 feet in places. The East Anglian fens were widely flooded by the same storm, and in Romney Marsh the sea came in so "outrageously" that it did not seem as if the area could ever be reclaimed.

Jan. 20, 1838. **Great Cold.**—On Jan. 7 a very severe frost set in and continued a month. Jan. 20 is described as the coldest day of the century in London; temperature fell to −4° F. at Greenwich, −13½° F. at Beckenham, and −14° F. at Walton near Claremont.

Jan. 21–22, 1904. **Hurricane in Fiji.**—A violent hurricane struck the eastern part of the Fiji Islands, probably coming from north of east, recurving near the group and passing away to the south-east. Many houses and coco-nut-trees were destroyed, and the lowlands were flooded six feet above high tide mark.

Jan. 22–24, 1879. **Glazed Frost.**—At Fontainebleau and Orleans rain fell steadily for three days at a uniform temperature of 27° F., freezing as it fell. A layer of ice an inch thick formed on the ground, while the branches and twigs of the trees and the telegraph wires were covered by shells of ice of the same or greater thickness.

Jan. 23, 1556. **Great Earthquake.**—The Chinese earthquake of this date, the most destructive in human life of all known earthquakes, was especially severe in the provinces of Shensi and Shansi. In some places, houses and parts of cities sank into the earth. More than 830,000 persons were killed.

Jan. 23, 1855. **Great Earthquake.** — The earthquake that occurred on Jan. 23 in 1855 was one of the strongest of New Zealand earthquakes, having disturbed an area of about 360,000 sq. miles. The earthquake is remarkable for the wide-spread changes of elevation that accompanied it. A tract of land in the southern portion of the North Island, about 4600 sq. miles in area, was raised from 1 to 9 feet, the greater amount being reached along an old fault for a distance of 90 miles along the foot of the Remutaka Mountains. In the South Island, the ground was usually depressed from 1 to 5 feet, though over a smaller area.

Jan. 23, 1895. **Thunderstorm and Squall.**—Shortly before 10 A.M., intense darkness and thick fog came on suddenly in London, followed abruptly by a sharp thunderstorm with a heavy shower of hail, while temperature dropped 5° F. and the wind rose suddenly from nearly calm almost to gale force. The storm was traced across England from Leeds to Sussex; at Bramley near Guildford there was heavy snow and great destruction of trees. The thunderstorm was followed by a severe frost.

Jan. 24, 1666. **Wind Storm.**—Pepys records that "It was dangerous to walk in the street [of London], the bricks and tiles falling from the houses that the whole streets were covered with them; and whole chimneys, nay, whole houses in two or three places, blowed down. But, above all, the pales on London-Bridge on both sides were blown away, so that we were fain to stoop very low for fear of blowing off the bridge. We could see no boats in the Thames afloat,

but what were broke loose, and carried through the bridge, it being ebbing water. And the greatest sight of all was, among other parcels of ships driven here and there in clusters together, one was quite overset and lay with her masts all along in the water, and keel above water."

Jan. 24, 1684. Great Frost.—Under this date Evelyn wrote: "The frost continuing more and more severe, the Thames before London was still planted with boothes in formal streetes, all sorts of trades and shops furnished and full of commodities, even to a printing presse. . . . Coaches plied from Westminster to the Temple, and from several other staires, to and fro, as in the streetes, sleds, sliding with skeetes, a bull-baiting, horse and coach races, puppet plays, and interludes, cookes, tipling, and other lewd places, so that it seemed to be a bacchanalian triumph, or carnival on the water." This frost continued from the beginning of December to Feb. 5, and according to Maitland's "History of London" a whole ox was roasted on the ice near Whitehall. On the Mendip Hills the snow was more than six feet deep in places and people were buried; some of it still remained at midsummer. This was the winter described in "Lorna Doone".

Jan. 24, 1926. The Largest Sunspot.—On this day the largest sunspot seen in recent years (certainly since 1874 when the Greenwich photographic series was instituted) passed across the sun's central meridian. The spot, complex in structure, was about 70,000 miles in length and occupied an area of nearly 4000 millions of square miles. This region of the sun was active in the preceding December, when a large spot, only slightly inferior to the great spot of January, was also easily seen with the naked eye. On Jan. 25 and again on Feb. 22, when the spot had diminished, brilliant gaseous eruptions were observed spectroscopically. The region was marked throughout by a great extent of bright faculæ which persisted for more than six months. A magnetic storm, presumably related to this active solar region, took place on Jan. 26–27, and was followed one synodic solar rotation later by another on Feb. 23–25.

Jan. 25, 1757. Damage by Lightning.—Above 20 feet of the upper part of the spire of Lostwithiel Church, Cornwall, were thrown down and dispersed in all directions, and some pieces were found at the distance of 200 yards. The vane was thrown down and bruised, its socket being rent open "as if it had been burst by gunpowder, and in such a manner as could not well be occasioned by the fall".

Societies and Academies.

LONDON.

Royal Meteorological Society, Dec. 18.—J. Edmund Clark and I. D. Margary: Floral isophenes and isakairs. It is now possible to compare the annual isophene map with the average map and to prepare from it a map showing for that year the variations from the average in all parts of the British Isles. Lines are drawn through points of equal variation defining areas of real earliness or lateness and are called 'isakairs' (equal unseasonableness). Maps so prepared are more instructive than the original isophene maps, for these are based on the original observations, which are always dependent on altitude, latitude, etc., in addition to the changing weather factors. In the isakair maps these constant influences are removed and the relation of weather to plant growth can thus be more readily followed. Isakair maps have been prepared for every year from 1891. They show the general distribution and degree of earliness and lateness in the first eight months of each year, and form a unique series for such information.—Sir Gilbert T. Walker: On the mechanism of tornadoes. The prevailing idea that the area of a tornado is roughly vertical has been opposed by Wegener, who maintained that it is horizontal. In this paper it is urged that while Wegener's evidence against a vertical axis is conclusive, he does not provide an adequate explanation of a horizontal direction, and that the rotation of the earth will, when convergence occurs, set up a spin parallel to its axis. This view is supported by the almost universal anti-clockwise rotation of tornadoes in the northern hemisphere and, in general, by the photographic evidence.—E. W. Bliss: A study of rainfall in the West Indies. The rainfall in the eastern islands of the West Indies is related to the circulation of the North Atlantic during the months March to May preceding, and is deficient when the circulation is more vigorous than usual; there is a close relationship with temperature in the Cape Verde Islands, and low temperatures tend to be followed by deficient rainfall. In addition, the rainfall in this part of the West Indies belongs to the first group of the southern oscillation.

Linnean Society, Dec. 19.—Dame Helen Gwynne-Vaughan and Mrs. H. S. Williamson: A contribution to the study of nutritive heterothallism. In *Humaria granulata*, a coprophilous member of the Discomycetes, nutritive heterothallism is associated with the presence of a functional oogonium. The spores are incapable of germination until five months after they are shed; they remain viable for a year or more. Single-spore cultures produce normal archicarps, but these fail to form ascogenous hyphæ. In about 50 per cent of cases fruits develop where two monothallic strains meet. The strains are of two kinds, + and −. Since each produces oogonia, the difference between them cannot be sexual. Mycelial fusions are common; when they take place between + and − strains, the oogonia in the neighbourhood form ascogenous hyphæ and develop into fruits. Their asci contain both + and − spores, showing that fusion of + and − nuclei takes place.—F. Howard Lancum: On the eviction-method of the cuckoo. Photographs of the process were secured last summer illustrating the various stages. The average time taken by young cuckoos to effect an eviction is three and a half minutes. In the case photographed, although the cuckoo ejected the egg many times during the morning, in only one instance did it take longer than twenty seconds to do so. The photographs showed that the cuckoo insinuated a wing underneath the egg and tilted it inward on to its hollowed back where it was held by the bird's wings and backward-tilted head. The egg is then pushed up the wall of the nest, the cuckoo meanwhile turning its back to it and maintaining a firm grip on the nest-material with its feet. The throwing-out movement commences by the cuckoo pushing the egg out backwards with its outspread wings, and finishes with a very vigorous push. This cuckoo evicted the same egg (which was replaced on each occasion) fifteen times in an hour. The strength and persistence of so young a bird (approximately thirty-six hours old), which could repeatedly evict an egg nearly as heavy as itself, climbing an almost perpendicular wall to do so, were remarkable.

PARIS.

Academy of Sciences, Dec. 9: Gabriel Bertrand and L. Silberstein: The relative importance of sulphur and phosphorus in the nutrition of plants. It has been proved in earlier communications that determinations of sulphur and phosphorus in the ash of plants

is liable to give erroneous figures for the proportions of these two elements present in the plant, owing to variable losses on ignition. Analyses avoiding this source of error are therefore given. In estimating the sulphur requirements of a soil, regard must be had to the fact that considerable proportions of it may be masked by the presence of barium. Sulphur must be considered as an element to be taken into account in the manurial treatment of the soil.—**E. Mathias**: Contribution to the study of fulminating matter. Globular lightning forming holes in the ground.—**A. Demoulin**: The theory of networks.—**H. Krebs**: The deformation of surfaces.—**Mandelbrojt** and **Gergen**: Functions defined by a series of Dirichlet.—**D. S. de Lavaud**: The variations of sensibility of self-tightening brakes on motor vehicles.—**H. Mineur**: The Keplerian movement disturbed by a field of external gravitation.—**P. L. Mercanton**: The true height of the Beerenberg of Jan Mayen. The values obtained for the height of this mountain by different observers show large variations. Barometric observations in 1921 gave 2276 metres: direct measurement with a base line of 1062 metres gave 2274 metres. Hence the map due to the Austrian expedition of 1882–83 requires correction in this and in other distances found in error.—**A. Gruvel**: A fishery map of a part of the western coast of Morocco. —**T. Takéuchi**: Machines which work between two radiant sources.—**A. Zmaczynski** and **A. Bonhoure**: The boiling point of water as a function of the pressure. A development of the apparatus devised by W. Swietoslawski for measuring the boiling points of water under different pressures. The two electrical resistances employed were standardised over the range 0°-200° C. at the Bureau International des Poids et Mésures. Over the pressure range 683-832 mm. of mercury, the results found were intermediate between the results of Holborn and Henning and of Chappuis, the concordance with the observations of the latter being close.—**A. Guillet**: The use of a galena detector in measurements worked with a variable current.—**Stefan Vencov**: The hydrogen spectra obtained by electronic shock in a mixture of hydrogen and mercury vapour.—**Adolfo T. Williams**: Spectral terms and chemical valency.—**R. Lucas** and **Mlle. D. Biquard**: The influence of temperature and of solvents on the rotatory powers of active substances. Data for the rotatory power of *l*-fenchone, *d*-cyanocamphor, *d*-anisylcamphor, and dimethylmalic ester at various temperatures and also in different solvents. In these cases it is not possible to account for the variations of the specific rotatory power by the hypothesis of the existence of only two active forms.—**Georges Fournier** and **Marcel Guillot**: The radiation responsible for the raising of the absorption curves relative to radium ($D+E$).—**F. Bourion** and **E. Rouyer**: Boiling point study of the molecular equilibrium of resorcinol in solutions of calcium chloride.—**M. Bourguel** and **Mlle. V. Gredy**: The mechanism of catalytic hydrogenation.—**H. Pélabon**: The action of iodine vapour on phosphorus vapour. The volatility product.—**E. Herzog** and **G. Chaudron**: The alteration of the mechanical properties of sheets of duralumin after corrosion by sea water. The pinholes produced in the duralumin by attack by sea water reduce the elongation, but do not sensibly reduce the breaking load. —**André Job** and **Georges Champetier**: The fixation of acetylene by phenylmagnesium bromide in the presence of ferric chloride.—**G. Dedebant**: Mathematical contribution to the analysis of the field of pressure.—**C. Dauzère**: The formation of electrical charges in storms. A discussion of Simpson's theory of rain, with special reference to the cause of the positive electrical charge.—**A. and G. Hamel**: The heterogamy of *Lola lubrica* (Cladophoraceæ).—**Paul Dop**: Two new genera of Bignoniaceæ of Tonkin.—**N. Wagner**: The evolution of the chondriome in the seeds of *Phaseolus multiflorus*.—**Jean Mercier**: Observations on the *Psammechinus miliaris* of the bay of the Seine.—**Mme. Y. Khouvine, E. Aubel**, and **L. Chevillard**: The transformation of pyruvic acid into lactic acid in the liver.

SYDNEY.

Linnean Society of New South Wales, Nov. 27.—**F. H. S. Roberts**: A revision of the Australian Bombyliidæ (Diptera) (Pt. 3). This paper deals with the lesser subfamilies.—**R. Broom**: On some recent new light on the origin of the mammals. Additional light is thrown on the problem by a recently discovered specimen from Ladybrand, Orange Free State, from the Cave Sandstone, of Rhaetic or Lower Jurassic age. The new animal is a small mammal-like creature about the size of a rat, but with relatively large head and a long tail. Together with *Karoomys*, *Pachygenelus* and *Tritheledon*, it is placed in the new suborder.—**W. F. Blakely**: A further contribution to our knowledge of the flora of New South Wales. This paper deals with the description of six new species of plants, one of each of the following genera: *Correa* (Rutaceæ), *Bertya* (Euphorbiaceæ), *Lasiopetalum* (Sterculiaceæ), *Kunzea* (Myrtaceæ), *Prostanthera* (Labiatæ) and *Goodenia* (Goodeniaceæ).—**W. L. Waterhouse**: Australian rust studies (Pt. 1). Teleutospore germinations of *Puccinia graminis tritici* E. and H. occur over a more extended period than had been previously determined. The æcidial stage has been produced repeatedly, but on no occasion by *P. graminis tritici* 43. Profound alterations in the reactions produced in seedlings by forms of *P. graminis tritici* and other rusts may be brought about by altering the environmental conditions in the plant house. In Australasia there have been found seven naturally occurring physiological forms of wheat stem-rust, and five of oat stem-rust, together with two forms of *P. triticina*. Certain grasses have been shown to be important hosts of cereal rusts. Evidence has been obtained pointing clearly to the fact that rusts over-summer in the uredospore stage on 'volunteer' cereals as well as on grasses.—**A. L. Tonnoir**: Australian Mycetophilidæ. Synopsis of the genera. A review of the Australian Mycetophilid fauna to date. A list of the genera is given, ten being described as new and the total recorded for the different States being brought to forty-seven. A peculiar adaptation of the palpi as prehensile organs in one species is described, as well as a case of mimetic resemblance of a Mycetophilid to a Hymenopteron.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 10, No. 10, Oct. 15).—**P. W. Bridgman**: (1) On the application of thermodynamics to the thermo-electric circuit. By a rearrangement of the argument, the equations of Kelvin for this circuit can be deduced rigorously from thermodynamics without assuming the justifiability of neglecting the effect of necessary irreversible processes. —(2) On the nature of the transverse thermo-magnetic effect and the transverse thermo-electric effect in crystals. There is a fundamental difference in sign in the relations connecting the Ettingshausen with the Nernst coefficient and their crystal analogues.—**F. Zwicky**: On the red shift of spectral lines through interstellar space. A qualitative, theoretical discussion of a new effect of masses upon light which is a sort of gravitational analogue of the Crompton effect. It offers an explanation of the high receding velocities of very distant nebulæ.—**E. L. Hill**: Relative inten-

sities in nuclear spin multiplets. A theoretical discussion.—M. S. Vallarta: On Einstein's unified field equations and the Schwarzschild solution.—Charles E. St. John: Elements in the sun. Of the 92 possible elements, 90 have been found in the earth and 58 in the sun's atmosphere. There are many faint lines and several strong ones in the solar spectrum as yet unidentified. Some of the strong lines are probably due to common elements, and since corresponding lines are not produced in laboratory, their presence suggests exceptional conditions of excitation.—Alfred J. Lotka: Biometric functions in a population growing in accordance with a prescribed law.—J. L. Walsh: Boundary values of an analytic function and the Tchebycheff method of approximation.—N. Wiener and M. S. Vallarta: On the spherically symmetrical statical field in Einstein's unified theory: a correction.

Official Publications Received.

BRITISH.

Canada. Department of Mines: Mines Branch. Memoir 157: Preliminary Report on Woman River and Ridout Map-Areas, Sudbury District, Ontario. By R. C. Emmons and Ellis Thomson. (No. 2191.) Pp. ii+30. 10 cents. Memoir 159: Bear River and Stewart Map-Areas, Cassiar District, B.C. By G. Hanson. (No. 2197.) Pp. iv+84. 20 cents. (Ottawa: F. A. Acland.)

Canada. Department of Mines: National Museum of Canada. Bulletin No. 56: Annual Report for 1927. Pp. 107. (Ottawa: F. A. Acland.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 396, December. Pp. 96+xxxviii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

The Journal of Dairy Research. Edited for the Dairy Research Committee of the Empire Marketing Board by Dr. R. Stenhouse Williams. Vol. 1, No. 1, November. (Published half-yearly.) Pp. 110. (Cambridge: At the University Press.) 10*s.* net.

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 13, Part 3, 18 December. Pp. 123-215. Vol. 13, Part 4, 18 December. Pp. 127-418. (Cambridge: Printed at the University Press.)

Catalogue of the Twentieth Annual Exhibition of Electrical, Optical and other Physical Apparatus, January 7, 8, and 9, 1930. Pp. 152+xxxii. (London: The Physical Society and the Optical Society.)

The Royal Air Force Quarterly: embodying also the Royal Australian Air Force, Royal Canadian Air Force, New Zealand Air Force, and South African Air Force. Edited by Squadron-Leader C. G. Burge. Vol. 1, No. 1, January. Pp. xlviii+234+21 plates. (London: Gale and Polden, Ltd.) 7*s.* 6*d.* net.

British Industries Fair, 1930, Olympia, London, W.14, February 17th to 28th. Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi+376+Ad. 174+Ad. xx. (London: Department of Overseas Trade.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929, December, Vol. 41. Pp. 787-883. (London.)

Journal of the Chemical Society. December. Pp. v+2661-2981+x. (London.)

Conference of Empire Meteorologists, 1929: Agricultural Section. 1: Report. Pp. 16. 1*s.* net. 2: Papers and Discussions. Pp. 308. 1*s.* net. British Agricultural Meteorological Scheme: Observers' Handbook. Pp. 34. (London: Ministry of Agriculture and Fisheries.)

The South-Eastern Naturalist and Antiquary: being the Thirty-fourth Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Thirty-fourth Annual Congress, held at Brighton, 1929. Edited by A. F. Ravenshear. Pp. lxiv+110. (London.) 5*s.* net.

FOREIGN.

Ministerio da Agricultura, Industria e Commercio. Annuario publicado pelo Observatorio Nacional do Rio de Janeiro para o anno de 1930. (Anno 46.) Pp. xvi+296. (Rio de Janeiro.)

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 7, No. 3: Photographic Photometry with the Thirty-inch Thaw Refractor. The Light Curves of Sixteen Eclipsing Variables. By Frank C. Jordan. Pp. 125-193. (Pittsburgh, Pa.)

Union Géodésique et Géophysique Internationale: Section de Magnétisme et Electricité terrestres. Bulletin No. 7: Comptes rendus de l'Assemblée de Prague, September 1927. Imprimés par les soins de Ch. Maurain. Pp. xii+269. (Paris: Les Presses universitaires de France.)

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 12: Über die Elliptizität des Erdäquators. Von W. Heiskanen. Pp. 18. (Helsinki.)

University of California Publications in American Archaeology and Ethnology. Vol. 27: A Grammar of the Wappo Language. By Paul Radin. Pp. viii+194. (Berkeley, Calif.: University of California Press; London: Cambridge: At the University Press.) 2.50 dollars.

Smithsonian Miscellaneous Collections. Vol. 81, No. 14: Prehistoric Art of the Alaskan Eskimo. By Henry B. Collins, Jr. (Publication 3023.) Pp. 52+24 plates. Vol. 82, No. 3: The Radiation of the Planet Earth to Space. By C. G. Abbot. (Publication 3028.) Pp. 12+2 plates. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Commerce: Bureau of Standards. Miscellaneous Publication No. 102: Annual Report of the Director o the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1929. Pp. iv+51. (Washington, D.C.: Government Printing Office.) 10 cents.

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University. Čis. 109: Étude de surfaces dont une droite canonique passe par un point fixe. Par Josef Kaucký. Pp. 37. Čis. 110: Generis Trigonella L. revisio critica II. Scripsit G. Sirjaev. Pp. 37. Čis. 111: Iter Turcico-Persicum. Pars 5: Plantarum collectarum enumeratio (Gramineae-Cryptogamae). Scripsit Dr. Fr. Nábělek. Pp. 42. Čis. 112: Příspěvek ke studiu adičních sloučenin organických zásad se soleni těžkých kovů. (Contribution à l'étude des composés d'addition des bases organiques avec les sels des métaux lourds.) Napsali J. V. Dubský a A. Rabas. Pp. 12. Čis. 113: Severní pokračování devonského pruhu šternbersko-benešovského ve Slezsku. (Continuation septentrionale de la zone dévonienne de Šternbeck-Benešov en Silésie.) Napsal Dr. Jan Stejskal. Pp. 39. Čis. 114: Příspěvek k analytickému studiu reakcí oximů. (Contribution à l'étude analytique des réactions des oximes.) Napsali J. V. Dubský a M. Kuraš. Pp. 43. (Brno: A. Píša.)

CATALOGUES.

The Salermo Process: Industrial Fuels from Coal by Low Temperature Distillation. Pp. 57. (London: Salermo, Ltd.)

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. (January 1930.) Pp. 130. (London: The British Drug Houses, Ltd.)

A List of Publications and Remainders. Pp. 128. (London: Bernard Quaritch, Ltd.)

Diary of Societies.

FRIDAY, JANUARY 17.

LONDON SOCIETY (at Royal Society of Arts), at 5.—F. W. Parker: London's Parks and Open Spaces.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. V. Coates: Tissue Reaction in Rheumatic Disorders, with Particular Reference to Subcutaneous Nodules.

BRITISH INSTITUTE OF RADIOLOGY (Medical Members), at 5.—Radiology in Bone and Joint Diseases.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. E. C. C. Baly: The Activated Sludge Process for Sewage Disposal.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester), at 7.—W. Kershaw: Faults in Textiles.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—T. Walley: The Pooling of Experience—a Function of the Institution.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—J. D. Johnston: Photographic Conventions.

ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—C. H. Smith: Domestic Hot Water.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—G. Andrew-Marshall: London's Water Supply.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dame Louise McIlroy and Miss Iris Ward: Three Cases of Imperforate Hymen occurring in one Family.—Dr. J. H. Hannan: Zondell-Ascheim Tests for Pregnancy.—Prof. J. P. Maxwell: Further Studies in Osteomalacia.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—J. Anderson: Cutting Currents.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Local Section of Institute of Chemistry) (at Thomas' Café, Swansea).—J. F. J. Dippy: The Geochemistry of Coal and the Natural Hydrocarbons.

SOCIETY OF DYERS AND COLOURISTS (London Section).—H. Clayton: Lake Colours—Manufacturer and Users.

SOCIETY OF DYERS AND COLOURISTS (Scottish Section).—J. G. Grundy: Colours Suitable for Hosiery and Tweeds.

PAPER MAKERS' ASSOCIATION (Technical Section—London Division) (at Connaught Rooms, Great Queen Street, W.C.).

PAPER MAKERS' ASSOCIATION (Technical Section—Northern Division) (at Engineers' Club, Manchester).—T. T. Potts: The Permeability of Paper to Air.

SATURDAY, JANUARY 18.

PHYSIOLOGICAL SOCIETY (at King's College), at 3.—Prof. J. Barcroft and J. J. Izquierdo: The Effect of Temperature on the Pulse Rates of the Frog and Cat respectively.—Prof. J. Barcroft and F. Verzar: The Effect of Temperature on the Pulse Rate of Man.—L. E. Bayliss and A. R. Fee: A Flow Recorder and Automatic Pump Control.—Prof. J. Mellanby: The Isolation of Prothrombase from Mammalian Blood.—Prof. R. J. S. McDowall: Vagus Restraint as a Rebound Phenomenon.—H. W. Kinnersley and Prof. R. A. Peters: Local Lactic Acidosis Accompanying Symptoms of Opisthotonus in the Pigeon.—F. R. Curtis: Adrenaline and Related Amines.—S. Wright: Action of Ergotamine on Vasomotor Reflexes.—C. Heymans and J. J. Bouckaert: Sinus Caroticus and Respiratory Reflexes, Cerebral Blood Flow and Respiration, Adrenaline Apnœa.—R. G. Garry: 'Amytal' and the Inhibitory Action of the Vagus on the Heart.—J. A. Hewitt: Protozoan Parasites in Human Heart Muscle.—B. Sarkar: The Use of Iron and Tannic Acid as a Tissue Stain.—A. D. Macdonald and E. D. McCrea: Observations on the Actions of the Nerves to the Bladder.—*Demonstrations:*—Prof. R. J. S. McDowall: (*a*) The Use of the Vertebral Clamp; (*b*) Central Sympathetic Stimulation; (*c*) A Convenient Method of Obtaining a Low Potential Current for Class Purposes; (*d*) On the Making of Tambours.—Prof. R. J. S. McDowall and A. Shore: The Action of Adrenaline on Perfused Pulmonary Vessels.—B. Finkleman: A Simple Inhibitory Nerve Smooth Muscle Preparation.—F. R. Curtis: The Interaction of Adrenaline and Ephedrine.—S. Wright and H. A. Bulman: Intestine of Cat following X-Radiation.—M. Pratt and E. B. Wright: Quantitative Estimation of Photosynthesis.—Elizabeth C. Eaves: The Fields of Vision for Colours of Normal and Colour-blind Students.—J. A. Hewitt: Sarcocystis in Cardiac Muscle.—B. Sarkar:

Tissues Stained by Iron and Tannic Acid.—F. W. R. Brambell and M. Allanson: Variation in the Number of Acidophil Cells in the Pars Anterior of the Pituitary of Adult Female Rabbits.

NELSON TEXTILE SOCIETY (at Preston Technical School).—C. A. Harrington: Designing of Fancy Fabrics.

MONDAY, JANUARY 20.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Lt.-Col. L. M. Davies: Scientific Discoveries and their Bearing on the Biblical Account of the Noachian Deluge.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Lt.-Col. R. C. F. Schomberg: Climatic Conditions in the Tarim Basin.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (jointly with Liverpool Engineering Society) (at Liverpool University), at 7.—Discussion on Low-Temperature Carbonisation of Fuel, with Special Reference to its Combination with the Production of Electricity. Introductory Papers by E. H. Smythe and E. G. Weeks (English Practice), and S. McEwen (American Practice).

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—T. W. Ross and H. G. Bell: Recent Developments in the Protection of Three-Phase Transmission Lines and Feeders.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—O. S. Nock: Modern Methods of Speeding-up Railway Traffic.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—Dr. B. P. Haigh: The Relative Safety of Mild and High-Tensile Steels under Alternating and Pulsating Stresses.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—D. R. H. Williams: Costing from a Manufacturer's Point of View.

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—Dr. S. G. Barker: Recent Developments in Woollen Yarn Manufacture, including Carding and Spinning.

ROYAL SOCIETY OF ARTS, at 8.—H. J. L. Wright: Three Master Etchers: Rembrandt, Meryon, Whistler (Cantor Lectures) (1).

TUESDAY, JANUARY 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. F. W. Aston: Isotopes (1).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—B. Ellinger: Japanese Competition in the Cotton Trade.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—E. J. Dobbs: Chrome Plating.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—W. G. Freeman: Trinidad.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.—L. C. Grant: The Breaking Performance of High-Power Switchgear and of a New Form of Quenched-Arc Switch.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—B. A. G. Churcher and A. J. King: The Analysis and Measurement of the Noise emitted by Machinery.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Milton Hall, Manchester), at 7.—R. Sutcliffe: Air Conditioning for Cotton Mills.

ILLUMINATING ENGINEERING SOCIETY (at Royal College of Music, South Kensington), at 7.—C. H. Ridge: The Art of Stage Lighting.

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester Athenæum), at 7.—L. G. Larmuth: Artificial Silk.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Capt. G. I. Finch: Mountain Shots in Kodacolor.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—L. Hathaway: Preparation of an Engine for Production.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Engineering and Scientific Club, Wolverhampton), at 7.30.—T. W. Cooper: Roller Bearings.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Albert Hall, Leeds), at 7.30.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—G. Stanfield: Temperature Distribution and Stress Effects in Heating and Cooling of Masses.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology, Leicester), at 8.—M. P. Applebey: Manufacture of Synthetic Nitrogen.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presidential Address to Students.

WEDNESDAY, JANUARY 22.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine and Surgery Sections), at 5.—Discussion on Actinomycosis Common to Man and Animals.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. J. W. Gregory, Dr. Ethel Dobbie Currie, Dr. J. Weir, Dr. S. Williams, and Dr. G. W. Tyrrell: On the Geological Collection from the South Central Sahara made by Mr. Francis Rodd.—J. V. Harrison: The Geology of some Salt-Plugs in Laristan (South Persia).

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—H. K. Whitehorn: Petrol-Electric Vehicle Characterstics.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—R. Harding: The Psychology of the Shipbuilding Industry.

ROYAL SOCIETY OF ARTS, at 8.—G. Stone: Observations on the Mining Laws of the British Empire.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 4.30.—Lord Rayleigh: Normal Atmospheric Dispersion as the Cause of the 'Green Flash' at Sunset, with Illustrative Experiments.—Dr. F. W. Aston: The Photometry of Mass-Spectra and the Atomic Weights of Krypton, Xenon, and Mercury.—Prof. O. W. Richardson: A New Connexion between the Absorption Spectrum of Hydrogen and the Many Lined Spectrum.—Dr. P. A. M. Dirac: A Theory of Electrons and Protons.—*To be read in title only*:—R. V. Southwell and L. Chitty: On the Problem of Hydrodynamic Stability. I.—P. J. Daniell: The Theory of Flame Motion.—N. K. Adam and Dr. O. Rosenheim: The Structure of Surface Films. Part XIII.—F. C. Johansen: Flow through Pipe Orifices at Low Reynolds' Numbers.—W. B. Pleass: Some Physical Conditions Affecting the Setting of Gelatin and the Bearing of the Results on the Theory of Gel Formation.—N. F. Mott: The Collision between Two Atoms.—C. C. Tanner and Prof. I. Masson: The Pressure of Gaseous Mixtures. III.—F. J. W. Roughton: The Time Course of the Heat Effects in Rapid Chemical Changes. Parts I. and II.—E. T. Hanson: Diffraction.—C. E. Marshall: A New Method of Determining the Distribution Curve of Polydisperse Colloidal Systems. Parts I. and II.—N. K. Adam: Structure of Surface Films. XIV.—Prof. E. V. Appleton: Some Measurements of Equivalent Height of the Atmospheric Ionised Layer.—T. E. Stern: Some Remarks on the Conduction of Electricity in Metals and upon Allied Phenomena.—A. Harvey: The Zeeman Effect in the Band Spectrum of Helium II.—N. F. Mott: The Wave Mechanics of α-Ray Tracks.

LINNEAN SOCIETY OF LONDON, at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. A. Harris: The Growth of Children in Health and Disease (1).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—L. C. Grant: The Breaking Performance of High-Power Switchgear and of a New Form of Quenched-Arc Switch.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. B. Howard: Certificates of Airworthiness.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—A. Clifford Morson: The Pathology and Treatment of Carcinoma of the Penis.

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Ltd., Manchester).—B. D. Porritt: Some Aspects of Standardisation.

INSTITUTION OF WELDING ENGINEERS (at Birmingham).—C. A. Hadley: Modern Improvements in Resistance Welding Machines.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—B. L. Martin: Wapiti Steel Wing Construction.

FRIDAY, JANUARY 24.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—J. M. Nuttall and E. J. Williams: A Method of Examining Stereoscopic Photographs.—S. E. Green: The Photography of Fabry and Perot Interferometer Fringes by the Use of a Simple Optical System.—Miss W. A. Leyshon: Characteristic of Discharge Tubes under 'Flashing' Conditions, as Determined by the Use of a Cathode Ray Oscillograph.—Demonstration by W. E. Doran of a pH Apparatus.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—E. Watson Smyth: General Operating Experiences with the first 'Wood' Steam Generator.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—R. A. MacGregor: Failure of Steel Forgings and Castings through Fatigue.

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. H. Levinstein: Films and Fibres derived from Cellulose (Lecture).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. J. Rees: Refractories for Steam-raising Furnaces.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—F. Willis: Knitted Footwear.

TEXTILE INSTITUTE (Lancashire Section) (at Harris Technical Institute, Preston), at 7.30.—J. Starkie: The Weaving of Artificial Silk.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. G. P. Crowden: Industrial Efficiency and Fatigue.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: Cellulose in the Light of the X-Rays.

SATURDAY, JANUARY 25.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. R. W. Chambers: Sir Thomas More and His Friends (1).

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum), at 6.30.—F. H. Smith: Foreign Yarn Business.

PUBLIC LECTURES.

FRIDAY, JANUARY 17.

UNIVERSITY COLLEGE, at 5.—G. P. Wells: Comparative Physiology. (Succeeding Lectures on Jan. 24, 31, Feb. 7, 14, 21, 28, Mar. 7, 14, and 21.)

MONDAY, JANUARY 20.

UNIVERSITY COLLEGE, at 5.—Prof. A. V. Hill: Oxygen and the Recovery Process in Muscle and Nerve. (Succeeding Lectures on Jan. 27, Feb. 3 and 10.)

TUESDAY, JANUARY 21.

KING'S COLLEGE, at 5.—Dr. S. Wright: Physiology of Posture and Movement. (Succeeding Lectures on Jan. 28, Feb. 4 and 11.)—At 5.30.—Dr. C. H. Lobban: Bridges and Bridge-Construction. (Succeeding Lectures on Jan. 28 and Feb. 4.)

UNIVERSITY COLLEGE, at 5.—Prof. S. Radhakrishnan: An Idealist Philosophy of Life (Hibbert Lectures). (Succeeding Lectures on Jan. 22, 28, and 29.)—At 8.15.—Miss E. Jeffries Davis: How London became the Capital of England. (Succeeding Lectures on Jan. 28, Feb. 4, 11, and 18.)

WEDNESDAY, JANUARY 22.

UNIVERSITY COLLEGE, at 5.30.—J. H. Helweg: Northern Mythology. (Succeeding Lectures on Jan. 29 and Feb. 5.

SATURDAY, JANUARY 25.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: Things Old and New from India's Treasury.