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CONTENTS.

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The Worth of Science.

At the nineteenth annual Conference of Educational Associations, held at University College, London, the president, Sir Richard Gregory, selected as the subject of his inaugural address "The Worth of Science". The address was no mere *catalogue raisonné* of the contributions of science to material progress and human comfort, no mere *addition* of the economic value of scientific discoveries. In terms of billion and bullion only, no such evaluation is possible; for the liberation of life and intellect brought about by the work of the pioneers of scientific discovery is beyond price. Galileo's classic words, *Eppur si muove*, helped to establish man's right "to think for himself in the realm of natural knowledge and to place personal observation above metaphysical and philosophical speculation and dogmatic assertion". Teachers may well be reminded of this debt to science, for without this spirit of freedom, "bequeathed from bleeding sire to son", their work would be degraded and the punishment reserved for them by Lucian, to sell kippers in the lower world, would be well deserved.

Science has suffered some hard buffetings, especially in the United States, because the doctrine of evolution is supposed to be concerned with the obvious resemblances between men and monkeys and to envisage human progress in terms of "Nature, red in tooth and claw". But, as Sir Richard Gregory pointed out, evolution embodies the idea of social ethics, making the welfare of the community the essential purpose of the life of the individual. If we study Nature we shall find abundant examples of ruthless cruelty, "void and empty of every drachm of mercy", but we shall also find most beautiful examples of patience, co-operation, self-sacrifice, and other virtues of which the human race cannot claim the patent.

Finally, if it is fair to attempt such rapid summary of this admirable address, Sir Richard impressed the great lesson that science must not be blamed for the use to which its riches, its *cornucopia*, its bulging corn-bins, are applied by the human race. For more than a century chlorine had served a useful purpose as a disinfectant and a bleaching agent, before its use in warfare provided one of the greatest tragedies of the War. If science offers to mankind a new earth, the question whether the new earth is better than the old depends on human will, on human judgment. Science enables us to speak by wireless across the estranging ocean, but when the ethereal link is joined, have we anything

worth saying? Thomas Love Peacock remarks that civilised man admits he is unhappy anywhere and then congratulates himself on devising a machine which will transport him rapidly from one place where he is unhappy to another where he is not less unhappy.

The wheel of life takes a full turn and, like the alarum clock which awakes us to another day's labour, science awakes us at intervals to a new world. Galileo escaped with the comfortable punishment of being immured in his own study; but some of his contemporaries might have gone to the stake for the simple proposition that the earth goes round the sun. After some centuries of intense study and research, the universe is still mysterious, more mysterious than to Galileo and his inquisitors; and if Einstein, Eddington, or Jeans were asked the simple question, "Does the earth go round the sun?" the answer, we suppose, would not be a plain yes or no. Whatever that answer may be, however incomprehensible the mathematics used for its demonstration, there would be no *auto-da-fé*, no question of martyrdom. *Eppur si muove*—though the modern world is able on occasion to devise subtle forms of persecution for the man of science.

The impossibility of reaching finality is part of the lure of science, and, in a sense, of the "Worth of Science". Turning to medicine, Sir Richard Gregory said, with perhaps a *soupçon* of superiority, "When a savage is ill, he naturally attributes his sufferings to some enemy within him, and to witchcraft putting the enemy there". As regards certain diseases, that is apparently also the present view. Dr. H. P. Newsholme in his essay on certain aspects of encephalitis lethargica, entitled "Health, Disease, and Integration", attributes this disease in man to a lack of balance "within him". Owing possibly to some evil thought or memory, to some repression, the body cells begin to behave in a peculiar way. Encephalitis lethargica has secured a new victim. We must not exclude the possibility of learning from the untutored savage, though he may not have the hebdomadal privilege of reading NATURE. The wise men of the east have wrested secrets from the book of Nature by the simple method of doing nothing, secrets which *Homo sapiens* of the west would not have discovered by fevered activity.

Who shall point the way to the birthplace of Christ? Sir Richard Gregory did not evade this aspect of his subject. He properly reminded us of Lessing's dilemma, the choice between truth and the impulse towards truth. Leave the reality of absolute truth to its Creator and accept the impulse towards truth as the guide of life, and we shall be as happy as George Meredith's costermonger's donkey, going blithely along at a trot, merry in harness while we have to serve. Happy—and humble too. Is it not one of the greatest assets in the balance-sheet of science that it teaches those lessons of true humility which helped and comforted Bunyan's pilgrim on his weary progress?—

> He that is humble ever shall
> Have God to be his guide.

T. LL. H.

Man and his Universe.

Man and his Universe. By John Langdon-Davies. Pp. xviii + 334 + 14 plates. (London: Harper and Bros., 1930.) 16*s.* net.

THE author of this book has set forth in non-technical language a series of pictures of man and the universe as seen by our primitive ancestors, by men of the Middle Ages, and by those who lived during the Renaissance, the Darwinian epoch, at the end of the nineteenth century, and finally in 1930. We may say at once that, when reconciled to the occasionally journalistic style, the reader can study the book with profit and interest. We may criticise points of historical detail and feel unconvinced by some of the lessons the author draws from modern science, but we must admit that on the whole the work is well done, and that at all events it makes a good story.

Mr. Langdon-Davies's main position is that science from one aspect is poetry (concealed by text-books) and from another a search for God, in the course of which a series of new gods are discovered. To explain the influence of science on religion, Mr. Langdon-Davies quotes W. K. Clifford: "The character of the emotion with which men contemplate the world, the temper in which they stand in the presence of the immensities and the eternities, must depend first of all on what they think the world is".

Mr. Langdon-Davies is quite right in holding that, to understand our present outlook on life, we must know something not only of savage superstitions and modern science, but something also of the thought of the intervening two thousand years. He overlooks the earliest part of this time—the age of the pre-Aristotelian Greek philosophers, and also that of the first Christian synthesis of knowledge, which was predominantly Platonic and Augustinian. He assumes that the influence of Aristotle was supreme throughout the

Dark and Middle Ages, and does not adequately appreciate the change in thought produced by the re-discovery of Aristotle's works by Europe in the thirteenth century. Hence his medieval picture is true only of the time of the later centuries, when the characteristic thought of the Middle Ages was drawing towards its close; but of that period he gives a fair representation.

The later Schoolmen, and especially Albertus Magnus and Thomas Aquinas, put together a new synthesis of knowledge, in which the science of Aristotle was combined with Christian dogma in a rational and consistent whole. Hence, at the Renaissance, to attack Aristotle was to attack the Catholic faith, and innovators had to walk warily. The Scholastic scheme regarded the earth as the centre and man as the meaning of creation, and the apprehension of God by the exercise of reason as the object of man. The sublunary world was imperfect and subject to change, but the celestial spheres were faultless and unchangeable, spheres indeed because the sphere is the 'perfect' form—here again, let us note, is a survival of one of Plato's ideas.

Ptolemy himself looked on his system of astronomy only as a mathematical exploration of the facts, and St. Thomas regarded the geocentric view of the universe as a hypothesis, but less clear-sighted men took it as indubitable reality, both from the evidence of the senses and from Christian dogma. Hence the Copernican system, when understood as a representation of fact, involved a true revolution in thought. Mr. Langdon-Davies points out that Copernicus and Kepler were searching for mathematical harmonies and simplifications, but he misses the interesting connexion between their views and the Platonic and Pythagorean background, which survived beneath the predominant Aristotelianism of their day.

Following mainly in the footsteps of Prof. Burtt, Mr. Langdon-Davies draws a contrast between the world of Aristotle and Aquinas and the world as it appeared when Galileo and Newton had done their work. The first was a world essentially as it appears to the senses and was interpreted in human terms, a world of colour and form, of truth, beauty, and goodness—or perhaps their opposites. In the second, the sole reality of the universe was matter in motion, regardless of human values, desires, or welfare. Although Newton and his immediate followers still saw God in Nature, in the eighteenth century the philosophy developed from Newtonian science led through mechanism to materialism. In the nineteenth, Lavoisier showed that matter was indestructible and unchangeable in amount, Dalton put the old atomic theory into modern guise, and Joule established the principle of the conservation of energy. Finally Darwin and Wallace seemed to have brought man himself under the iron sway of 'natural law'.

There seemed little more to learn and nothing much to do. The whole of Nature appeared to point to determinism. But, while nineteenth century science was reaching its climax, the new renaissance was coming into being. Matter, which the plain man thought he understood as inert, solid lumps, was resolved into electric charges, sparsely scattered through the vast empty spaces of atoms, and radioactivity showed that some atoms at least are not eternal. Quantum mechanics destroyed the idea of continuity, and the principle of uncertainty within the atom threw doubt on determinism as an ultimate character of Nature. Finally, the principle of relativity showed that many things thought to be absolute depend on circumstances.

Mr. Langdon-Davies has as much right as the rest of us to draw what conclusions in philosophy, religion, and morality seem to him to follow from these recent revelations. The old orthodoxy and nineteenth century materialism are alike dead to him, and the chief consequences of the modern outlook on life are the removal of the sense of fear—fear of most of the evils of this world and of any other—and the passing away of the longing for immortality and of other age-long desires which to him seem to be beyond our reach, if not meaningless. Mr. Langdon-Davies will not expect us all to see eye to eye with him, but we can at least agree that the change produced in philosophic thought by the new scientific renaissance is and must be profound. W. C. D. D.-W.

Science and Armaments.

The Problem of the Twentieth Century: a Study in International Relationships. By David Davies. Pp. xvii + 795. (London: Ernest Benn, Ltd., 1930.) 21*s.* net.

MAJOR DAVID DAVIES has given us a very fine and weighty book. It is an admirable illustration of the power of one definite idea, strongly held, to organise a great mass of knowledge and make it all subserve one supreme point. This point to Major Davies is the need of an international police force to secure the obedience of the world to the dictates of the League of Nations. It is not a new point, of course. The French put it forward when the League was first started, and ever since

the critics of the League have been saying, "What can the League do to enforce its will, when it is faced by a recalcitrant Power, stronger than those, like Greece, Bulgaria, Jugoslavia, or Albania, with whom it has hitherto dealt? When a serious crisis arrives, will it not be defied and the world plunged again into anarchy and war, worse, no doubt, than we suffered in 1914–18?" It is because Major David Davies has felt so deeply the force of this argument and the horror of the prospect that he has been moved to write this eloquent and persuasive book.

The author assumes all the dangers of the present situation at their worst, and sets to work to plan a complete and watertight scheme to meet them. For, granting his premise and granting the feasibility of winning the assent of the Powers to it, nothing could be better thought out or fitted together than what he has given us. It is well worth the somewhat considerable time needed for reading nearly 800 large pages to see how he presses all the resources of literature and knowledge into the service of his cause. History in abundance, politics, statistics, even poetry, find a place. But how many people will be found to read the book, good as it is, or still less, to buy it? Every sincere sympathiser—and it may be predicted that anyone who gets through will sympathise—will join with this reviewer in an earnest wish that the author himself, or someone for him, will issue an abridged edition in a quarter of the volume, at a tenth of the price.

Major Davies's plan is simple and attractive. It has the great merit that every part of it has some foundation, either in the actual constitution of the world or of the League, or in the recent achievements of science and human thought. In the first place, there is to be what we might call an international General Staff, which would be recruited, as the Secretariat of the League now is, from all the signatory nations according to their weight. The principle of the 'barème', which is followed in assessing the contribution of the States Members of the League, is often invoked by Major Davies in this and other connexions. As the force is to be essentially of a police nature in regard to its duties, its chief would be called the High Constable, and this post might at first be held by a Frenchman, but only for a short period of years. Then there would be other constables at the head of the different sections—mechanical warfare, navy, air, and gas—into which the force would naturally be divided. But the central permanent staff would be but small, and arrangements would have to be made for speedily enlarging it at times of crisis by drafting into it the national quotas which all States members would train in their own countries, and which would be under their own control except when drafted into the international force.

In this matter Major Davies appears to us to show best his good judgment and his sense both of compromise and of the politically possible. It should be, he thinks, in the discretion of the national governments whether their quota should be sent for the particular service; but he looks to the growth of the community spirit, to the fact that the expenses would be borne by the community and that those who need protection themselves would be inclined to help in the protection of others, to secure that sufficient forces were always available to repress the aggressive or disturbing Power. But, in order to make concentration as quick and easy as possible, it is suggested that besides the headquarters, which might well be placed in Palestine, there should be unit bases of the international force all over the world. Strategic points and centres of existing international contact would be carefully chosen, such as Suez, Gibraltar, Panama, and it might always be made worth while for any Power, say the Turks in Constantinople, to allow a part of their territory to be used for this purpose, either by a substantial payment or by concessions elsewhere. Because—and this is one of the strongest two arguments in Major Davies's favour—he can count confidently on so large a saving in the general expenditure on armaments, that the world could afford to do well what he regards as the most necessary part of the whole. For it will be understood that it is as a step towards general disarmament that the scheme is planned. If the nations could gain a sense of security from the proposed international force, they would be content to let their domestic forces be cut down to a point of which the position of Germany under the Treaty of Versailles is the standing model.

We have left to the last what is perhaps the strongest, certainly the most impressive, of Major David Davies's arguments. It is the side which links up his case with science. He shows how the War was a turning-point in the evolution of armaments, due to science; and that the process has gone on with increasing rapidity ever since. The air and gas are the two outstanding cases. One modern fighting aeroplane, we are told, could ward off and possibly put out of action a thousand aeroplanes of the pre-War or early War type; and the chemists go on making more and more deadly gases, in spite of several international undertak-

ings not to use any. This appalling fact gives the author his most effective argument. "Hand over", he says, "all those recent and future applications of science to warfare to your new international police force, and let domestic armies be content with pre-War armaments." Would that the nations would agree!

One feels at the end of this most suggestive book that it would prove as easy to persuade the world to turn all its swords into ploughshares as to adopt Major Davies's suggestions. Meanwhile, let us labour incessantly to improve the existing machinery of the League and to carry out our existing obligations. In this we shall have his support, no doubt, as he has our sympathy for his ingenious and further-reaching scheme.

F. S. MARVIN.

Bacteriology.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 1. By F. W. Andrewes, J. A. Arkwright, J. E. Barnard, C. H. Browning, W. Bulloch, H. Chick, A. D. Gardner, A. Harden, H. McCombie, J. W. McLeod, E. K. Rideal, R. St. John-Brooks, A. Slator, H. G. Thornton. Pp. 374 + 18 plates. (London: H.M. Stationery Office, 1930.) 21*s.* net.

IN Chapter i.—"History of Bacteriology"—Prof. Bulloch leads us from the ancient theories of epidemic disease and the discoveries of Leeuwenhoeck, through the work on spontaneous generation and many of the fascinating, though imperfect and often erroneous, results of some of the early investigators up to the brilliant work of Cohn, Pasteur, and Koch. We are glad to read the high tribute given to the work of Cohn, who has been largely overshadowed by the man whom he discovered—Robert Koch. The work of Pasteur, Koch, and many other brilliant investigators is given very fully, and the author finishes off with the history of the immunity doctrines. Our only regret, in reading this chapter, is that much more space has not been given to Prof. Bulloch. We feel sure that this article will be read and re-read many times by all ardent bacteriologists, not merely because it contains such a mass of interesting particulars, but also because of the style in which it has been written. The illustrations are of supreme interest, and, might we add, we are glad to see in this volume many illustrations which are regretfully absent from the volumes which have been issued.

The short chapter on morphology will prove of value, though we think the more bacteria and bacterial variation is studied, the less importance will be attached to morphology.

In Chapter iii. Rideal deals with the physics of the bacterial cell and McCombie with bacterial pigments, while Chapter iv. is concerned with growth and reproduction of bacteria. A great deal of work has been summarised in these chapters, but the most interesting, and we think the most valuable parts, are those on cell division, colony formation, and spore formation, by Dr. Gardner, and on the life cycle of bacteria, by Thornton. The work of these authors makes us go back and re-read with greater interest and much more appreciation the work of the late Prof. Löhnis.

Chapter v., on the theory of disinfection, is of great interest, and quite well written. There are many suggestive thoughts in it, but we consider its practical value somewhat limited. We would have expected some information as to the action of common disinfectants on various types of bacteria. In the section by C. H. Browning, which is very good, the selective action of the various dyes is emphasised, but this selective action is almost as well marked with the antiseptics in common use; so much so that the usual Rideal-Walker test for antiseptics is regarded by us as of very little value. In a 'System' of this importance, so many omissions of points of practical value—unless a further chapter on disinfection is to appear in subsequent volumes—renders this chapter a very imperfect one.

Chapter vi., on the metabolism of bacteria, by Arthur Harden, is such as one would expct from so distinguished a bio-chemist. It is very readable and should prove of considerable value to all scientific bacteriologists.

Prof. McLeod's work on the reducing action of bacteria, the production of peroxide and its bearing on anaerobiosis, has already taken a prominent place in bacteriological literature. We expected in the chapter on bacterial respiration to have a paper somewhat unusual in character, of scientific interest and of practical value. We have not been disappointed. It is a chapter well worth careful study and thought.

In Chapter viii. Sir Frederick Andrewes has undertaken an extremely difficult task. Classification is needed, and to bring order out of the present chaos is a worthy ambition. We have in this chapter a very accurate account of the various attempts, the successes, and the failures, and then we are given the criteria for classification—the morphology, cultural characters, etc. The author concludes that "in any given case it is the sum of

the various characters which counts". After we have read the chapter, we feel that though the principles have been carefully demonstrated, we are to-day no nearer an accepted and international classification or nomenclature than we were years ago. We would like to have said more about "the marriage between Northern names and Latin terminations", but perhaps the polished language of the author is a better protest against these 'barbarisms' than our more vigorous language would have been.

Chapter ix. deals with variation. In this chapter there is a great deal of new work, much of it based on the researches of the author. The material is of very great importance, and the facts are all well put. The general literature on this subject is very confusing, and we welcome the attempt—and we think the successful attempt—to make it clear. The chapter requires careful and thoughtful reading, but it will well repay the time and labour spent on it.

Taking this volume as a whole, it is the most interesting one yet issued, and, in itself, will give this 'System' a very high place in bacteriological literature. J. M. BEATTIE.

Biological Control of the Coconut Moth.

The Coconut Moth in Fiji: a History of its Control by means of Parasites. By Dr. J. D. Tothill, assisted by T. H. C. Taylor and R. W. Paine. Published for the Government of Fiji. Pp. vii+269. (London: The Imperial Bureau of Entomology, 1930.) 31*s*. 6*d*. net.

THIS sumptuously produced volume is in reality a detailed account of a single experiment in applied entomology. It is concerned with the biological control of a species of moth the larva of which, in attacking the coconut palms of Fiji, threatened the copra industry of those islands with disaster. The insect in question, *Levuana iridescens*, belongs to the family Zygænidæ and, so far as is known, is confined to Fiji. Its larvæ, by destroying the foliage of the coconut, converted what were originally waving green fronds into remnants of miserable lifeless grey. Since the insect proved to be free from parasitic enemies, this fact in itself suggested that its original home may be in some land other than Fiji. It also appeared probable that the introduction, under favourable conditions, of some effective insect enemy might go a long way towards solving the problem of its control. The present volume is a record of how this theory was translated into practice.

Since a search among the Pacific islands for *Levuana* in its native home, where it would most likely be subject to attack by parasites, proved fruitless, recourse had to be made to allied coconut pests. Insects of the family Zygænidæ are rarely destructive, but the species *Artona catoxantha* is known to attack coconuts in Malaysia and Java. It proved, furthermore, to be subject to attack by the Tachinid fly *Ptychomyia remota*. Since *Artona* and *Levuana* are closely related, it appeared probable that a parasite of the former genus would find the *Levuana* an acceptable host. The campaign hinged on this possibility and, after considerable difficulties, the Tachinid fly was eventually introduced into Fiji. The success of the experiment was remarkable: six months after its introduction, the fly had spread throughout the areas of Fiji affected by the *Levuana*, and many of the outbreaks had subsided entirely owing to the destructive effects of this parasite upon the caterpillars of the moth. There has, to-day, been no outbreak of the pest for more than three years, and the copra industry of Fiji has been extricated from an awkward predicament by this fortunate biological experiment.

The history of the campaign is described in detail in this volume: the structure and life-history of the moth are elaborately dealt with and the parasitic *Ptychomyia* is similarly discussed. Allied Zygænid moths and their natural control also come in for treatment, and there is a wealth of text-figures and beautifully executed coloured and half-tone plates appended. The whole volume thus serves as a detailed permanent record of an experiment of equal importance to those achieved in Hawaii and elsewhere. No similar biological triumph has so far been placed upon record in so complete and elaborate a form. The high price of the volume may militate against its rapid circulation, but all whose business is concerned with pest control will need to add it to their bookshelves. It should prove a valuable propagandist source in that it will focus attention upon the possibilities of biological control—when it is applied intelligently to problems amenable to this method of solution.

A number of entomologists, administrators, and others have played their part in the campaign recorded. To each of these we tender our sincere congratulations upon an achievement that should rank high in the annals of applied entomology. The Imperial Bureau of Entomology, which published the volume on behalf of the Fiji Government, also deserves commendation for the faultless style in which it has been produced. A. D. IMMS.

Our Bookshelf.

Lord Balfour in his Relation to Science. By Lord Rayleigh. Pp. viii + 46. (Cambridge: At the University Press, 1930.) 2*s*. 6*d*. net.

FOLLOWING the death of the Earl of Balfour, F.R.S., Chancellor of the University of Cambridge, which occurred on Mar. 19 last, an obituary notice by his kinsman, Lord Rayleigh, was published in the *Proceedings of the Royal Society*. This memoir was limited to an account of Lord Balfour's early history and mental development, his scientific and philosophical thought, and his administrative work for scientific, industrial, and medical research. Quite justifiably it was soon realised that, beyond strictly scientific circles, there was an interested public desirous of knowing about those very matters detailed therein, their kind and substance. Accordingly, the memoir has been republished, with a photograph as frontispiece.

In all probability the public referred to would have welcomed more about this many-sided personality in fields of knowledge and inquiry which embraced science. The earlier part of the memoir recalls Balfour's upbringing, and the springs of scientific interests which welled up in the family brotherhood and sisterhood and immediate connexions. As regards the latter, Lord Salisbury, sometime Prime Minister, was Balfour's uncle; Lord Rayleigh (father of the writer of the memoir), his brother-in-law. We are told that throughout his life Balfour had the highest admiration for Darwin, "because", he said, "he was not a partisan—he really wanted to find out the truth—an attitude of mind seldom found among men of science, and never among theologians". Rather contrariwise, an extract from Lady Rayleigh's journal, June 16, 1892, records that "Paderewski was at the Royal Society soirée last night, and in discussing it Arthur remarked of the scientific guests, 'They are the people who are changing the world and they don't know it. Politicians are but the fly on the wheel—the men of science are the motive power'".

Throughout this study no passing allusion is made to Lord Kelvin, yet contact with Balfour must have been close and cordial, and fraught with inherent interest. He was, in fact, president of the Royal Society at the date of the soirée mentioned above.

State of Arkansas: Arkansas Geological Survey. Bulletin 3: *Geology of the Arkansas Paleozoic Area, with especial reference to Oil and Gas Possibilities.* By Carey Croneis. Pp. xx + 457 + 45 plates. (Little Rock, Ark.: Arkansas Geological Survey, 1930.)

THE area covered by this work is some 25,000 square miles in the central, northern, western, and north-western parts of the State of Arkansas, constituting the highlands and embracing the well-known physiographic elements the Ozark Plateau, the Arkansas River Valley, and the Ouachita Mountains. The volume is of interest to geologists generally because of the good account of the different palæozoic faunas given, an account enhanced in value by the excellent illustrations of the characteristic fossils. In fact, the illustrations as a whole are such a conspicuous feature that they may almost be said to make the book. Certainly, some of them depicting field-features would adorn many a well-recommended text-book of physical geology, and it is a pity that they are comparatively lost in a State survey memoir.

With regard to oil and gas possibilities, the Ouachita Province is regarded as unfavourable, the Arkansas Valley implies for the most part dry gas resources, and the southern part of the Ozark highland has a slight chance of oil production. There is a sidelight on the applicability of the carbon ratio theory in connexion with the gas prospects; some of the ratios of the Carboniferous coals are so high as eighty-eight, which should rule out any possible existence of gas-fields; these ratios, in point of fact, are without significance, since some of the largest producing gas-fields are located in such terrain.

This is a readable memoir. It gives a clear impression of the pure and economic geology (in so far as oil and gas are concerned) of a vastly interesting region, and in style and presentation breaks away from the more monotonous conventions of the national survey. There are two maps included, both tectonic, one depicting structural axes of the Arkansas Valley and Ozark Provinces, the other, axes of the Ouachita Mountain Province.

H. B. M.

Sedimentary Petrography: with Special Reference to Petrographic Methods of Correlation of Strata and to Subsurface Oil Geology. By Henry B. Milner. Second (revised and complete) edition. Pp. xxi + 514 + 40 plates. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1929.) 21*s*. net.

MILNER'S "Sedimentary Petrography" is essentially a laboratory manual and text-book. It incorporates two previously published works by the same author—"An Introduction to Sedimentary Petrography" and "Supplement to an Introduction to Sedimentary Petrography".

In the new volume the author's aim has been to provide a comprehensive text-book of the petrology of all types of sediments, consolidated as well as incoherent. Not only, therefore, is the text of the earlier volumes amplified and brought up-to-date, but also much entirely new matter has been added. Chief among this is a lengthy chapter on the petrography of the consolidated sediments, that is, limestones, shales, etc., as opposed to loose sands. In another new chapter the author discusses at some length the desirability of the employment in the study of soils of the methods of examination of sedimentary rocks dealt with earlier in the text.

The whole bias of the book is admittedly towards the examination of sedimentary rocks by study of their 'heavy residue' content, with emphasis on the economic applications of the results obtainable. Commendable features are the numerous diagrams and plates, and the large

number of references in the text to original papers. There is also an extensive bibliography.

The practical study of sedimentary rocks has been much to the fore in recent years. To all interested, whether from a scientific point of view, as oilfield geologists, or as soil mineralogists, this manual should prove invaluable.

Production Conditions, Organisation and Results of Czechoslovak Farming. Edited by Dr. Vladislav Brdlik. Part II. Pp. 242 + 79. (Prague: State Agricultural Institute, 1930.) 24*s*.

AN elaboration of statistical material touching the production and yield conditions in Czechoslovakian agriculture is set forth in this volume. The material is based on returns from 1652 farms for the years 1909–1913, and contains, on one hand, deductions from the statistical material published in Part I. with comparisons from a territorial point of view, and on the other hand, a critical consideration of the data from the point of view of representative investigations. The question brings into relief the changes in the organisation of farms and the results of their workings in the case of transition from the intensive and highly developed western methods to the extensive system as now practised in Czechoslovakia. The deductions arrived at from the various points of view form a basis for measures of practical and economic policy (for example, customs, finance) and for scientific purposes, and so on. The published material also has a historical significance, for it shows farming conditions as they existed before the great changes produced by the War. The data, as worked up, provide a basis for various economic calculations, as they represent stabilised and normal relations both in regard to prices and methods of farming, and the method of presentation makes it possible to use the material in the case of changing price conditions. It is claimed that this published statistical material will remain a basic and firm starting-point for the study of what is translated as the "dynamic economic phenomena".

For convenience of reference the critical examination of the data by Dr. Stanislav Kohn is given in French and German as well as Czech, similar treatment being given to the introduction, chapter headings, and certain tables.

Chinese Civilization. By Prof. Marcel Granet. Translated by Kathleen E. Innes and Mabel R. Brailsford. (The History of Civilization Series.) Pp. xxiii + 444 + 12 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1930.) 25*s*. net.

DR. GRANET'S study of Chinese civilisation ranges from the beginnings as set forth in the traditional account of the Tsu-King down to the end of the second Han dynasty in the early years of the third century A.D. It falls into two parts. In the first the political history is briefly surveyed. In the second the constitution and development of Chinese society is reconstructed. M. Granet deals critically with the traditional history and shows it to be an ideal projected into the past by antiquarian reconstruction and remodelling of the materials. Up to the present the auxiliary studies of ethnology and archæology have thrown little light on the problems of tradition, and M. Granet constantly emphasises the need for excavation. At the same time, he is prepared to put it forward as a working hypothesis that Chinese civilisation is to be explained by the contact of two principal civilisations, one a civilisation of terraces and millet, and the other a civilisation of rice and the low-lying plains. M. Shirokogorov's investigations of the physical anthropology of Northern China would appear to support this view.

In his second part, in dealing with Chinese society M. Granet accepts tradition, but interprets it by a correlation with the evidence of the historic periods. This makes possible a reconstruction beginning with the initial organisation among the peasant families and rural communities of the plains, passing on to the foundation of the chieftainships and the seignoral towns, and ending with the state of society at the beginning of the empire. Here M. Granet's work is a brilliant piece of interpretation.

Birth Control on Trial. By Lella Secor Florence. Pp. 160. (London: George Allen and Unwin, Ltd., 1930.) 5*s*. net.

THE enthusiastic claims of the contraceptive literature of a few years ago have now given way to a general impression that there is no satisfactory method of preventing pregnancy. This is confirmed by an investigation undertaken by Mrs. L. S. Florence at the Cambridge Birth Control Clinic, and now published under the title of "Birth Control on Trial". Her conclusion that such methods as can be recommended are too complicated and unreliable is fully justified. Every doctor sees occasional patients whom he must warn to avoid pregnancy, and to such warning there ought to be added some instruction concerning methods. There is obviously a demand for research into this subject, which can only be undertaken by the medical profession. The book is not intended to hold a brief for the ethics of birth control, but some of the case-histories it contains are sufficiently tragic to shake the convictions of the most confirmed opponent of contraception.

General Practice (*Some further Experiences*). By Dr. Ernest Ward. Pp. iv + 108. (London: John Bale, Sons and Danielsson, Ltd., 1930.) 3*s*. 6*d*. net.

DR. ERNEST WARD'S second book on the joys and troubles of general practice is as entertaining as his former "Medical Adventure", in which were described clinical, obstetric, and pathological experiences. The present volume is devoted to the other side of a practitioner's life, and covers a wide range of subjects, from where and how to secure a practice, to when and whom to marry. The chapters on the arrangement of the day's work, and the attitude of the doctor to his patients, his colleagues, and unorthodox treatment, are particularly good. The author disclaims any intention of giving advice, but every page contains the equivalent of years of experience. The book is sure to be of interest to every medical man.

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.*]

Stellar Structure.

IN NATURE of Jan. 3, Prof. Milne writes that my theory of stellar structure accounts for the existence of giant, dwarf, and white dwarf stars, "only at the cost of *ad hoc* hypotheses quite outside physics. It assumes stars to contain atoms of atomic weight higher than that observed on earth, and it assumes them to be relentlessly disappearing in the form of radiation; it appeals to discontinuous changes of state consequent on successive ionisations, for which there is little warrant."

This seems to me a mass of highly concentrated inaccuracy. My actual hypotheses are that the stars we observe in the sky must be stable and need not be gaseous; it seems odd to describe these as "*ad hoc* hypotheses quite outside physics". What Milne describes as "assumptions" are inferences after the main results have been obtained. After the Russell diagram has been obtained, an atomic number of 95 seems to give the *best* fit with observation, but I could have "assumed" a far lower number and obtained quite a *good* fit. Incidentally, no other theory gives any fit at all—or even anything to fit. The appeal "to discontinuous changes of state" appears to be a highly coloured description of the fact that I find that bands of stability and instability alternate.

I find it hard to believe that other astronomers understand my theory as little as does Prof. Milne. If they do, he is no doubt right in saying that the majority do not accept it.

I am not writing to challenge Milne's inaccuracies, so much as to ask whether his new theory must not ultimately prove identical with my own theory, which "the majority of astronomers do not accept". We start out on the same road, by not seeing eye-to-eye with Sir Arthur Eddington. Milne's recent discoveries—that mass and luminosity are independent, that the mass-luminosity relation is a happy (or unhappy) accident, etc.—are merely old familiar landmarks on a road which I travelled and described fully in NATURE and *Mon. Not. R.A.S.* more than ten years ago.

Milne and I part company on the question of stellar boundary conditions. The classical Emden solution starts with a finite density at the star's centre and integrates outwards. Eddington, and then I, followed Emden in thinking that Nature was bound to look after the boundary conditions somehow or other. Then I noticed ("Astronomy and Cosmogony", §§ 80, 81) that what appears to be a single solution in a star's interior, spreads out into a whole tassel near the photosphere; it proves to be merely an asymptote to a whole family of solutions which correspond to different boundary conditions. This shows that any boundary condition can be satisfied, so that "the influence of the special conditions which prevail at the surface soon disappears as we pass inwards into the star" (l.c. § 80).

This fundamental point can be illustrated by a simple model suggested by Milne (*M.N.*, **90**, p. 53). Represent a star by a sphere of copper s with a heating coil at its centre, and its photospheric layers by s', a thin coat of asbestos, paint, or other substance. Varying the substance of s' represents varying the photospheric conditions of a star; we want to find how interior conditions depend on s'. Milne solves the problem wrongly, as I think, and concludes that the sphere coated with asbestos will be "much hotter inside" than one wholly of copper, "for it is jacketed by a bad conductor". As every plumber knows, this is not so; only a thick layer of asbestos will make things much hotter inside. It is, I think, the same with the stars. Whatever the photospheric conditions, the photospheric layers are not thick enough to make any real difference.

Thus Milne's involved procedure of integrating inwards, getting infinite or zero density, and then letting masses of unsupported gas crash to finite densities, seems to me all unnecessary; he could have assumed a finite central density to begin with and integrated outwards, and as this is the exact procedure followed in my theory I cannot see how our final results can be different—unless one of us makes a mistake in analysis or arithmetic.

It is, of course, also the procedure followed by Eddington in his classic papers. Where I differ from Eddington is not on general questions of procedure; it is that he thinks a star's centre must be gaseous, whereas I do not. Also, we differ as to whether his very restricted model with $\kappa\eta$ constant is a very good or a very bad model. Milne appears to have followed Eddington so far in tying himself down to this particular restriction. Unless I am greatly mistaken, all that is essentially novel in his theory (as shown in Figs. 1 and 2 in his NATURE article) will vanish to nothing as soon as he frees himself from this impossible and misleading restriction.

J. H. JEANS.

Cleveland Lodge, Dorking,
Jan. 5.

Aurora Display and Magnetic Disturbance.

ON Saturday evening, Dec. 20, at about 18 h. 35 m., I noticed that the sky was strongly illuminated along the northern horizon, the light extending about 40° in azimuth, with its centre, as near as could be estimated from the position of the pole star, true north, and a maximum altitude of about 15°. It was at once suspected as an auroral arch, but as the magnetic curves which had come off that morning showed the magnetic conditions to be exceptionally quiet, some doubt was felt as to the auroral character of the light. A suspicion was entertained that it might be due to the illumination of a sheet of very high cloud, though the sun was far below the horizon. This, however, appeared unlikely, both from the length of time after sunset and from the fact that there was no illumination over the western or north-western horizon.

The light was kept under observation, and was very steady, with no indications of streamers, though once or twice there was a suspicion of a flicker higher up in the sky. At about 18 h. 50 m. the light began to fade out, commencing at the eastern end of the display, and at 18 h. 55 m. the last traces at the western end had disappeared.

That this phenomenon was an auroral display is confirmed by the magnetic curves which came off on the morning of Dec. 22, which show that a quite notable magnetic disturbance was in progress at the time.

The magnets began to be slightly disturbed at about 16 h., a 'bay' forming in the declination trace, centred at about 17 h. 10 m., and the horizontal force falling to a minimum at 17 h. The most notable feature of the disturbance was the fall in value of the declination from a maximum at 18 h. 2 m., to a minimum at 18 h. 53 m. through a range of 39′. The major

portion of this fall occurred at a practically uniform rate between 18 h. 28 m. and 18 h. 53 m., during which interval the range was 31′, followed by a sharp rise of 18′.

The chief feature of interest in this observation is that the auroral light persisted whilst the declination value was falling rapidly, and ceased at practically the same moment as that fall ceased. There is some doubt as to the exact moment when the auroral light ceased to be visible. It was certainly not later than 18 h. 55 m., but it may have been from one to two minutes earlier.

Now if the aurora and magnetic disturbance be attributed to a stream of ionised particles emanating from the sun and reaching the earth's upper atmosphere, consideration of the above conditions enables us to assign the nature of the charge carried by the particles. For such a stream would, in the northern hemisphere, be proceeding from lower to higher latitudes, and descending earthwards in the vicinity of the pole; and considering such a stream as equivalent to an electric current, the application of Clerk Maxwell's 'corkscrew' rule shows that to produce a diminution of the westerly component of the earth's magnetic field (a decrease of westerly declination), the charge carried by the particles must be negative.

When the stream ceased, it would be expected that both the ionisation of the upper atmosphere, causing the auroral light, and the magnetic deflecting force would cease at about the same time. That the light should have first faded out at the eastern edge, and persisted longest at the western, remains unexplained.

It is worth noting that this magnetic disturbance, though not very large, is one of an unbroken sequence at approximately 27 days' interval, persisting since December 1929. The eruption on the sun observed with the spectroheliosCope at Greenwich on Nov. 25, as noted in NATURE of Dec. 20, occurred about a day after the commencement of the November member of the series.

The disturbances of this sequence have commenced throughout with the passage of solar longitudes 120° to 150° over the central meridian of the visible disc, and have lasted for 8 to 10 days, coming to an end with the meridian passage of solar longitude about 30°, thus indicating exceptional activity over the sun's surface between these longitudes throughout the year.

J. P. ROWLAND, *S.J.*

Stonyhurst College Observatory,
Nr. Blackburn,
Dec. 23.

The Latent Splitting of Bars undergoing Transverse Vibrations.

THE formation of slip-bands in bodies subjected to different kinds of stresses has been studied by several observers. These have been regarded as dependent on the crystalline nature of the materials. More recently A. Nadal [1] has given an interesting account of his experiments with marble, paraffin, and several metals, illustrated with numerous photographs.

While studying the variation of Young's moduli of materials under low stresses by a method similar to the one described by me,[2] it was noticed that considerable fluctuations occurred in the frequency of a fixed length of a bar when observations were taken over a long period of time. These could not be ascribed to any sources of error. Further, it was also observed that these distinct frequencies did not vary in any continuous manner, but that certain definite values repeated themselves when a large number of observations was taken. For many purposes these fluctuations are usually ignored and a mean value of the frequency determined for a given length of the vibrating bar. The observations reported here, however, leave no room for doubt, as others have also pointed out, that a vibrating bar clamped at one end is not a constant source of frequency at all. What these fluctuations in reality signify is the purpose of this note to suggest.

These fluctuations in frequency can be explained on the assumption that the experimental bar is in reality made up of a number of thinner strips of nearly equal thicknesses coupled together by cohesive forces. It has been then found possible to work out a relation between the thicknesses of the component strips of the bar and the distinct frequencies into which the bar as a whole vibrates from time to time—the frequencies generated being the result of the action and reaction of the component parts on each other.

If t_1, t_2, t_3, etc., be the thicknesses of the component strips of a bar of total thickness d, so that

$$d = t_1 + t_2 + t_3 + \ldots t_N,$$

where N is finite and small, and if n_1, n_2, n_3, etc., be the distinct frequencies of the bar as a whole, it can be shown that

$$\frac{t_1}{t_1 + t_2 + \ldots t_N} = \frac{n_1}{n_1 + n_2 + \ldots n_N}$$

or

$$t_1 = \frac{d \,.\, n_1}{n_1 + n_2 + \ldots n_N};$$

and

$$t_2 = \frac{d \,.\, n_2}{n_1 + n_2 + \ldots n_N}; \quad t_3 = \text{etc.}$$

Since d, n_1, n_2, etc., are all measured directly, we have here a method of calculating the thickness of the component strips into which the bar, although sound to all appearances, really splits. In support of this view of the phenomenon, it is interesting to point out that the actual lines of ruptures, separated by distances exactly predicted from the above theory, have been observed and measured in a large variety of substances under a microscope. These rupture lines are very sharp and run parallel to the surface of the bar perpendicular to the plane of its bending. The agreement between the calculated and observed values of t's is remarkably good. The substances examined so far include, among others, copper, steel, aluminium, marble, slate, and different kinds of wood. All these materials show the effect described above very clearly. In view of the general nature of the phenomenon common to such different substances as wood and metal, and also in consequence of the fruitfulness of the idea that the experimental bar can be looked upon as made up of a discrete number of thinner bars held cohesively together, it is here suggested that 'latent splitting' is a more appropriate name for the effects observed than formation of 'slip-bands', which seem to refer to crystalline substances in particular.

Since the t's and their differences for any material must be an integral number of times the thickness of its ultimate component parts, an interesting application of the theory sketched above leads, with the power of the apparatus used in the present investigations, to a determination in the case of :

(*a*) Wood—of the mean diameter of its fibres.

(*b*) Metals and stones—of the thicknesses of crystal grains or distances between cleavage planes which are exact multiples of the lattice cell constant as given by X-ray analysis. Full details of theory and experiments will be published shortly in a paper

in preparation. Only a few typical results are given here :

Material.	t from theory in cm.	t from obs. in cm.	Mean diameter of fibres from theory in cm.	Fibre diameter directly measured in cm.
Boxwood	0·0746 ; 0·0759 0·058 ; 0·051	0·075 0·055	$6·55 \times 10^{-4}$	$6·58 \times 10^{-4}$
Copper	0·0333 ; 0·0338 0·0449 ; 0·0665	0·033 0·045 ; 0·070	The thickness of grain deduced = $906·24 \times 10^{-8}$ cm. and this is $251 \times 3·610$ A., where 3·610 A. is the value from X-ray measurement.	
Slate	0·0442 ; 0·042 0·0381 ; 0·0370	0·045 ; 0·040 0·038 ; 0·037	The thickness of grain deduced = $605·54 \times 10^{-8}$ cm., and this is $200 \times 3·027$ A., where 3·02 A. is the value from X-ray measurement.	

The wood fibres were prepared by the Schulze process, and their mean diameters were measured directly under a microscope.

K. PROSAD.

Physics Department, Science College,
Patna, India, Nov. 21.

[1] *Zeits. tech. Physik*, **5**, 9, pp. 369-378.
[2] *Phil. Mag.*, vol. 7, p. 548, March 1929.

Systems of Four Immiscible Liquid Layers.

SYSTEMS of three immiscible layers are sufficiently uncommon to be noteworthy, and no system of four layers appears to have been described (excluding systems containing free mercury). Nor is this remarkable when it is recalled, first, that practically all *dry* organic liquids are completely miscible, almost the only exceptions being polyhydric alcohols ; secondly, that a system of four liquid phases requires the existence of four substances or solutions, which taken three at a time yield at a fixed temperature four systems each of three liquid phases, the immiscibility of which is in no case destroyed on saturation with the fourth component. The majority of the hitherto-described systems of three liquid phases (of which the system water–aniline–hexane is typical) owe their existence to the properties of a substance such as aniline or succinic nitrile, which is not completely miscible with water, but itself absorbs sufficient water to destroy its miscibility with another solvent, such as hexane or carbon disulphide, which absorbs only traces of water.

A study of systems containing soaps revealed a different type of three-layer system. When an electrolyte is added to an aqueous soap solution in equilibrium with an organic solvent not completely miscible with it (or when the soap concentration is increased beyond a certain limit), one of three things may happen :

(1) The soap is salted out as solid curd.

(2) The soap is transferred completely to the solvent layer.

(3) The salted-out soap absorbs water and solvent to form a third layer immiscible with either lye or solvent.

The system sodium oleate, sodium chloride, ethyl acetate, water, illustrates all three possibilities : the first, for example, at 25°, the second at 55° for high salt concentrations, the third for lower salt concentrations at the same temperature. These three-layer systems differ from the type previously mentioned in that two of the layers are predominantly aqueous in composition. Since such systems can be prepared using either aniline or hexane as the solvent, and since wet aniline, hexane, and water are mutually immiscible, the conditions are fulfilled for a system of four liquid layers, provided the presence of soap in at least three of them does not destroy their immiscibility. Suitable proportions do, in fact, yield a four-phase system at room temperatures ; this is most easily prepared by mixing the organic liquids and oleic acid (which are miscible in the absence of water), and adding sufficient aqueous sodium hydroxide to saponify the fatty acid and salt out the soap. The following proportions yield approximately equal volumes of the four layers :

Hexane (or light petroleum)	12 c.c.
Aniline	7 c.c.
Oleic Acid	0·5 c.c.
Alcohol	1·5 c.c.
Aqueous Sodium Hydroxide – 0·8N	10 c.c.

The alcohol is not essential to the system, but reduces the time required for separation of the layers from hours to minutes. An increase of temperature or of electrolyte concentration renders miscible the hexane and aniline layers (first and third from the top), which then form the top layer.

This four-phase system contains five components (excluding the alcohol), which is one more than the minimum required by the phase rule. Although both aniline and hexane could probably be replaced by other liquids, there seems to be no possibility of producing a four-phase system of this type with only four components.

It need scarcely be added that the addition of mercury gives a five-layer system—a unique scientific curiosity.

E. LESTER SMITH.

Research Laboratory,
Chelsea Polytechnic, S.W.3,
Dec. 9.

The Longitudinal Distribution of Photoelectrons.

FORMULÆ of the type

$$P(\theta)d\theta \propto (A + B\cos\theta)\sin^3\theta d\theta \quad . \quad . \quad (1)$$

as a first approximation to more complex forms have been proposed as illustrating the existence of longitudinal asymmetry in the spatial distribution of photoelectrons.[1] Here $P(\theta)d\theta$ is the probability of photoelectric emission between angles θ and $(\theta + d\theta)$ to the ray, A is usually unity and B some function of the frequency of the incident radiation and of the atomic number of the atoms upon which the radiation falls. The angle of bipartition θ_b is then obtained from the relation

$$\int_0^{\theta_b} (A + B\cos\theta)\sin^3\theta d\theta = \int_{\theta_b}^{\pi} (A + B\cos\theta)\sin^3\theta d\theta \quad (2)$$

and the average forward momentum

$$mv\overline{\cos\theta} = mv\int_0^{\pi} (A + B\cos\theta)\sin^3\theta\cos\theta d\theta \Big/ \int_0^{\pi} (A + B\cos\theta)\sin^3\theta d\theta \quad (3)$$

I should like to point out that from another point of view the distribution formula (1) does not give the information concerning θ_b and $mv\overline{\cos\theta}$ that is ascribed to it. A similar expression can be built up from quite simple principles, which, however, preclude us from performing any integration outside the limits 0 to $\pi/2$.

Assuming the wave mechanical principle of interference $P(\theta) \propto \sin^2\theta$ and that independent groups of photoelectrons originate from a small plane circular area of radius b normal to the ray and a small spherical volume of radius a respectively, situated at the origin, we could write down at once the whole probability

$$P(\theta)d\theta \propto (A'\pi a^2 + B'\pi b^2\cos\theta)\sin^3\theta d\theta \quad . \quad (4)$$

where A' and B' are factors independent of θ.

From the way in which the problem is stated and because of the inclusion of the cosine term involving

negative probabilities, expression (4) must be regarded as unilateral and integrable only between the limits 0 to $\pi/2$. If the other half of the spherical aperture surrounding the origin is to be considered, the ray must be reversed. Everything would then be symmetrical about the plane $\theta = \pi/2$, there would be no justification in drawing any other conclusions with regard to θ_b or to the average forward momentum. Of course, if equation (4) is integrated as in (2) and (3) it will yield results which are obviously fictitious.

That longitudinal asymmetry exists has been abundantly shown by experiment. It is introduced in the Compton effect, and it is apparent that the probability of the interaction between a photon and an electron must depend on some mutual directional relationship existing between the two during the period of interaction.

LEWIS SIMONS.

Birkbeck College, London, E.C.4,
Dec. 1.

[1] Sommerfeld: "Wave Mechanics", p. 187, 1930. G. Schur: *Ann. d. Physik*, **4**, p. 441; 1930. See also Carrelli, NATURE, June 1, 1929, and E. J. Williams, NATURE, April 13, 1929.

Part-Absorption Phenomena of X-Rays.

IN connexion with the partly absorbed lines observed by Ray (NATURE, May 17, p. 746; June 7, p. 856; Sept. 13, 1930, p. 399), I have observed the following lines, using similar arrangements:

Incident Radiation.	Absorbing Substance.	Modified Lines.	Origin.
$FeK\alpha_{1,2}$ (471·0)	C	2022 X.U. (450·6)	$FeK\alpha_{1,2} - CK\alpha$ (20·4)
,,	N	2053 X.U. (443·8)	$FeK\alpha_{1,2} - NK\alpha$ (27·2)
,,	Al	1975 X.U. (461·4)	$FeK\alpha_{1,2} - AlL_1$ (9·6)
$FeK\beta_1$ (519·9)	,,	1784 X.U. (510·8)	$FeK\beta_1 - AlL_1$ (9·1)
$NiK\alpha_{1,2}$ (550·0)	,,	1688 X.U. (540·0)	$NiK\alpha_{1,2} - AlL_1$ (10·0)

The figures in the bracket indicate the values of ν/R.

A current of 7 ma. was passed through the X-ray tube at a peak voltage of 24 kv. The transmitted beam was analysed by a calcite crystal.

The appearance of the lines with aluminium as the absorbing substance is rather interesting. Though the actual value of AlL_1 is not known, the theoretical value obtained by Mukherjee and Ray (*Zeit. f. Phys.*, vol. 57) is 9·2 (ν/R). As yet I have not observed any line having $K\alpha_{1,2} - AlL_2$ as origin. This seems to be in accordance with the observations of Robinson, who found that if the energy of the incident quanta is large when compared with those of L-levels, the L_1 absorption edge has a much greater intensity than that of L_2.

The partly absorbed lines are diffuse and have a definite breadth, and as such they can be selected from known faint lines. The breadth of the lines, when measured in volts, approximates to the ionisation potential of the atom in question, and thus points to the fact that the electron, which is lifted from the original level to the periphery or to any other optical level by the part-absorption of the radiation, is not removed from the atom completely.

In this connexion it may be pointed out that as the partly absorbed lines are very weak and diffuse, great precautions were taken to reduce the blackening of the plate from the general radiations, especially from higher orders, as much as possible, by decreasing the voltage and increasing the current through the X-ray tube. Further, by varying the thickness of the absorbing layer and the time of exposure, a condition was found where the best photographs were obtained in about 8 hours. Agfa-Röntgen films are more suitable for this type of work than ordinary plates.

R. C. MAJUMDAR.

Department of Physics,
University College of Science,
Calcutta, Nov. 19.

The Equivalence of the Valencies of Carbon.

I POINTED out some time ago,[1] that despite Pasteur's original statement, or at all events, the text-book version of it, optical enantiomers were possibly not completely identical. I followed this up with an investigation of the rotatory powers of the mandelic acids,[2] in which at least preliminary evidence of non-identity was obtained. I am about to publish an account of a lengthy investigation of the camphoric acids, in which differences of the same kind have been observed.

In the paper to the Faraday Society (loc. cit.) I pointed out that a probable consequence of the non-identity of enantiomers would be that, in the language of the tetrahedral conception, the carbon valencies were not symmetrically distributed in space, and that, therefore, numerous unsuspected isomers, differing only slightly in physical properties, should exist. It therefore behoved us to investigate anew the properties of such bodies as methylene chloride, bromide, and iodide, the supposed non-existence of isomers of which was formerly adduced as evidence in favour of the tetrahedral, as opposed to the plane, distribution of the carbon valencies. I am, of course, not contending for a plane distribution of valencies. It is of interest that my suggestion of alternative orbits for an electron in the same atom has been brought forward independently as an explanation of the existence of 'electro-isomers'.

As a preliminary to commencing work upon the methylene halides, I read through the literature on the subject, or at least such of it as is accessible to me here, and I was surprised to find that two crystalline modifications of methylene iodide are already known to exist.[3] Polymorphism is not considered as evidence of chemical difference, but merely of difference in crystal lattice; but one may be permitted to ask, why should alternative lattices be possible, if the molecules themselves are identical in size, configuration, and fields of force? The obvious method of attack here is to investigate the melts obtained from each form, after the manner in which the keto-enol transformation has been investigated, and this I shall proceed to do. In my opinion, two modifications of methylene bromide and of methylene chloride would also have been observed, had not these bodies been liquid at and below room temperature.

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Winnipeg, Canada.

[1] NATURE, Nov. 23, 1929.
[2] Campbell and Garrow, *Trans. Faraday Soc.*, **26**, 560; 1930.
[3] Beckmann, *Zeit. physik. Chem.*, **46**, 853; Bruni and Callegari, *Atti Accad. Lincei*, (5) 13, I, 485 (this from Beilstein).

Relation of the Liquid to the Crystalline State.

IN a recent note E. Gross has found that the Debye elastic heat waves also give rise to modified scattering in liquids.[1] The fact that electromagnetic waves are modified by the elastic heat waves shows that the origin of the latter in liquids is also electrical and akin to lattice oscillations in crystals. In order to explain facts connected with X-ray diffraction in liquids, it

was found that a liquid has to be regarded as a broken up crystal in which there is thermodynamic equilibrium between heat motion and forces of crystal formation.[2] It was seen both theoretically and from observations on X-ray diffraction that there is a maximum in the molecular arrangements in liquids corresponding to the structure of the substance in the crystal state. It is evident that this partial crystallinity of liquids is responsible for the modified scattering found by Gross. It is, therefore, expected that those liquids which produce sharp diffraction effects should also produce sharp modified lines, and it will be interesting to see whether that comes out true.

In the same paper Gross suggests an instructive explanation of the broadening of Raman lines: that each Raman line consists of a number of unresolved lines modified further by the elastic heat waves; he supports this view also in his later paper.[3] This does not appear to me sufficient to explain the fact that in some cases where he observed modified scattering due to elastic waves there is no broadening of the Raman lines. The following explanation appears probable to me. In a crystal the natural frequencies of a molecule that are responsible for the Raman effect are modified, due to the surrounding molecules; but on account of the regular arrangement all the molecules are affected in the same manner, and hence Raman lines are sharp. But in a liquid the regularity of arrangement is broken, and hence the broadening out of the natural frequencies of the molecules. We may, therefore, say generally that the more diffuse the X-ray diffraction of a liquid the broader are its Raman lines, provided the natural frequencies of molecules are sufficiently influenced by the surrounding molecules.

KEDARESWAR BANERJEE.

Alipore Observatory,
Calcutta, Nov. 15.

[1] NATURE, Aug. 9, 1930, p. 201.
[2] *Ind. Jour. Phys.*, vol. 4, pt. 7, pp. 541-556.
[3] NATURE, Oct. 18, 1930, p. 603.

The Photo-Reaction of Hydrogen and Iodine Monochloride.

WE are unable to accept the conclusions of Rollefson and Lindquist[1] that hydrogen and iodine monochloride do not react at ordinary temperatures under the influence of light. These authors maintain that the reaction $H_2 + Cl = HCl + H$ does not readily take place because the Cl atoms resulting from the photo-dissociation of ICl are mostly in the unexcited state. They consider that the accompanying reaction $ICl + Cl = I + \overset{*}{Cl}_2$ is more probable. We had already concluded certain experiments with H_2 and ICl before the above paper appeared, and had found, as we now find on repeating the work, that H_2 and ICl reacted rapidly in strong light if the hydrogen pressure were large compared with the pressure of ICl. This must mean that conditions favour the greater probability of the reaction $H_2 + Cl = HCl + H$, and that excited Cl atoms may not be necessary for it to take place. The idea, however, that ICl dissociates into normal atoms is not accepted now by the original investigators.[2]

In some of our preliminary experiments we passed carefully purified hydrogen at atmospheric pressure and ICl at a pressure of about 20 mm. into thin glass bulbs, which were then sealed off. The reaction was very slow in artificial light (electric globe), more rapid in diffuse daylight, and very rapid in direct sunlight, I_2 and HCl being the main products. We have also used hydrogen filtered through palladium and dried over phosphoric oxide, and Kahlbaum's purest, crystalline ICl. No special precautions were taken to eliminate possible inhibitors except oxygen. It is easy to understand why the reaction proceeds very slowly compared with the hydrogen-chlorine reaction, as the chain will terminate with the formation of iodine atoms.

We hope to publish some quantitative results very shortly.

D. P. MELLOR.
T. IREDALE.

University of Sydney,
N.S.W., Australia.

[1] *Jour. Amer. Chem. Soc.*, **52**, 2793; 1930.
[2] Gibson, NATURE, **123**, 347; 1929. *Zeit. für Physik*, **50**, 692; 1928.

Crystal Structure of Molybdenum Trioxide.

CRYSTALS of molybdenum trioxide, prepared by subliming MoO_3 powder, obtained from the pure ammonium compound, have been examined with X-rays. The crystals were small, thin, lustrous plates, parallel to *b* (010).

Laue photographs showed orthorhombic symmetry. Oscillation photographs about the three principal axes gave the cell size as

$$a = 3{\cdot}93 \pm 0{\cdot}02 \text{ A.}$$
$$b = 13{\cdot}91 \pm 0{\cdot}05 \text{ A.}$$
$$c = 3{\cdot}57 \pm 0{\cdot}02 \text{ A.}$$

These seem to bear no relation to the crystallographic axial ratio given by Nordenskiold,

$$a : b : c = 0{\cdot}3874 : 1 : 0{\cdot}4747.$$

There are four molecules of MoO_3 per cell. The space group is Q^{16}_h, (*bnm*), since (*h*01) is halved if $h+1$ is odd, and (0*k*1) is halved if *k* is odd. The co-ordinates of the molybdenum atoms are as follows, the centre of symmetry being taken as origin:

$$uv\tfrac{1}{4}: \bar{u}+\tfrac{1}{2}, v+\tfrac{1}{2}, \tfrac{1}{4}; \quad u+\tfrac{1}{2}, \bar{v}+\tfrac{1}{2}, \tfrac{1}{4}; \quad \bar{u}\bar{v}\tfrac{3}{4}.$$

$u = 36°$, $v = 30°$, approximately.

Intensity measurements are being made on an ionisation spectrometer, to fix the oxygen positions.

A full account of the structure will appear later in the *Zeitschrift für Kristallographie*.

NORA WOOSTER.

The Mineralogical Laboratory,
The Museums, Cambridge,
Dec. 8.

The Emission Bands of Sulphur.

H. H. VAN IDDEKINGE[1] has made the interesting observation that in the emission spectrum of sulphur produced by him, such of the bands as were found by Rosen[2] and Henri and Teves[3] to be diffuse in the absorption spectrum, are entirely absent. This gives strong evidence in favour of the view of 'pre-dissociation' in the molecule.

A few months ago, when I was working at King's College, London, I obtained spectrograms of the emission bands of sulphur by exciting them in a discharge tube containing sulphur vapour in the presence of high pressure argon. Analysis of the bands is in progress, but I find on my plates all the bands recorded in absorption by previous workers and many more towards the red end, and the bands are all sharp. This indicates that argon helps in some way to arrest the pre-dissociation of the sulphur molecule. Analogous influences of rare gases are known, for example, in the production of the Cameron bands, the Baldet-Johnson bands, etc.

In addition to the already known bands attributed to sulphur in the visible and the ultra-violet, a few new bands degraded towards the shorter wave-length side have been also photographed in the extreme ultra-violet beginning from about λ2100.

This system apparently extends into the region of the vacuum spectrograph, but until now I have not been able to make any attempt to photograph them there.

R. K. ASUNDI.

Wilson College, Bombay, 7,
Nov. 14.

[1] NATURE, **125**, 858; 1930.
[2] *Zeit. für Phys.*, **43**, 69; 1927: **48**, 545; 1928.
[3] *C.R.*, **179**, 1156; 1924, etc.

An Unusual Sex-Ratio in Red Deer.

IT is the practice among stalkers in the deer forests of Scotland to shoot a certain proportion of the hinds each year after the stag-shooting season has finished. So far as possible the hinds chosen are those called 'yeld' or dry hinds. A 'yeld' or dry hind is one which did not have a calf during the preceding season. It may either never have had a calf or may have missed a season. Consequently the 'yeld' hinds have no calf following them. They are almost always pregnant at the time they are shot.

In September 1927, whilst staying at Langwell, Caithness, I was informed by H.G. the Duke of Portland, K.G., of a very wide-held belief amongst deer stalkers that these 'yeld' hinds always had a male embryo in the uterus and never a female. The Duke, being interested in this matter, sent me six pregnant uteri from 'yeld' hinds shot at the end of 1927. On opening them it was found that five of the embryos were male and one female.* In 1928 I received 17 uteri. Apparently the hinds had been shot much earlier in the season, for in none of these cases was it possible to determine the sex by ordinary visual examination. The genital glands from the base of the kidney were accordingly sectioned, and it was taken that the presence of testicular tissue was positive evidence that the embryo was a male. Of the 17 uteri, *one* proved not to contain an embryo at all, and in 3 other cases identification was impossible. The remaining 13 embryos were all male.

It will be seen that of the cases examined, in which it was possible to sex the embryos, 18 were males and only one female.

I feel bound to mention that on arrival at Langwell in 1928 I was informed by the stalkers that one of the 1927 uteri had been sent by mistake, and that it was in all probability not taken from a 'yeld' hind; but even without relating this to the single female in the 1927 cases, the figures appear sufficiently striking.

I am deeply grateful to the Duke of Portland, not only for his original suggestion, and for sending the specimens, but also for the kindly interest he has taken throughout.

I am also greatly indebted to Dr. H. S. Davidson and Dr. J. S. Sturrock, of the Obstetrical Department of the University of Edinburgh, who prepared the sections of the sex glands; and to Prof. Arthur Robinson, of the Anatomy Department of the University of Edinburgh, who finally identified the preparations.

GLYN DAVIES.

The Jessop Hospital for Women,
Gell Street, Sheffield,
Dec. 24.

* The Duke incorporated these results in a letter on this subject published in the *Field*.

Behaviour of a New Species, *Digitalis mertonensis*.

HYBRIDS have often been obtained between *Digitalis purpurea* and *D. ambigua*, but it was not until 1926 that a few F_2 seedlings were raised by crossing such hybrids *inter se*.[1]

These seedlings were giant, highly fertile, and showed no segregation of the parental characters. They had 112 chromosomes and arose by a suppression of the reduction division in their parents, each of which had 56 chromosomes. The inference was drawn that, as in other cases, it was the doubling of the chromosome number that *determined* the regular pairing of identical chromosomes, the formation of uniform germ cells, and consequently fertility.

The new form has been carried on for five generations and remains giant and tetraploid. The linear measurements of the flowers are $\sqrt[3]{2}$ times those of the diploid hybrid. It throws about a quarter of less fertile forms at each generation. These are presumed to arise through the occasional pairing and segregation of the homologous chromosomes derived from the opposite parents, as in *Primula kewensis*.[2]

It crosses with the parental species, readily with *D. purpurea*, less readily with *D. ambigua*, but yields offspring which, being triploid, are highly sterile. There is no difficulty, therefore, in preserving the new form effectively uncontaminated by crossing, and we consider that it can conveniently be regarded as a new species: *Digitalis mertonensis*.

Amongst the rare seedlings of *D. mertonensis* × *D. ambigua* was one small sterile plant showing all the characteristics of the F_1 hybrid and none of the characteristics of the back-cross. This plant proved to be diploid. At meiosis its chromosomes failed to pair, as in the original hybrid. It can only have arisen from an unfertilised germ-cell of its female parent, that is, by parthenogenesis. Thus the halving of the chromosome number is associated with the removal of all the conditions associated with the doubling.

Since we see that (1) the halving of the chromosome number is directly determined by omission of fertilisation (an intercellular phenomenon), while the doubling of the chromosome number is directly determined by the omission of reduction (an unrelated, intracellular phenomenon), and (2) in both cases the difference between high and low chromosome number is associated with the difference between fertility and sterility, it follows that the change of chromosome number is the cause of the change of fertility rather than a parallel effect of a common cause.

B. H. BUXTON.
C. D. DARLINGTON.

John Innes Horticultural Institution,
Merton Park, London, S.W.19,
Dec. 16.

[1] Buxton and Newton, *J. Genet.*, **19**.
[2] Newton and Pellew, *J. Genet.*, **20**.

The Designation of Women Biologists.

I WAS very glad to see from Prof. Cockerell's letter in NATURE of Dec. 20, that scientific men now realise the importance of continuity in a woman's name. When I first married in 1911 and kept my own name I had to overcome the opposition of a number of the leading scientific people of that day, who bitterly objected to my utilising the laws of our country, which permit a woman *not only to use* her maiden name throughout her married life, but also retain it *as her only legal name*. The Royal Society even refused to continue a grant which I had from it unless I adopted my husband's name! So may I, as one who persistently kept her own name for scientific work (and has borne the brunt of the difficulty of doing so against an unreasoning antagonism), welcome and support Prof. Cockerell's suggestion that all women should do so?

MARIE C. STOPES.

Heatherbank, Hindhead,
Surrey, Dec. 30.

Vitamin B.

ASSAY AND VITAMIN B_1.

THE separation of vitamin B into two factors, antineuritic and antipellagrous, a few years ago, led to considerable attention being devoted to the properties of this vitamin, with the result that it is now possible to distinguish at least four B factors, quite apart from any grouped under the name 'Bios', which may be necessary for the growth of lower organisms. The factors are distinguished by differences in their chemical properties and physiological effects: their differentiation has necessitated a revision of the methods of assay, since it is possible that a failure to respond to an addition to the diet is an indication of the absence of a factor other than that for which the test was designed. In this type of research a preventive test is less delicate than a curative, whilst the growth test may be considered still cruder: a single factor should cure the specific symptoms due to its absence, preventive tests may test for more than one, whilst it is clear that a positive growth response can only be obtained when every factor is adequately supplied; and our knowledge of all the factors required for growth is still incomplete, as the recent work on vitamin B has shown.

H. W. Kinnersley, R. A. Peters, and V. Reader (*Biochem. Jour.*, vol. 22, p. 276; 1928) have analysed the pigeon curative test for vitamin B_1, or the antineuritic factor. By adherence to certain principles, the test can be made reasonably accurate and has been successfully used in following the vitamin in its concentration from a yeast extract. The birds should be in the laboratory for a month on a mixed grain diet before being placed on the diet of polished rice, and only those developing symptoms within 30 days should be used. As soon as signs of head retraction appear, the bird should be transferred to a warm room for 2 hours and given 50 mgm. glucose in water by stomach tube: this procedure eliminates birds showing false cures. The dose of extract must be given within 6-12 hours of the onset of symptoms and, provided the cure lasts more than 1 and less than 10 days, the amount of active principle present can be considered as directly proportional to the length of the cure. After the test is over, the bird is given marmite and kept warm for a few days. It is then placed on the stock diet again for about a month, when it is ready for another period of polished rice feeding. Individual birds show a remarkable constancy in the time symptoms appear after commencement of the experimental diet, but there is no correlation between this interval and the duration of the subsequent cure, or between it and the colour or weight of the bird.

H. Chick and M. H. Roscoe (*ibid.*, vol. 23, p. 498; 1929) have used the growth of young rats as a criterion for the presence of vitamin B_1. It is difficult to carry out a curative test with this animal, since there is only a very short interval between the onset of acute symptoms and death: Reader has, however, been successful and has found that the adult rat requires about one pigeon day dose each day (quoted by Peters, the Harben Lectures, 1929). Chick and Roscoe used synthetic diets free from vitamin B_1: vitamin B_2 was supplied as autoclaved yeast or as fresh egg-white. After 2-3 weeks the animals began to lose weight: growth was resumed if Peters' antineuritic concentrate was then administered. The egg-white diet, however, did not maintain growth to maturity. B. C. Guha and J. C. Drummond (*ibid.*, vol. 23, p. 880; 1929) have used both the pigeon curative and the rat growth tests: in the latter, vitamin B_2 was supplied as marmite autoclaved at an alkaline reaction.

Chick and Roscoe (*ibid.*, vol. 22, p. 790; 1928) have used a similar method for the assay of vitamin B_2, young rats being placed on a diet complete except for this vitamin, and the B_1 factor being supplied as Peters' concentrate. It was found that the caseinogen used contained traces of vitamin B_2 unless it was reprecipitated with acetic acid and thoroughly extracted with alcohol before being heated at 120°. Animals on this diet fail to grow but respond to a supplement containing vitamin B_2. If the supplement is not given, after about six weeks a generalised dermatitis appears, which can be cured by administration of the vitamin.

B. C. P. Jansen and W. F. Donath (*Mededeelingen van den Dienst der Volksgezondheid in Ned.-Indië*, Anno 1927, Part 1) obtained highly active preparations of vitamin B_1 from rice polishings by a process involving extraction with acid water, adsorption on fuller's earth, eleution with baryta, and fractionation of the extract with silver sulphate and baryta. The activity was precipitated with phosphotungstic acid, the precipitate decomposed with baryta, and after removal of barium the concentrated solution was treated with platinic chloride, which precipitated the vitamin. Further purification was effected by acetone precipitation from alcoholic solution and by treatment with picrolonic acid or gold chloride. 0·012 mgm. of the final fraction a day was sufficient to maintain pigeons in health over six weeks: C. Eykman (*Kon. Akad. van Wetensch. Amsterdam*, vol. 30, p. 376; 1927) confirmed the activity with both pigeons and cocks. The final product was obtained in crystalline form, as a hydrochloride, a picrolonate, or a double salt with gold chloride.

Kinnersley and Peters (*Biochem. Jour.*, vol. 22, p. 419; 1928) have continued their work on antineuritic yeast concentrates (see NATURE, vol. 121, p. 516; 1928). It is not yet certain whether the curative substance is the same as that obtained from rice polishings by Jansen and Donath: the activity of the final product does not appear to be quite so great and its properties are not quite the same. In all work on the concentration of vitamin B_1, it has been found that the properties of the active fractions vary according to the nature of the accompanying impurities, so that methods developed for use with an extract of rice polishings may not be applicable without modification to an extract of yeast. The extract from the charcoal adsorption, after removal of metals, can be fractionated by successive additions of alcohol, the

vitamin passing into the portion soluble in 99 per cent ethyl alcohol. The authors failed to get consistently successful results with a silver fractionation, but were more successful with the use of phosphotungstic acid and platinic chloride. The most active preparations contained a day dose in 0·027 mgm., but more lately some have been obtained with a curative activity of 0·01 mgm. a day dose.

Guha and Drummond (*loc. cit.*) prepared active concentrates from wheat embryo. After extraction by means of acid alcohol, two different methods of concentration were employed: in the first, impurities were precipitated by lead acetate, and the activity adsorbed on norite charcoal at *p*H 4·5 and eleuted with acid alcohol: it was then precipitated by phosphotungstic acid, adsorbed on silver oxide, and the product fractionated with alcohol. Picrolonic acid then precipitated impurities from the material, which was soluble in alcohol. The first product had a pigeon day dose of 0·043 mgm. In the second method, Jansen and Donath's process was followed, namely, adsorption on fuller's earth at *p*H 4·5 and eleution with baryta, and fractionation with silver nitrate and baryta followed by precipitation with phosphotungstic acid. The product was then submitted to precipitation with platinic chloride, followed by gold chloride; at the last stage most of the activity passed into the precipitate, but it was observed that smaller doses of both precipitate and filtrate together restored growth in the rat or cured the pigeon than of either when given separately, suggesting that vitamin B_1 may itself be composed of more than one factor. The smallest pigeon day dose was 0·0025 mgm., and 0·015 mgm. promoted good growth in rats. These figures indicate that the preparations were more active than the crystals obtained by Jansen and Donath.

Although formulæ have been assigned to vitamin B_1 preparations, it does not appear that a pure substance has yet been isolated. A certain amount is, however, known about its properties. It appears to be a tertiary base: it is soluble in water and alcohol, but is unstable in the latter solvent when highly purified: it is insoluble in the other common organic solvents. It is destroyed by alkali, but is stable to oxidising and reducing reagents and to nitrous acid. Cruder preparations give a definite Pauly reaction, but as purification proceeds the reaction becomes very weak. Sulphur is absent, and the purer preparations do not give the xanthoproteic, purine, or Millon's reactions. In extracts from rice polishings, after treatment with lead acetate and concentration of the filtrate, vitamin B_1 is destroyed by fermentation and by heating to 95°, and is removed by filtration through a Berkefeld filter (J. L. Rosedale and C. J. Oliveiro, *Biochem. Jour.*, vol. 22, p. 1362; 1928), although it will dialyse through cellophane.

The isolation from contentrates of supposedly pure substances and the fact that false positives may be given by the pigeon test have led to claims that different pure compounds are the vitamin. J. M. Gulland and Peters (*ibid.*, vol. 23, p. 1122; 1929) have examined the claims that certain quinoline and glyoxaline derivatives have curative properties. Without exception all those examined, including 4 (or 5) glyoxaline methylethyl carbinol hydrochloride and 2:6-dihydroxyquinoline, were quite inactive when tested on pigeons by Peters' technique.

The Adler Planetarium of Chicago.

THE Adler Planetarium is a new and striking feature on the shore between a small lagoon and Lake Michigan. In plan it is dodecagonal: the walls are faced with large slabs of red granite and it is surmounted by a dome. The principal object of this new institution is explained on the dedication plaque that confronts the visitor when he crosses the threshold of the entrance lobby. Eight sculptured figures by Vannelli, symbolising the eight principal planets, are disposed around a circular disc representing the sun, upon which is set the inscription: "*The Astronomical Museum and Planetarium of Chicago—Gift of Max Adler—To further the Progress of Science—To guide to an Understanding of the Majesty of the Heavens—To emphasise that under the Great Celestial Firmament there is Order, Interdependence and Unity—1930.*"

For this purpose the principal instrument is a large projection apparatus built by the firm of Zeiss on lines similar to those of the one described in NATURE for Dec. 27, 1924, p. 937, and by which large audiences can watch the movements of the starry firmament as projected upon the inside of the great dome of 68 feet in diameter. On the north and south sides of the dome are two spacious exhibition halls, while to the east of it are library, lecture- and work-rooms, and also the office of the director, Dr. Philip Fox.

The Adler Planetarium is, however, designed on broader lines than those of a public hall for planetary demonstrations. It includes a collection of important historical instruments used by astronomers in past centuries. Among the more modern instruments are one of Sir William Herschel's reflecting telescopes, given by Sir Frank Dyson with the authorisation of the British Admiralty; Burnham's 6-inch telescope, loaned by the University of Wisconsin, with various mementoes of him; Nichol's star heat radiometer from the Yerkes Observatory; refractors loaned by Carl Zeiss and by Richard E. Schmidt; a large model of an observatory with movable dome, telescope, and floor, based on the U.S. Naval Observatory. An appropriate exhibit is an orrery by Isenbroeck, of 1737; while in wall-cases are displayed that important series of instruments of earlier date, known as the Mensing Collection, which was purchased *en bloc* in January last by Mr. Adler from the firm of Messrs. Frederik Muller and Co., of Amsterdam.

While keenly regretting the loss to Europe of so many astrolabes, armillary spheres, sundials,

early telescopes, sextants, and surveying instruments—all most interesting relics of the past—it is well that the great country of America, where science is relatively so new, should have some material record of the tools by which astronomical knowledge has been painfully won, and taught, in the Old World. Thanks to the generosity of yet another recruit to the ranks of noble benefactors who have given the United States its greatest institutions, Chicago now takes the lead among American cities equipped for the study of the instruments of ancient astronomers. Thanks to Dr. Adler, within a few months the city has acquired historical riches surpassed only by the famous collections of European cities, such as Munich, Dresden, Paris, London, and the Lewis Evans Collection at Oxford. The selection has been ably made and arranged by Mr. Adler's lieutenant, Dr. Fox, and the instruments will be on view at the Chicago Centenary Exhibition this year, with the planetarium as the most considerable side-show. We require benefactors like Mr. Adler in Great Britain.

Obituary.

SIR OTTO BEIT, K.C.M.G., F.R.S.

DURING the last fifty years, and more especially in the last twenty-five, much has been done in Great Britain to promote the advancement of the science of medicine, by providing facilities for the furtherance of research, both by the development of laboratories of high efficiency and also by the foundation of research fellowships to enable investigators of promise to pursue their work. Many generous benefactors have taken a part in this work; some have built institutions or laboratories, others have endowed professorships, and others have founded research fellowships.

Amongst those who have devoted their benefactions to the foundation of fellowships, the name of Sir Otto Beit will always be honoured, not merely, or even mainly, for the magnitude of his foundation, which amounted to nearly a quarter of a million sterling, but rather for the breadth of view that determined the scope of the scheme that was founded as a memorial by him to his brother, the late Mr. Alfred Beit. Mr. Alfred Beit had taken a considerable interest in certain proposals that had been made in the early years of the present century for improving the teaching of the earlier subjects of the medical curriculum of the University of London, and had made a gift of £25,000 towards this object and bequeathed a further like sum for the same purpose. The scheme failed to secure the necessary support of those concerned, and, consequently, the gift and the legacy ultimately lapsed, and reverted to the residuary legatee, Sir Otto Beit. He decided to use the money to establish a memorial to his brother, to whom he was devotedly attached; and after consultation with, and advice from, Sir James Kingston Fowler, the late Prof. Starling, and others, the scheme was promulgated in December 1909 as a "Memorial to his brother, Mr. Alfred Beit, to promote the advancement by research of Medicine, and the Allied Sciences in their relation to Medicine".

Although the scheme was originally drafted on the basis of the provision of a capital sum of £25,000 and the foundation of three fellowships, it transpired that Sir Otto had increased the benefaction tenfold, and one, at any rate, of his advisers only learnt this by telephone from him, twenty-four hours before the announcement was made publicly. This act exemplifies not only the great generosity of the donor, but also the decision with which he acted when he considered the proposals put before him were such as to deserve support.

Although the Foundation is justly remarkable for its magnitude, it is more especially to be commended for its scope. Many benefactors would have desired to impose limitations; some would have failed to realise that medicine can be furthered in any other way than by research directed to some immediate so-called practical object, for example, the eradication of some individual disease. Not so in the case of Sir Otto Beit; and hence the inclusion in the scheme of the "Allied Sciences in their relation to Medicine". He was well aware of the close and intimate connexion of many sciences, not only with the science of medicine, but also with the practice of the art of medicine.

The actual scheme of administration of the Foundation was modelled on that adopted by one of the City companies, namely, the Worshipful Company of Grocers, in its scheme for the award of the well-known Grocer Research Scholarships in Sanitary Science. This City company in the early 'eighties established three scholarships for the promotion of research into the nature and prevention of disease, and always allowed its scientific advisory committee a wide discretion in interpreting the relation of the proposed research to the actual practice of medicine; and many Grocer scholars have made notable additions to knowledge in physiology and in pathology as well as in pure medicine, and thus medicine has been assisted both directly and indirectly. This same policy has characterised the awards of the Beit Fellowships; and the record of the discoveries of the Beit fellows in the course of the last thirty years is one of which any Foundation might be justly proud. Sir Otto Beit, as chairman of the Beit Trustees, took a personal and active interest in the work of the fellows, and was remarkably conversant with their work, as throughout his life he took a lively interest in the progress of medical knowledge.

In November 1928 he made another very notable benefaction to medical science, by giving King Edward's Hospital Fund £50,000 for the purchase of radium for the benefit of London hospitals; and shortly before his death he gave a further £8000, required by King Edward's Hospital Fund to complete the purchase of a further quantity of radium. Here again the value of the gift was greatly increased by the wise foresight of the donor. Many donors would have been satisfied by merely providing radium for the relief of suffering, but Sir Otto Beit went much further by saying that he "should

like the Committee to endeavour to secure that the hospitals thus to be provided on loan with radium, should be preferably those in which the cure of disease, or the alleviation of suffering, is associated with a keen interest in the furtherance of knowledge 'for the relief of man's estate'".

This shows very clearly the wide view and the profound interest he took in the advance of knowledge, and his great faith in the paramount necessity of research. Few laymen had such an intelligent appreciation of the problems of medical research, and of the need of much patient work before the realisation of success; and he was not one who was always expecting immediate and striking results to follow on a programme of work.

Sir Otto Beit was elected a fellow of the Royal Society in 1924, and certainly it may be said of him, in the words of the statutes of the Society, that he had "rendered conspicuous service to the cause of science". JOHN ROSE BRADFORD.

ON the death of Sir Julius Wernher in 1912, Sir Otto Beit took his place as a representative of the Crown on the Governing Body of the Imperial College of Science and Technology, thus preserving unbroken the close connexion of the College with the famous firm of Wernher, Beit and Co. Sir Julius Wernher himself was an original member of the Governing Body, and took an influential part in the negotiations which led to the foundation of the College in 1907. Practically the whole of the endowment of the College since its incorporation has been provided by Sir Julius Wernher, Mr. Alfred Beit, and Sir Otto Beit.

Sir Otto Beit was an active and inspiring member of the Governing Body. A firm believer in the intellectual and practical value of the highest scientific education, he did everything in his power to promote it. In 1913 he created a Trust Fund, which he increased later to £26,500, to provide for Research Fellowships tenable at the College and open to men and women of European descent by both parents, but otherwise of any nationality, being graduates of universities within the British Empire. From time to time he gave sums of money, amounting to £32,500 in all, towards the cost of the Imperial College students' hostel and of the extension to the hostel and the students' union which forms part of a new building now nearing completion. His other gifts, which were many in number, included a sum of £10,000 towards the general development of the College in a time of financial stringency.

These benefactions are illustrative not only of Sir Otto Beit's generosity, but also of his good judgment. He never gave money away indiscriminately; he had a clear insight as to the right thing to do at the right moment. He was always ready to be guided, but never allowed himself to be swamped by the enthusiasm of others. It was this quality which brought him the full confidence of his colleagues, and when in 1919 Sir Francis Mowatt resigned the chairmanship of the finance committee of the Governing Body shortly before his death, there was no hesitation about the appointment of his successor. Sir Otto Beit continued to hold this important post until his death, and though he was greatly handicapped in recent years by ill-health, he worked untiringly to further the interests of the College. He interested himself not only in the government of the College, but also in the life of the students, many of whom are indebted to him for unobtrusive acts of kindness. We have lost a great friend and a great benefactor.

H. T. TIZARD.

PROF. C. E. MOSS.

THE death on Nov. 11 last of Prof. C. E. Moss, at his home in Johannesburg, at the age of sixty, is a serious loss to South African botany and to systematic botany at large. Charles Edward Moss was a native of Cheshire, the youngest child of a Nonconformist minister who settled at Halifax in 1874. He gained his early education at elementary schools in that town, eventually becoming a pupil-teacher. At the age of twenty-three he had a serious illness and his convalescence involved spending much time in the open air. This led to a keen interest in field botany and close acquaintance with the local naturalists, who were at that time a very active body. Moss thus became a competent field botanist before he was able, at twenty-five years of age, to go to the Yorkshire College, Leeds, and work for his degree as well as his teacher's certificate. At Leeds he found Miall's teaching and outlook very acceptable, and in 1896, when the late Dr. W. G. Smith went to Leeds as lecturer in botany, Moss was greatly attracted by the new method of studying and mapping plant communities in the field which had been inaugurated in Scotland by Smith's elder brother Robert.

Moss took his degree in 1898 and collaborated with Smith in the first 'primary survey' of vegetation to be made in England (Leeds and Halifax district), published in the *Geographical Journal* in 1903. He also published several minor botanical studies in local journals. After leaving Leeds he taught at a school in Bradford, and later at Bruton in Somerset, where he applied the new method to the local vegetation with conspicuously successful results. In the Somerset paper, too, which was also published by the Royal Geographical Society (1907), he worked out a logical system of units of vegetation which he elaborated later in another publication (1910), and which was made the basis of the treatment adopted in "Types of British Vegetation" (1911). Moss was anxious to leave schoolmastering, and in 1902, at some financial sacrifice, he migrated to Manchester and lectured in biology at the Municipal Training College, at the same time improving his knowledge of general botany by attending honours lectures at the University.

In 1904 the British Vegetation Committee was founded to facilitate the co-operation of the small band of active workers on the survey of British vegetation. Moss was one of the original and certainly one of the most valuable members of the Committee. His acute logical mind and his

increasingly critical knowledge of species were of the greatest use in accelerating the rapid advance in our knowledge of British vegetation which marked the first decade of the century. While at Manchester he undertook a survey of the Peak district which gained him his D.Sc. degree and was published much later (in 1913) by the Cambridge University Press. In 1907 Moss was invited to go to Cambridge as Curator of the University Herbarium, and gladly accepted the invitation, though again at some financial sacrifice. He joined Emmanuel College as an advanced student and took his B.A. degree by research. During the ten years he was at Cambridge he lectured in systematic botany, demonstrated to the elementary students, and was very active in field work.

From about 1910 Moss turned more and more to critical systematic botany. After publishing several excellent and illuminating critical papers on different small genera, he conceived the idea of a new British flora on a monumental scale. This the University Press agreed to publish as the "Cambridge British Flora", and vol. 2, dealing with the Amentiferæ and allied families, to which Moss had paid special attention, appeared in 1913. The outbreak of War, however, seriously compromised the financial prospects of this ambitious undertaking, and, together with other difficulties, led to the suspension of the work, only one other volume (vol. 3) appearing, under the editorship of an old pupil, Mr. A. J. Wilmott of the British Museum, after Moss had left England.

In 1917 Moss was appointed to the professorship of botany at Johannesburg, and here he gradually developed a very living and flourishing department, which was becoming a centre of research on South African floristics. At the same time Moss applied himself with characteristic energy and thoroughness to the task of becoming acquainted with the South African flora. He found that the published and herbarium material was to a large extent untrustworthy, and he set himself to revise various groups, travelling widely for the purpose: for he was never content until he had seen the species he studied in their native habitats. He had published very little since he went to South Africa, but he had a large amount of material in hand. Another five years would almost certainly have seen the appearance of so great a body of accurate systematic work as would have securely established his repute as a critical taxonomist of high rank.

Moss was a man of singularly acute, logical, and independent mind. With no adventitious advantages, he fought his way by sheer ability, hard work, and devotion to his subject, to a high place in the science. After attaining one reputation as a pioneer ecologist, he was making another, no less distinguished, as a taxonomist, and only his untimely death has prevented its full fruition. A. G. T.

PROF. FELIX LÖHNIS.

BY the death at Leipzig on Dec. 8 of Prof. Felix Löhnis, the science of bacteriology has sustained a serious loss. Löhnis was born in Dresden on Aug. 3, 1874. After he left school and before he finally turned his attention to academic work, he was engaged in practical agriculture for several years. In 1901 he received the degree of Ph.D. from the University of Leipzig, and in 1905 he became responsible for the instruction and research in agricultural bacteriology in that University. During the period 1905–1914 Löhnis's investigations did much to clarify the position of his subject. The chief contributions of his department were concerned with methods, the seasonal variation in bacterial activities, the decomposition of calcium cyanamide, and nitrogen fixation. This period in Löhnis's career was also notable for the publication of a manual of methods which has been translated into several languages, a text-book which is still the best work of its kind on the subject, and the well-known "Handbuch der landwirtschaftlichen Bakteriologie", which is the only comprehensive and critical review of the literature in existence. In 1912 Löhnis had attained a position of such eminence among agricultural bacteriologists that the British Association extended to him an invitation to address Section M (Agriculture) at the Dundee meeting.

In the spring of 1914 Löhnis was offered and accepted an appointment in the United States Department of Agriculture, and in 1923 he took over the direction of the Department's work on the bacteriology of soils. Between 1914 and 1923 he devoted much of his time to researches on the life-cycles of the bacteria. The results of this work, contained in a monograph published in 1921 and in other papers, are of a far-reaching nature, challenging as they do the fundamental principle of monomorphism, upon which the science of bacteriology has been built. Whether all Löhnis's views will be accorded general acceptance is still uncertain, but there is no doubt that his investigations on the life-histories of bacteria will exert a profound influence upon the ultimate development of the science.

In 1925 Löhnis returned to the University of Leipzig as professor of agricultural bacteriology and soil science, and in a very short time he had under his direction a volume of work which was probably greater than that undertaken by any other department of the kind in Europe. The chief contributions of the later years are those which deal with the fermentative and other changes which take place in the making of the various types of farmyard manure and in the preservation of forage crops. In 1929 Löhnis became editor of the *Zentralblatt für Bakteriologie*, Abt. II, and a short time before his death he was at work upon a new edition of his "Handbuch".

Those who have had the privilege of working under Löhnis will always treasure the remembrance of his enthusiasm and inspired direction. In the planning, conduct, and supervision of research he was unsurpassed, and his intuition frequently proved to be of quite an exceptional nature. In such matters his extensive and accurate knowledge of the literature of his subject was of the utmost value. It also enabled him to detect at once the rather frequent modern practice of

publishing, as new discoveries, already well-established facts. Of all such tendencies, as well as of work carried out in a perfunctory manner, he was most intolerant and did not hesitate to express his opinion in emphatic terms. His later publications were often greatly condensed and consequently difficult to read. As a result he has sometimes been misunderstood and has not always received the credit to which his work entitles him. His contributions to science, however, have been outstanding and will yet cause his name to be placed among those of the pioneers in bacteriological work.

DR. P. PINKERTON.

PETER PINKERTON was born in Kilmarnock on Jan. 8, 1870, and received his early education at the Academy there. At the University of Glasgow he gained the degree of M.A. with highest honours in mathematics, and afterwards he studied for two years at the Royal College of Science, Dublin. After a period of six years as mathematical master in Allan Glen's School, Glasgow, he was appointed head of the mathematical department of the Royal Academical Institution, Belfast, a position which he resigned after a short tenure to take up a similar one in George Watson's College, Edinburgh. Sixteen years ago he was appointed Rector of the High School of Glasgow, and he discharged the varied and responsible duties of that post with marked success and increasing distinction until his death on Nov. 22 last.

Dr. Pinkerton was a very great teacher. He had an exceptionally alert mind and an unfailing sense of humour. About a very clever student he once remarked, "He will make a poor, poor teacher; he never had a difficulty". His own outstanding success was largely due to his complete sympathy with all his pupils. He appreciated the difficulties of the dull, as well as the eager curiosity of the brilliant.

Under Dr. Pinkerton's inspiration and guidance, marked developments took place in the High School of Glasgow. The intellectual and social life was quickened, and the provision of splendid playing fields opened up a new era in athletics. Quietly and unobtrusively he devoted all his powers of mind and heart to the welfare of the School in all its aspects, and its betterment was his constant aim.

Dr. Pinkerton was a prominent member of the Edinburgh Mathematical Society, and served as secretary, as president, and as first editor of *Mathematical Notes*. He frequently contributed to the *Proceedings*, and was the author, in collaboration with the late Prof. Gibson, of a book on the "Elements of Analytical Geometry". Throughout this volume old students have no difficulty in recognising his characteristic methods of treatment and exposition.

The University of Glasgow, for which Dr. Pinkerton acted as examiner for degrees in mathematics at various times, conferred on him the degree of D.Sc. in 1909 and of LL.D. a few months before his death.

DR. H. BORNS.

THE death of Dr. Henry Borns on Dec. 12 last, at the age of seventy-five years, removes a very familiar figure from the meeting-places of scientific societies in London. Until the last year or two, when ill-health made his attendances not so regular, he was present at nearly every meeting concerned with physics or subjects related thereto. Always one would find him busily reporting the proceedings (for many years he acted as reporter for *Engineering*) and anxious to supplement his notes by a talk with the lecturer and a perusal of the manuscript. Although he was thus well known to the secretaries of the societies, few people seem to have known him intimately. He seldom volunteered information about himself, and he probably led a rather lonely life apart from his meetings. He was born in Austria, but must have come early in life to England, for he became a member of the British Association forty-eight years ago, attended the Montreal meeting in 1884, and missed very few meetings since that date. He joined the Physical Society in 1895, and was an original member of the Faraday Society.

Dr. Borns in the course of his work acquired a wide knowledge of physical subjects and his reports displayed expert discrimination. His notes were made without ordinary shorthand, in a curious abbreviated script, presumably legible to himself but a terror to his correspondents, for he used it in his letters also. He was a kindly soul, always anxious to be of assistance to the secretaries with whom he came into contact, and punctual in keeping his promises for the return of manuscripts lent to him. For half a century in a quiet way he served science well and faithfully, by giving it the best form of publicity—that based on accurate and well-informed records. His many scientific friends will miss him greatly.

WE regret to announce the following deaths:

Mr. J. H. Emerton, an authority on American spiders and formerly secretary of the New England Federation of Natural History Societies, on Dec. 5, aged eighty-three years.

M. Henri Gall, a former president of the French Society of Civil Engineers and president of the Industrial Chemistry Society, aged sixty-eight years.

Prof. Emile Gley, professor of general biology in the Collège de France, who was known for his work on the ductless glands, particularly the thyroid and parathyroid, aged seventy-three years.

Dr. O. P. Hay, formerly of the Carnegie Institution of Washington, known for his researches in Pleistocene palæontology and as author of the "Catalog and Bibliography of the Fossil Vertebrates of North America", on Nov. 2, aged eighty-four years.

Prof. E. W. Hyde, formerly professor of mathematics at the University of Cincinnati and vice-president in 1891 of Section A of the American Association for the Advancement of Science, aged eighty-seven years.

Vice-Admiral Sir Charles Royds, K.B.E., who served as first lieutenant of the *Discovery* in the British Antarctic Expedition of 1901–4, on Jan. 5, aged fifty-four years.

News and Views.

THE important announcement has just been made that in the near future there will be established in the vicinity of Toronto an astronomical observatory which will rank with the world's greatest institutions of this kind. It will be erected by Mrs. D. A. Dunlap and her son, D. Moffat Dunlap, as a memorial to the late David A. Dunlap, who died on Oct. 29, 1924, and will be known as the David Dunlap Observatory. Astronomy and geology were both favourite studies of Mr. Dunlap, but the former had a peculiar attraction for him. He was a keen student of the heavens, and always liked to share his knowledge with others. This project has been under consideration for the last five years and will now be brought to completion. In working out the plans, Mrs. Dunlap has had the assistance of Prof. C. A. Chant, head of the Department of Astronomy of the University of Toronto.

THE outstanding feature of the David Dunlap Observatory will be a large reflecting telescope seventy-four inches in diameter. There is only one of greater aperture in the world, namely, that on Mount Wilson in California. The instrument was ordered some time ago from the firm of Sir Howard Grubb, Parsons and Co., of Newcastle-on-Tyne. It will be housed in a circular metal building, such construction being best for this purpose. The observatory building will be a beautiful structure in the classic style. It will be erected on a suitable site near Toronto, in the midst of a large acreage which will be converted into a park, to be known as the David Dunlap Park. When the observatory is completed, it will be under the Department of Astronomy of the University of Toronto, while the park will be developed in a scientific way by the Faculty of Forestry. The new institution will bring distinction to the University, the city, the province, and indeed the whole Dominion. It will be an enduring memorial to a worthy citizen.

IN a recent leading article (see NATURE, Nov. 22, 1930, p. 797) we pointed out the urgent need for increased attention to the systematic study of the Indian peoples and cultures in view of the probable political conditions of the future. Bearing on this, it may be mentioned that Lord Winterton, in the *Empire Review* for January, closes an article discussing the problems of form and organisation in the government of India, with which the Round Table Conference has been concerned, by very pertinent illustration of the extraordinary range of variation in the peoples whose destiny is being decided. Discussion since the Conference opened has served to bring out even more clearly the fundamental importance, beneath the purely political problem, of questions of race, of religion, and of culture. At the same time, letters to the Press, such as that from Mr. Codrington which appeared in NATURE of Dec. 13, 1930, p. 919, and the correspondence in the *Observer* and elsewhere, while directing attention to such facilities as exist in England for Indian studies which are essential to the understanding of these questions, have emphasised their inadequacy.

STRONG support for the views on the question of anthropological studies in India itself, which we ourselves expressed, may be drawn from the presidential address delivered in the Anthropological Section at the seventeenth Indian Science Congress held last year at Allahabad and now available in the recently published congressional proceedings (Calcutta: Asiatic Society of Bengal, 1930. 15 rupees). The president, the Rev. P. O. Bodding, most urgently impressed upon his hearers the necessity for a record of the facts relating to custom, even the commonest facts of everyday life. Admitting the attraction of theory, he pointed out that an unbiased and uncoloured record of the facts is an essential preliminary to study, and alone affords any certainty of permanent value. Mr. Bodding is primarily and indeed solely interested in the scientific aspect of the matter: but he made use of a cogent argument in support of his plea, the force of which is equally, if not more, applicable in relation to the bearing of anthropological study upon the problems of administration. In India to-day, he urged, change in custom is taking place continuously and everywhere. He quoted from his own long experience among the Santals, where, for example, their attitude of mind in marriage customs appears to have changed entirely, passing, it would seem, from an attitude of potential hostility to one of union with the 'parties of the other part'; while in religion, it is now customary to find that at the celebration of a Hindu festival the greater number of the participants, and those who make the most noise, are Santals, officially classified as 'animists'. It is obvious that if from the scientific point of view it is important that a record of the facts should be preserved at the earliest possible as well as at the later stages of development, it is no less important that the administrator should have an exact knowledge of the changes that are taking place and of their direction.

A CURIOUS feature of the industrial situation is the pronounced shortage of administrators competent to direct and organise industry on the scale which the magnitude of modern industrial combines and their international relationships require. Men of the requisite ability are not automatically produced by the present system. On the contrary, authorities such as M. Henri Fayol have pointed out that under the specialisation involved in rationalisation the departmental manager or executive rarely has the opportunity of gaining the wider experience which is essential in higher administrative duties. It has been authoritatively estimated, moreover, that in the case of the managing director even of a highly technical organisation, the amount of technical ability essential is only 10 per cent as compared with 50 per cent of administrative ability, and even in the head of a technical department 35 per cent of administrative as compared with 30 per cent of technical ability is required. Such factors accordingly present serious obstacles in the promotion or training of staff for promotion to the higher administrative positions. Valuable work to remedy this state of affairs is being

done in Europe by the International Management Institute founded in 1927 by the XXth Century Fund, the International Labour Office, and the International Committee for Scientific Management. This Institute has already made a number of important studies on the application of scientific management in special factories, in banking, and in railway undertakings, and is fast becoming a clearing-house of world information and a focus of activity on all questions covered by the resolutions of the World Economic Conference.

IN Great Britain the Institute of Industrial Administration is carrying out similar work, and claims to have united in a comprehensive view the principles underlying the various aspects of industrial administration. It aims, further, at establishing industrial administration among the recognised professions; and with the further objects of education and the maintenance of high standards of skill and responsibility among its members, has modelled itself to some extent on the lines of established professional institutions. In opening a public discussion on Dec. 12, Mr. A. S. Comyns Carr, president of the Institute, pointed out that modern competition calls for a higher standard of administration, to eliminate waste and reduce costs of production, as well as in the introduction of new methods, and this is true of all sizes of business undertakings and of marketing as well as of production. Mr. Comyns Carr believes that the foundations of the knowledge required can be laid by suitable reading and instruction, and that examination can test these foundations and the capacity for initiative and common sense. Primarily, in its educational work, the Institute is an examining and not a teaching body. Arrangements are now being made by educational authorities to provide instruction by lectures in some or all of the subjects of the Diploma of the Institute, and this work is supplemented by the formation of a Students' Society to provide reading courses at very moderate fees.

ONE of the present Government's measures for assisting agriculture has been the Land Drainage Act of 1930. It would appear to be a popular subject with politicians, and recent governments, when asked what they have done for agriculture, have generally been able to give good accounts of what they have done to encourage the drainage of agricultural land. The cynic asks why this zeal for draining, when the land that is already drained cannot produce crops at a profit. There has, however, been a definite need for the present Act, and Mr. A. T. A. Dobson has explained this and the provisions of the Act very clearly and concisely in a paper read recently at the Surveyors' Institution. Rationalisation is a universally-acclaimed palliative for our economic troubles to-day. Agriculture cannot expect to escape, nor does it deserve to. This Act rationalises one thing in agriculture, the law of land drainage; it is intended to produce order out of something approaching chaos. Previously there was a large number of drainage districts under the jurisdiction of authorities of different types, and there was too much clashing of responsibilities and interests. Large rivers were rarely dealt with satisfactorily. The War years caused drainage works to fall badly into arrears. In 1926 trouble arose in the Great Ouse district in the form of passive resistance to the payment of drainage rates. A special Commission was set up in consequence, followed by a Royal Commission to investigate the whole question of the law of land drainage.

THE present Land Drainage Act follows closely the recommendations of the Royal Commission, and most of Mr. Dobson's paper is devoted to an explanation of its provisions. The general effect is that there will be two classes of drainage authority: the catchment board, responsible for all works on its main river, with supervisory jurisdiction over a wide area, and with considerable powers of raising revenue; and the ordinary drainage board, called within a catchment area an internal drainage board, responsible for the drainage of limited areas. Mr. Dobson then describes the methods of financing the drainage operations of these two types of authority, explains other points in the Act, and concludes by claiming that "the Act provides the necessary machinery for securing that, in future, all the waterways and drainage channels in England and Wales can be kept in a proper state of efficiency, including main rivers". If this proves to be the case, a very useful and necessary Act has been passed.

REPRESENTATIVE exhibitions of British chemical plant are of infrequent occurrence. Though the last one, held in 1926 in conjunction with the London meeting of the Society of Chemical Industry, was very successful, a favourable opportunity for repeating this venture has so far not occurred. A unique opportunity for remedying this state of affairs and for bringing British chemical plant to the notice of the chemical and allied industries throughout the world will occur next July on the occasion of the jubilee celebrations of the Society of Chemical Industry. The British Chemical Plant Manufacturers' Association has decided, in co-operation with the Chemical Engineering Group of the Society, to stage an exhibition which will be open during the whole week of the celebrations, July 13–18 inclusive, at the Central Hall, Westminster. The exhibiting area will be twice as great as in 1926. The exhibition will cover all types of plant, apparatus, instruments, constructional materials, and general equipment required by the chemical industry and the numerous other branches of industrial activity associated with it. Only makers of British plant will be eligible to exhibit. There will be a section devoted to the work of the various research associations and to the Department of Scientific and Industrial Research; this will be organised on non-trade lines by the Chemical Engineering Group of the Society of Chemical Industry, and its object will be to demonstrate the important part which science plays in the development of British industry and in the control of the products. Admission to the exhibition will be free, and invitations will be widely distributed to those who are interested in British chemical plant. The public will also be admitted free on the Friday

afternoon and the Saturday. Special steps will be taken to ensure the production of a fully classified catalogue, which will be supplied free either on admission or on application to the British Chemical Plant Manufacturers' Association. Further information regarding the exhibition can be obtained from the office of the British Chemical Plant Manufacturers' Association, 166 Piccadilly, London, W.1.

THE Newcastle-upon-Tyne Electric Supply Co. and its associated companies supply an area exceeding 4000 square miles, extending from Scarborough to Alnwick and including York. The power supplied is used for domestic purposes, mining, shipbuilding, engineering, and general manufacturing. The system of supply is three-phase alternating, at voltages ranging up to 20,000. Naturally, the accurate metering of all this energy was a problem of great difficulty. A full description of the difficulties and the methods by which they have been overcome is given in a paper read to the Institution of Electrical Engineers on Jan. 2 by E. Fawssett and G. E. Moore. The records show that good meters need not be examined oftener than once a year. Small meters are only examined once in every two years and very small meters once in every four years. The meter readers use motor cars which carry the testing equipment, including check meters. Each car carries two testers, each of whom must be able to drive the car and perform all the routine tests. About forty cars are always at work, and the performances of the meters under a variety of conditions are tested, the larger meters being subjected to more thorough tests. It is found that the lower bearing of the meter disc, which revolves on a vertical spindle, is the most unsatisfactory part of the whole meter. Oil is used to prevent rust, and the pivot and the jewel are immersed in it. Considering that electric meters are running sometimes for years at a stretch with a maximum inaccuracy of sometimes less than one per cent, it will be seen to what a pitch of perfection manufacturers have developed them. It is satisfactory to learn that the cost of the elaborate arrangements made to safeguard the revenue of the Newcastle company by accurate metering is less than the thousandth part of the revenue.

IN 1914 the developments in the design of thermionic relays enabled a telephone cable to be laid across the United States from ocean to ocean. Each relay has a filament from which electrons are liberated when it is heated by current from a battery. The most desirable filament at present in use is that used in the circuits of the Bell Telephone System. It consists of a platinum alloy the surface of which is coated with a mixture of barium oxide and strontium oxide. A minute trace of barium in each filament permits the use of a much smaller amount of power for heating. We learn from the *Bell Laboratories Record* for October that a quarter of a million telephone repeaters are in everyday use. The amount of barium used for each filament is only about one-sixth of a microgram. For all the tubes in use the total amount of the barium effective in the emission of electrons is not more than the twentieth of a gram. A clean tungsten filament required 35 watts for heating as compared with only 2·2 watts required for a filament coated with barium. Multiplying the quarter of a million tubes in use by the cost of the current taken from storage batteries, we see how the minute quantity of barium utilised in accordance with the methods found by fundamental research effects a great saving in the commercial working of the system. Experiments are quoted that prove the remarkable fact that the electron current which is possible at any heating temperature from a single layer of barium atoms on a platinum wire is enormously greater than the current which could be obtained from a filament of either substance alone.

SINCE 1926 there has been issued at Woods Hole a paper devoted to the work and workers at the Marine Biological Laboratory and the Bureau of Fisheries Laboratory. With the increasing number of workers at Woods Hole the need for some such organ is apparent. The *Collecting Net*, as it is called, is issued weekly during the summer months, and contains, besides items of local interest to workers, short summaries of some of the research carried out at the laboratories, each accompanied by a critical review. A glance at last year's issues, together with the directory of investigators, emphasises how Woods Hole becomes during the summer months a great meeting ground for biological workers, who form a unique community some hundreds strong. But this centre of biology is to be even further enriched by the addition of the largest oceanographic institution in the world. The issue of the *Collecting Net* for Aug. 30 of last year contains plans and details of the proposed Woods Hole Oceanographic Institution, the construction of which has already begun. The Institution has been endowed by the Rockefeller Foundation with grants of 1,000,000 dollars to finance the buildings and equipment, and 1,000,000 dollars as a permanent endowment fund. An additional working grant of 50,000 dollars a year has been promised for a period of ten years. The Institution is under the directorship of Dr. Henry B. Bigelow, and is to be a four-storied building with about fifty rooms and three or four large laboratories for student investigators. From here an ocean-going research vessel will operate in the Atlantic. The ship, 105 feet long at the water-line and with a displacement of about 380 tons, will be a two-master with ketch rigging, fitted with an auxiliary Diesel engine. Work has already started on this vessel, which is being built at Copenhagen. The Institution will possess a resident staff of eight or ten workers, who will remain at Woods Hole all the year round. It is hoped that building will be completed so that the laboratory will be able to open its doors next summer.

ON Jan. 6 a film on "The Sirex Woodwasp and its Parasites" was shown privately at the London Pavilion. This film is the first attempt at applying the talking-film to biological research. The woodwasp is responsible for serious havoc to timber, especially in New Zealand. This film is to form the first of a series dealing with the habits of the more important Empire forest insects. It is to be in-

corporated also in the new "Secrets of Nature" series of films, which will be produced this year. Many excellent silent films of scientific subjects, especially relating to natural history, are already available, and the use of the sound-film for like purposes is therefore to be welcomed. Educational films are shown in various theatres throughout the country, comprising biology, chemistry, other branches of science, history, and so forth. They are, in some cases, used to make up a complete programme. These, however, are of the popular or very elementary type and, where they from a complete programme, are meant for school children. On the other hand, the illustration of a biological or any other scientific subject, which one supposes will be of a specialised nature, by means of the sound film, is a different problem. It is too much to expect many members of the general public to pay for performances made up of films of such a nature, so, at the most, the films could only be used for filling up a programme of entertainment. The value of the film would thus be seriously diminished. The best use that could be made of such films, the production of which should be encouraged, is for presentation before societies and academic and research institutions. However, much was suggested in this direction with regard to the silent film; but little has yet been done, probably for financial reasons. Nevertheless, the project has a possible future; and its development does not rest so much with production and photography as in securing a sufficient demand to justify producers undertaking the costs involved in making films of this nature.

On the afternoon of Dec. 18, at the Lister Institute of Preventive Medicine, a large company, consisting of the staff and other research workers, past and present, met in the library of the Institute to offer parting gifts to Sir Charles Martin and Prof. Arthur Harden on the eve of their retirement. Prof. J. C. G. Ledingham, who is succeeding Sir Charles Martin as director, presided, and referred to the fact that only a few years ago a very similar gathering assembled to celebrate the conferment of knighthood on Sir Charles Martin by presenting him with his portrait. Sir Charles had directed the activities of the Institute for twenty-seven years. His highly successful administration might justly be attributed, in the first instance, to the great charm of his personality, and secondly, to his tact, his business ability, and the surprising catholicity of his scientific interests. Prof. Harden had served the Institute for thirty-three years and, as biochemist-in-chief, during that period made his department an important centre of biochemical research. Only a year ago he was awarded a Nobel prize in chemistry for his work on fermentation. While the departure of Sir Charles Martin and Prof. Harden would mean a severe loss to the Institute's forces, the traditions they had set would long remain a potent source of inspiration to their successors. On behalf of the many subscribers at home and abroad, Miss Harriette Chick presented to Sir Charles and Lady Martin a silver coffee service, designed and executed by Mr. Philip Alexander of Walberswick, Suffolk; while Miss Muriel Robertson unveiled and presented to Prof. Harden his portrait in oils by Mr. Neville Lewis. Sir Charles and Lady Martin sailed on Jan. 2 for Cape Town, en route to Australia, where Sir Charles will take charge of the Division of Animal Nutrition of the Commonwealth Council for Scientific and Industrial Research for at least two years.

In a paper reprinted from the *Transactions* of the Indian Philosophical Congress (1927), Mr. J. Walker Tomb declares that 'time' is used in two senses, metaphysical and mathematical. The former is the duration or continuance of personality, depending upon consciousness and memory. The latter, in his opinion, is the duration of matter, and he considers that the definitions of Aristotle, Newton, Einstein, and Eddington are quite wrong. Moreover, "the relativists . . . have built upon this misconception a bewildering philosophy which dethrones reason". To support this view, passages are quoted concerning bodies travelling with the velocity of light. (This, of course, is a case in which the equations cease to hold. As Einstein says, "Lumen is a fraud".) It is interesting to compare these views with Sir Arthur Eddington's opinions. In an interview reported by Mr. J. W. N. Sullivan (*Observer*, Dec. 21, 1930), he said: "We must remember that the notion of time, as it occurs in science, is a mere abstraction. The notion of time is, I believe, an abstraction from the dynamic nature of consciousness. Consciousness is essentially dynamic, and the 'time' of science is a most imperfect representation of this quality." The drawing together of science and philosophy is much hindered by the tendency of each side to misunderstand the other.

Fourteen of the leading French publishing firms which specialise in the production of technological literature have combined to produce a "Bibliographie des livres français d'Industrie et de Technologie". The lines of the "Catalogue of British Scientific and Technical Books" of the British Science Guild have been closely followed, with the following difference, namely, that books published in 1929–30 precede the General Catalogue for 1919–30, which forms the bulk of the work. Entries in Part 1 are annotated; those in Part 2 are not. The name and subject indexes include both sections. Hence there is some danger of confusion, and the writer of the prefatory note wisely counsels the user of the Bibliography to consult both sections "en cas de recherche". An annual supplement to the bibliography is promised with a consolidated edition every third year. The classification and indexing of the entries have been carried out in a workmanlike manner, and we have no doubt that the bibliography will prove a useful guide in the selection of French technological books in all parts of the world.

The north-east of Scotland has many points of contact for the archæologist, the historian, and the naturalist, and each of these, as well as the general reader, will find articles of interest in the latest issue of the *Deeside Field*. Selecting from a wide variety of topics, we mention only the Rev. Dr. Walker's

account of "Some Memorable Naturalists of the North-East". He recalls the accomplishments of William MacGillivray, naturalist and ornithologist; George Dickie, botanist; James Nicol, the geologist, who first saw a glimmer of light in the upheavals of the North-west Highlands; of George Sim, taxidermist and naturalist; and Thomas Edward, of Banff, who spent his boyhood in Aberdeen. But there are others, for no account could be complete which omitted the name of the Army surgeon, Dr. A. Leith Adams, who, in addition to writing popular accounts of his natural history observations in India and Egypt, became an authority on fossil elephants.

PROF. WILLIAM KING GREGORY has been elected president of the Galton Society for the Study of the Origin and Evolution of Man, New York, and Mr. Frederick Osborn has been elected secretary-treasurer.

A MEETING to inaugurate a British Society of Motion Picture Engineers will be held at the rooms of the Royal Photographic Society, 35 Russell Square, on Monday, Jan. 19, at 7 P.M. A draft constitution has been drawn up by the provisional committee, the secretary of which is Mr. Leslie Eveleigh, Gaisford House, Gaisford Street, Kentish Town.

THE following advisory committee has been appointed for the purpose of advising the Minister of Health on the practical application of modern advances in the knowledge of nutrition: Prof. Major Greenwood (chairman), Prof. E. P. Cathcart, Sir F. Gowland Hopkins, Miss Jessie Lindsay, Prof. E. Mellanby, and Prof. V. H. Mottram. The members will hold office until Dec. 31, 1933, and will be eligible for reappointment. The secretary to the committee will be Mr. F. R. Hudson, of the Ministry of Health.

THE Council of the Royal Astronomical Society has awarded the gold medal to Prof. W. de Sitter, director of the Observatory of Leyden, for his theoretical investigations on the orbits of the satellites of Jupiter and his contributions to the theory of relativity. Prof. de Sitter has also been invited to deliver this year's George Darwin Lecture. The Council has awarded a Jackson-Gwilt medal and gift to Mr. Clyde W. Tombaugh, of Lowell Observatory, Flagstaff, Arizona, in recognition of his discovery of the extra-Neptunian planet, Pluto.

ON Tuesday next, Jan. 20, at 5.15, Mr. J. W. T. Walsh will deliver the first of a course of three lectures at the Royal Institution on the art of illumination; on Thursday, Jan. 22, at the same hour, Prof. H. Dingle begins a course of three lectures on the nature of physical science. The opening Friday evening discourse of the year will be given by Sir William Bragg, on "The Scattering of Light", on Jan. 23; Mr. J. M. Keynes will deliver the Friday evening discourse on Feb. 6, on the mechanics of the trade slump.

THE Council of the Royal College of Surgeons of England has appointed Mr. J. H. Thompson, lecturer in physiology at King's College, London, to the research scholarship endowed by the late Lord Melchett. The subject to which Mr. Thompson proposes to devote himself is the influence of the parathyroid bodies on growth. His research will be carried out in the new laboratories of the Royal College of Surgeons and also in the physiological department of King's College. Mr. Wilfred Trotter has been appointed Hunterian Orator of the Royal College of Surgeons for 1932.

AT the meeting of the Grand Council of the British Empire Cancer Campaign, held on Jan. 12, arrangements were approved in connexion with the Garton Prize of £500 and Gold Medal, which is to be awarded to the person or persons submitting the best original dissertation on "The Early Diagnosis of Cancer" by December 1931. It was also announced that the subject, "The Biological Effects and Mode of Action of Radiations upon Malignant and other Cells", had been chosen for the second Garton Prize and Medal, the dissertations for which must be received by December 1933.

THE following appointments have recently been made by the Secretary of State for the Colonies in the colonial agricultural and forestry services: Mr. G. H. Gethin-Jones, to be soil chemist, Kenya; Mr. H. Evans, to be physiological botanist, Mauritius; Mr. M. H. French, to be biological chemist, animal nutrition research, Tanganyika Territory; Mr. R. J. A. W. Lever, to be entomologist, British Solomon Islands; Mr. C. O. Flemmich, to be assistant conservator of forests, Federated Malay States; Mr. T. E. D. Vigne, to be assistant conservator of forests, Nigeria; Mr. C. E. Duff, to be assistant conservator of forests, Northern Rhodesia; Mr. C. H. Holmes, to be assistant conservator of forests, Ceylon.

AT the annual meeting of the Association of British Zoologists, held on Saturday, Jan. 10, in the rooms of the Zoological Society of London, with Prof. E. B. Poulton in the chair, the morning session was devoted to discussions as to whether zoologists should accept fees for lectures and expert advice, and on the future of zoological collecting. In the afternoon it was moved "that training for applied zoology must be based upon a broad general zoological foundation", the three principal speakers being Dr. W. T. Calman, who dealt with museum work; Dr. E. S. Russell, with fisheries work; and Prof. J. W. Munro, with entomological work. The Association has only recently been formed and this was its first meeting, although, for seven years previously, there has been an annual meeting of British zoologists to discuss matters affecting the interests of the science.

DR. FRANK CONRAD, of the Westinghouse Electric and Manufacturing Co., Pittsburgh, has been awarded the Edison Medal, the highest award of the electrical engineers n the United States, for pioneering work in radio-telephone transmission before the days of broadcasting. In addition to his developments in radio communication, Dr. Conrad has made important contributions to alternating current work and arc lamp design; he has been in the employ of the Westinghouse Co. since 1890, and is now assistant chief engineer. The Edison Medal was founded by associates and friends of Thomas A. Edison and is

given annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts", by a committee of the American Institute of Electrical Engineers.

MESSRS. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, have just circulated a catalogue of their No. 7 department, containing the titles of books, both second-hand and new, relating to most branches of technology and applied science. Being carefully classified, the catalogue should be of service to many readers. The list is obtainable upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research scholar in mental diseases under the Joint Board of Research for Mental Diseases of the University of Birmingham and the City Mental Hospital Committee—E. Eyles, Hon. Secretary, Council House, Birmingham (Jan. 24). An advisory research entomologist at the Seale-Hayne Agricultural College, for the South-West Province—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon (Feb. 8). A physicist or engineer to carry out researches and standardisation in wireless telegraphy and telephony, and a physicist to carry out researches in optics, each under the National Research Council of Canada—The Secretary-Treasurer, National Research Council, Ottawa, Canada.

Our Astronomical Column.

The Near Approach of Eros.—Prof. H. N. Russell gives, in the *Scientific American* for January, a clear account of the methods being employed for using the present approach of Eros for obtaining improved values of the solar parallax and the mass of the moon. He estimates that fully ten years will be needed for a full discussion of the measures: but there is one source of delay that he has not considered. Several observatories have been co-operating during the past six or seven years in obtaining accurate places of selected stars near the planet's track. But the track diverges appreciably from the predicted one, to the extent of 1 minute of time in R.A. at the nearest approach. This makes some of the selected stars unsuitable, as being too far from the planet. It will be necessary to select others on the opposite side of the planet to take their place, and these will need to be carefully observed. One precaution that was not considered in 1901 is now being taken. The spectra of the stars have been examined, and those that differ markedly in type from Eros (the spectral type of which resembles that of the sun) will be rejected, owing to the different amount of their refraction by the earth's atmosphere. The article notes that the opposition of 1938, though inferior to the present one, will be much better than that of 1901, which was the best since the planet was discovered in 1898. 1968 will be about equal to 1938, and the next really favourable oppositions will be in 1975 and 2012.

Axial Rotation of Stars.—In the *Astrophysical Journal*, vol. 72, p. 1, Dr. O. Struve discusses the spectroscopic evidence for the existence of rapidly rotating stars. The occurrence of rapid rotations is assumed in many astronomical theories, such as the fission theory of binaries, but so far there has been no direct evidence that they are anything but rare exceptions. Dr. Struve shows that broad, shallow absorption lines are caused by axial rotation. The broadening exhibits the proportionality to wave-length required by the Doppler effect, and the line contours agree with the theoretical shapes for rapidly rotating stars. There is also a correlation of line width with period and amplitude in spectroscopic binaries. Two stars (α Virginis and η Ursæ majoris) are treated in detail, and the evidence suggests the existence of an evolutionary transition between close spectroscopic binaries and rapidly rotating single stars, though the direction of such transition is not established by the observations.

Old Eclipses of Jupiter's Satellites.—Some of the secular variations of the elements of Jupiter's satellites are so slow that they cannot be satisfactorily determined from recent observations alone. All the calculators of tables of the satellites have made some investigations of this kind; that which Prof. W. de Sitter has lately published in *Annals of Leiden Observatory*, vol. 16, part 4, is one of the most complete. The earliest observations used are those of Wargentin, beginning in 1668; the extensive list prepared by Delambre in preparation for the construction of his tables has also been used. The systematic errors of the observations have been investigated; they are very considerable, but in spite of these a very marked improvement in the secular variations of the elements of satellite III has been obtained in this discussion. The improvement is less noticeable in the cases of satellites I and II, as their changes are more rapid and can be determined from the modern observations.

Prof. de Sitter is much interested in the question of the changes of the earth's rate of rotation, and includes a discussion of the evidence afforded by Jupiter's satellites; the old observations do not add much weight to the determination. He considers that the amount of uncertainty of his curve derived from all sources is not more than 5 seconds at the date 1670; the uncertainty from the satellites at the date 1750 is fully 10 seconds.

A New Catalogue of the Naked-eye Stars.—The Yale University Observatory has published a useful catalogue of 9110 stars, edited by Prof. F. Schlesinger. It contains practically all the stars down to mag. 6·5 and a few fainter ones. The reference numbers in Boss P.G.C. and in the northern and southern Durchmusterungs are given. The positions are given only to the nearest time second in R.A. and the nearest minute of declination. The Proper Motions have been revised and, where possible, are given to the third decimal of a second of arc; those in R.A. are expressed in great circle. The spectral type, parallax, and radial velocity are given, where they are known. There is also a column of remarks, which includes notes of companions, of variation of light, or of radial velocity. There is also a table for reduction to galactic co-ordinates, and one giving the new constellation boundaries as fixed by a committee appointed by the I.A.U. The following systematic corrections have been applied to the proper motions of the P.G.C.:

In R.A.	$+0{\cdot}00021^{s} - 0{\cdot}00015^{s} \sin \text{R.A.} \tan \text{Decl.}$
In Decl.	$-0{\cdot}0023'' \cos \text{R.A.}$

A bad misprint on page 4 of the introduction should be corrected. The R.A. of the galactic pole is given as $18^{h}\ 40^{m}$; it should be $12^{h}\ 40^{m}$.

Research Items.

Totemism of the Wik-munkan Tribe, Gulf of Carpentaria.—Miss Ursula McConnel continues her study of the Wik-munkan tribes in *Oceania*, vol. 1, pt. 2. Each clan has a number of totems of varying importance which are common to all members of the clan. These are mostly drawn from objects of utility round which daily interest centres, and in the case of natural supplies, from those found in the locality, thus reflecting their economic interests. Thus, totems of the coastal tribes include dugong, sea turtle, sharks, and other fish; 'thunder' which heralds the north-west season, 'high-tide' which brings food, and a 'small bird' which is supposed to guard the fishing operations of a clan; bark-canoes and spears, necessary to the success of the hunt; pelicans, geese, pigeons, flying-fox, and so forth. The Wik-mean tribes include milk-wood trees, porcupines, and swamp turtle, all belonging to the Wik-mean country. The totems of other tribes are similarly differentiated according to their economic resources. Dangerous and disagreeable objects also figure in the lists—for example, crocodiles and flies; and objects of social significance such as fire, which is not only useful, but is also the centre of social life as well as the means of disposing of the dead; the bull roarer, and the shooting star or meteor, which is supposed to signify the death of a relative. The 'baby', 'sweetheart', and 'ghost' totems reflect the chief phases of human life—birth, mating, and death. Personal names are derived from the characteristics of the clan totems, or reflect their social value to the clan, sometimes their occupations in association with the totem. Thus, men take their names from the spear handle, women from the fishing-net and dilly-bag which they make and use. Women of the dilly-bag totem take a special pride in their string work, as if they were mistresses of the art. Or again, women may be called after the crab which they hunt, while men are called after the barramundi fish which they spear. Where totems are animals, women often take their names from the female of the species and its feminine functions.

Dimensions of Flint Implements.—The study of flint implements has in the past been confined to a consideration of the characteristic features displayed by the implements in virtue of the special uses for which they were designed and of the technique employed in making them. Prof. A. S. Barnes (*Proc. Prehistoric Soc. East Anglia*, vol. 6, pt. 2) applies to groups of 100 implements, selected at random, the mathematical methods developed by Galton, Karl Pearson, and others dealing with the characteristics of a crowd or large assemblage of objects, the dimensions used being those of maximum length, breadth, and thickness. It is shown that the 'medians' for length, breadth, and thickness are approximately constant for a given industry and can be used to describe the dimensional characteristics of that industry with precision. Prof. Barnes combines these medians into a single expression which he terms the 'index figure'. The index figure consists of two parts, a whole number and a fraction. The whole number is the median for length, the numerator of the fraction is the product of the medians for breadth and thickness, and the denominator is the median for thickness. Thus an index figure of $61 \cdot 7 : \frac{544}{13 \cdot 6}$ means that for a group of 100 implements from the industry in question the median length is 61·7 mm., the median cross-sectional area is 544 mm.^{2}, and the thickness is 13·6 mm. It may be urged that the size of the blocks of flint available will influence the size of the implements made from them. From recent measurements made by the author it appears that this is so only to a limited extent, except in rare cases where the raw material available is exceptionally small. For example, the index figure for the Mousterian of Acheulean traditions at Le Moustier itself is $62 \cdot 2 : \frac{940}{20}$ whereas the index figure for implements of the same culture at Combe Capelle, where the raw material is much larger and more abundant than at Le Moustier, is $66 : \frac{900}{18}$. The various methods of measuring closeness of packing of the measures are also described and discussed. The statistical methods employed enable a precise statement to be made of the dimensions of a group of implements in a simple manner, and form a useful adjunct to morphological considerations in determining to which cultural series a group of implements belongs. There are a number of diagrams illustrating the results.

Placentation of the Cony.—Dr. George B. Wislocki gives an account of observations made on the placentation of the cony (*Hyrax capensis*), in vol. 21 of *Contributions to Embryology*, issued by the Carnegie Institution of Washington. The hyrax is usually regarded as having its nearest allies in elephants and hoofed vertebrates, but Dr. Wislocki finds that its placenta differs in structural type from that of the ungulates and resembles that of the insectivores. He also concludes that in its placentation hyrax has many resemblances to that of the much-discussed aberrant primate form, *Tarsius*. That there should be a considerable resemblance between the form of placentation of these two aberrant mammals is very remarkable, for they appear to represent different mammalian phyla. Nevertheless, both have a disc-shaped placenta which is provided with a dense massive covering of invasive trophoblast. The trophoblast remains poorly vascularised by vessels of fœtal origin. Dr. Wislocki is inclined to regard the form of placentation found in *Hyrax* and *Tarsius* as primitive, while the diffuse placentation of ungulates he would look upon as a later and more fully specialised form. One rejoices to see, in these volumes of *Contributions*, that Mr. Carnegie's benefaction is serving so well the needs of those engaged in embryological research. Under the directorship of Dr. George Streeter a very high ideal has been established amongst the contributors to this valuable publication.

Culturing Insects for Virus Research.—One of the difficulties to be encountered in the rearing of insects for experimental tests of their transmission of virus diseases in plants, is the necessity for maintaining stocks of them free from any possibility of infection. In the *Annals of Applied Biology*, vol. 17, August 1930, Dr. Marion A. Hamilton describes a method for keeping pure and uninfected cultures of aphides and kindred small insects in cages of a special type. These are constructed of a metal framework covered with cellophane and roofed over by means of fine bolting-silk. Such cages have the advantage of being portable and freely permeable to light and air. They are, at the same time, proof against the accidental entry of minute forms of insect life, that are commonly so difficult to exclude in experimental work. She further describes a method of rearing aphides apart from their plant hosts. Specially constructed glass capsules were used to contain the feeding medium; these were closed by a membrane of fish skin and then inverted. By this means the aphides (*Myzus persicæ*) were induced to insert their stylets through the fish skin and feed upon artificial media, plant extracts or dyes. Cultured in this way, a certain number lived for six days, and in one case seven days. A longer period of survival may be possible if more suitable media be found.

Genes affecting Chromosome Behaviour.—In connexion with the intensive studies of the genetics and cytology of maize, now being carried on at Cornell University, a new genetic factor has been discovered (G. W. Beadle, *Memoir* 129, Cornell Univ. Agric. Expt. Station), which causes asynapsis, or a failure of the chromosomes to pair in meiosis. A similar factor has already been found by Blakeslee in *Datura*, and Gowen has described a condition in *Drosophila* in which there is complete absence of crossing-over. All these mutations are inherited as simple Mendelian recessives. In *Matthiola* a strain with long and another with short heterotypic chromosomes exist, the difference being ascribed to a single Mendelian gene. These cases are of special interest in that in each an alteration in the shape or synaptic behaviour of all the chromosomes is due to a single germinal change, which affects the cytological characters but not the phenotypic appearance of the organism, except in so far as it results in sterility. The asynaptic strain of maize is almost completely sterile both in pollen and ovules. In the pollen meiosis there is no pairing of threads, and in diakinesis 20 univalent chromosomes appear instead of 10 bivalents. That the normal attraction between all the chromosome elements should thus be completely inhibited by a single genetic factor is a remarkable fact. If such a factor appeared in a species of plant which also reproduced vegetatively, it would lead to a condition of pollen sterility without previous crossing. These asynaptic plants, like haploids, occasionally produce viable pollen grains with the unreduced number of chromosomes.

Studies of Lactose-fermenting Yeasts and of Moulds of Milk, Cream, and Butter.—M. Grimes and J. Doherty in the routine examination of milk, cream, and butter have isolated two types of yeasts which ferment lactose with gas formation and produce slight acidity in milk (*Sci. Proc. Roy. Dub. Soc.*, vol. 19, No. 20, May 1929, p. 261). In both types the cells are ovoid, measuring 3-6 μ in length; neither forms spores. They appear to be identical with *Torula lactosa*, Harrison, and *T. cremoris*, Hammer, isolated from cheese and from cream respectively. M. Grimes, V. C. E. Kennelly, and H. A. Cummins in a study of mould fungi found in butter isolated twenty-nine species (*ibid.*, vol. 19, No. 47, October, 1930, p. 549). Several of the species, while closely resembling, did not altogether conform to type species, and it is suggested that Irish fungi as a result of insularity have developed characters of their own. In an examination of moulds from butter, V. C. E. Kennelly and M. Grimes report the isolation of a new species of *Paecilomyces* (*ibid.*, vol. 19, No. 44, September 1930, p. 513). It is a coremia-forming species, with pink spores; it clots milk and partially liquefies gelatin, with evolution of gas and an acid reaction. It is named *Paecilomyces hibernicum*.

Methods for Fruit Disease Survey.—"Epidemic Diseases of Fruit Trees in Illinois, 1922–1928", is the somewhat modest title of a *Bulletin* (Art. 3) in vol. 18 of the State of Illinois (Department of Registration and Education) Division of the Natural History Survey. The paper is by L. R. Tehon and G. L. Stout, and these workers summarise the results of six years' work on an intensive survey of fruit tree diseases in their area. They have visited a very large number of orchards, making full records, which include accounts of spray treatments and their efficacy, times of application, notes on phenology, and the time and severity of disease incidence. It appears from the collected work that pomaceous fruits are usually opposite, in their reaction to a fungus epidemic, to drupaceous fruits; but the main value of the report lies not in the particular conclusions that emerge and which apply to local conditions, but in the careful and exhaustive attempts which have been made to standardise the observations which form the basis for such a survey.

The Great Whin Sill.—A very important paper by Dr. J. A. Smythe, recording the results of many years' work in the field and laboratory on the group of intrusions known as the Whin Sill, appears in the *Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne*, vol. 7, pt. 1, pp. 16-150. Samples from practically every fresh exposure have been collected, 2950 in all, and two average analyses and ten others, covering the whole area, are presented. A large number of specific gravity determinations are recorded. These reveal a progressive variation on a regional scale, and additional analyses of alkalis (26), FeO (31), and H_2O and CO_2 (28) indicate that the variation is related to slight differences in the composition of the original magma. A chemical study of the chief minerals and of micropegmatite makes it possible to calculate the mineral composition of each of the rocks analysed. The results agree very closely with the micrometric measurements previously made by Holmes. It is shown that the titaniferous black ores cannot be regarded as mixtures of magnetite and ilmenite. Analyses are given of seven exceptional rocks ranging through leucocratic varieties to a felsitic type, and these with the normal rocks give a variation diagram closely parallel to that of the normal magma series of Mull. A noteworthy feature is the record of five occurrences (all analysed) of fine grained basaltic rocks intrusive into the Whin Sill. Only one of the dykes (the Hampeth) associated with the Whin Sill is given detailed treatment, since these were dealt with in a recent paper by Holmes and Harwood (*Min. Mag.*, p. 493; 1928). Alterations due to chloritisation, pectolitisation, vein solutions, and weathering have been closely investigated with the aid of ten new analyses. The problem of assimilation is very thoroughly examined; the chemical evidence is entirely unfavourable, and a convincing explanation involving the mode of emplacement is given to account for the puzzling field evidence which drove Clough to face the possibility that assimilation had taken place. The paper is one that will provide data for discussion for many years. Apart perhaps from the work of Brammall and Harwood on Dartmoor, no limited group of intrusions has ever been so thoroughly investigated.

A Low Aurora and its Effect on a Radio Receiver.—Though no photographic determination of the height of auroræ has ever yet yielded reliable values below 80 km., cases of auroræ coming much lower, even to the ground, are occasionally reported. Mr. A. C. Cummings, Room 1111, 180 Varrick Street, New York, sends us such a report—which also has other unusual features—of an aurora witnessed by his brother at Norwood, Ontario, Canada, early in the winter of 1929–30. He observed that his radio set was 'dead', though the valves were alight and the aerial and ground wires were connected; no reason for the absolute quietness of the set was apparent. Looking out, he saw that a bright aurora was in progress; on going outside to get a better view he found, "to his astonishment, that a curtain of streamers extended from the sky to the ground and completely surrounded the house but at a distance of several feet". The curtain was many-coloured and unsteady, its scintillations being accompanied by "visible sparking" and by "snapping sounds".

Thermionic Emission.—The October number of *Reviews of Modern Physics* contains an article on thermionic emission, by Dr. S. Dushman. In this he has summarised the existing literature on the subject, with, however, special reference to the work of the last ten years. This has proceeded partly on the lines of the determination of the emission constants of pure substances, but perhaps most characteristically in the development of composite emitting surfaces, both of the well-known type of the thoriated filament, in which monomolecular films of one substance are formed on a base of another, and of the oxide type; coated filaments can now be prepared which will operate in arc tubes, as well as in highly exhausted containers. Theoretically, the outlook has naturally been changed by the advent of the new quantum mechanics, which accounts qualitatively for almost all of the phenomena in question, and quantitatively for many of them. Dr. Dushman remarks with justice that it is difficult at the present time to realise that only sixteen years ago the very existence of a pure electron emission from incandescent solids was questioned by many physicists of good repute.

Operating a Loud Speaker without High Tension Circuit.—We have received an interesting communication from Dr. S. R. Khastgir, of University College, Colombo. One of his students, P. U. Ratnatunga, has invented a very simple method of operating a loud speaker by means of a diode valve without using a high tension circuit. It seems to us that his method is of practical importance. It would be useful, for example, in connexion with portable sets, as the usual high tension battery adds appreciably to the weight. It would also be useful in connexion with aeroplanes and in military manœuvres. The receiver Mr. Ratnatunga uses is a single-valve receiver which has a diode valve. One side of the filament of the diode is directly connected to the earthed point of a tuned aerial circuit. The anode of the diode is inductively coupled to the tuned circuit by means of a coil with which the loud speaker is in series, and then goes back to the filament. The loud speaker operates at nearly full volume when working. Good results were obtained even with an indoor aerial. The reception took place about four miles from the receiving station, the power of which was 1·75 kilowatts. The resistance of the loud speaker was 2000 ohms and the current through it was only 0·1 of a milliampere. When a high tension battery was used the current was 6 milliamperes. An ordinary Cossor valve was employed.

Dielectric Properties of Ionised Gases.—An investigation of the dielectric properties of ionised air described by E. V. Appleton and E. C. Childs in the December number of the *Philosophical Magazine* provides a very satisfactory demonstration of some of the properties of the Heaviside layer which are required to account for its action on wireless waves. The air was ionised in a glow-discharge at low pressure, and auxiliary electrodes inserted in the discharge tube to form the condenser of an oscillatory circuit. The two chief results concern the dielectric constant of the ionised gas, which, for small concentrations of ions, was found to be less than unity, in accord with theory, and the effect of a superposed magnetic field, which, when appropriately oriented and of the right magnitude, was shown to produce a type of resonant spiral motion of the free electrons of the discharge with the same frequency as the oscillations in the condenser circuit. In addition, however, Prof. Appleton and Mr. Childs have found that the thin positive ion sheaths, which form on the condenser plates in the gas when this is heavily ionised, alter completely the capacity of the condenser; the ionised gas between the sheaths acts as a conductor, and the effective capacity is simply that of the two sheaths in series. The alteration in the capacity of these sheaths with change in the steady potential applied to the plates follows the law required by Langmuir's theory of exploring electrodes. It is of interest to find that the reduction of the dielectric constant below unity was probably detected by the late Prof. Barton immediately after the publication of Eccles's theory of the ionic refraction of wireless waves in 1912.

Conductivities of Salts in Ethyl Alcohol.—The *Journal of the Chemical Society* for November contains some results of measurements of electrical conductivities of uni-univalent salts in ethyl alcohol by Murray-Rust and Hartley. Lithium chloride, nitrate and perchlorate, and sodium and silver perchlorates were investigated. The fall in conductivity is proportional to the square root of the equivalent concentration in accordance with the theory of strong electrolytes. A comparison of the slopes of the equivalent conductivity $-\sqrt{c}$ curves with the theoretical values calculated from the Debye-Hückel-Onsager equation shows that the experimental slope is greater than the theoretical, the percentage deviations from theory varying between 10 and 130 per cent. This would be expected if there were any ionic association. The range of concentration used was $N/500$-$N/10{,}000$. The perchlorate ion has a greater mobility than other anions in ethyl alcohol.

Activity Coefficients of Salts.—There are cases where the activity coefficients of salts deviate considerably from the expected values, and in two papers in the *Journal of the Chemical Society* for November, C. W. Davies shows that these can be explained on the assumption of incomplete dissociation of the salts concerned. When allowance is made for the incomplete dissociation of the added salts, the activity coefficients found for thallous iodate from solubility measurements are no longer abnormal. The activity coefficient becomes independent of the nature of the added salt at concentrations, with uni-univalent salts, below 0·1 ionic strength. The activity coefficient of thallous iodate in the most dilute solutions is expressed by the equation $\log f = A\sqrt{\mu}$, but the value of A is smaller than the value given by Debye and Hückel's theory. It appears that this result is general, and also that A may vary from salt to salt. Large deviations from the Debye-Hückel theory with salts, which have been described as 'electric type' effects, or 'unsymmetrical valency type' effects, are considered to be due wholly to incomplete dissociation of the salts concerned.

Keto-Enol Equilibrium.—Although the keto-enol tautomerism of aceto-acetic ester and some of its alkyl derivatives has been previously studied, it is clear that interesting results would be obtained by studying the effect of substituents in the α-position, and some experiments are described by Posl and Michalek in the November number of the *Journal of the American Chemical Society* which deal with this problem. The α-phenyl ester was prepared and was found to contain 28·6 per cent of the enol form. The percentages of enol in esters substituted in the α-position by methyl, ethyl, and benzyl are 4·1, 0, and 3·4 respectively. The values obtained from molecular refractions were entirely different from those with bromine titrations (for example, more than 100 per cent enol was found by the first method as compared with 28·6 per cent by the second), and the chemical method is preferred.

Twenty-first Annual Exhibition of the Physical and Optical Societies.

THE twenty-first annual exhibition of the Physical and Optical Societies was opened by Sir Arthur Eddington, president of the Physical Society, on Tuesday, Jan. 6. Sir Arthur commented on the growth of the exhibition since its inception in 1905, and spoke of the mutual debt of the scientific worker and the instrument maker, saying that progress is making them more and more interdependent. All types of apparatus for physical and optical work could be seen at the exhibition, and everyone should find something of particular interest to himself. Sir Frank Smith proposed a vote of thanks, and this was seconded by Mr. H. T. Tizard, Rector of the Imperial College, where the exhibition was housed.

Electricity has steadily and rapidly taken its place at the foundations of physical science, and one has only to imagine the great reduction which would be effected on removing all electrical instruments to realise the truth of this fact. The task of making a selection of interesting items for this article would then become decidedly simplified. An interesting feature of this year's exhibition was the wide use made of photoelectric cells. Several different kinds were on view, and one of copper oxide on copper, shown by the Westinghouse Brake and Saxby Signal Co., Ltd., operating a relay, merits special comment. The Mullard Wireless Service Co., Ltd., was using a photo-electric cell to count the number of visitors to its stand, a beam of light being interrupted by each person as he approached. The exhibits of the Gramophone Co., Ltd. (H.M.V.), Research Laboratories included a demonstration of the sensitivity of its own cell with a commercial potassium cell. The former is of cæsium and of the same type as used in the television apparatus; unlike the copper oxide cell, it is most sensitive to red light. An interesting method of measuring the sensitivity of a photoelectric cell by using it to control the output of a 'thyratron' was demonstrated by the British Thomson-Houston Co., Ltd. The current through the valve was used to drive a direct-current motor the speed of which depended on the light falling on the cell, and a loud-speaker emitted a note of a frequency dependent on the speed of the motor. A photoelectric outfit shown by Messrs. Bellingham and Stanley, Ltd., is worthy of mention. It is suitable for the photometry of light sources or general spectrometric investigations. Provision is made for the variation of the voltage on the cell as well as that on the electrometer plates, and particular care is taken to guard against the interference of external electrical disturbances.

The Research Section of the exhibition has always attracted a great deal of well-deserved attention, and has expanded considerably since it came into being only a few years ago. There is little chance here of being called upon to admire an imposing box with knobs and other protuberances which the writer personally suspects of being either empty or filled with unwanted spare parts. Perhaps a hint to exhibitors may not be out of place here. Let all apparatus be uncovered on these occasions, even if protection is necessary in general use. The physicist loves to see the wheels go round. To return to the subject: undoubtedly the most popular item in this section was the demonstration of television arranged by the Gramophone Co., Ltd. (H.M.V.), Research Laboratories. During the whole exhibition a crowd was waiting to see what further progress had been made in making the Arabian Nights become fact. The definition of the image is good and the colour is also attractive. Cinematograph pictures were scanned at the transmitter in five sections of thirty lines each, a lens drum being used to traverse a succession of images over five scanning apertures, and the received image was thrown on to a screen about two feet square. The picture was built up of 150 scanning lines and was composed of 15,000 picture elements. The frequency needed to give such detail, scanning at 12 times a second, is 23,000 cycles. Among the fifteen demonstrations arranged in this section by the National Physical Laboratory, selecting any one for special comment is not easy. The Radio Research Board was using a resonant wavemeter circuit to show the existence of side-bands when a radio-frequency oscillation is modulated by an audio-frequency oscillation. Messrs. L. F. G. Simmons and H. C. H. Townend were demonstrating an interesting method of examining the air-flow past models by heating the air in horizontal layers with hot wires. The changes in refractive index of the air were used to trace the shape of the flow lines round the body in a shadowgraph. Apparatus shown by Messrs. F. H. Schofield and J. A. Hall was some of that used in establishing the absolute scale of temperature from -183° C. upwards, and included a platinum resistance thermometer, platinum thermocouple, and optical pyrometer. Dr. Ezer Griffiths had on view a multiple thermo-element type hygrometer for distant reading which can be used in a ship's hold. An apparatus for measuring the flow through flues was demonstrated by the Gas, Light, and Coke Co. (Research and Training Section). The temperature at various points is observed and from the temperature-gradient the rate of flow deduced. A surprising fact is that the temperature across a section is far from uniform. Since the flow of gases is turbulent, this is rather unexpected and opens the field for further work on the subject. The Rothamsted Experimental Station showed a bridge for studying the water in soils and the nature of the association of the two, by passing an alternating current and noting the phase angle between this and the electromotive force. Not all the water is available for plant life, and vegetation may wither in quite damp soil if the water present is combined with the soil. An exhibit illustrating phase-change in tuned circuits, due to the British Thomson-Houston Co., Ltd., is worthy of note. A fixed primary coil formed the inductance of an oscillating circuit, and a swinging secondary coil was arranged so that the coupling between the two coils was periodically varied. As the secondary vibrated the circuits passed through the resonance point and there were alternating attracting and repulsing forces due to sudden phase-change. The position of the pendulum at which the phase-jump occurred was different for the two directions of movement, and this caused a series of impulses which maintained the motion.

The Trade Section of the exhibition had many examples of good workmanship, and the optical instruments—especially epidiascopes shown by Messrs. Carl Zeiss (London), Ltd., and Messrs. W. Edwards and Co.—may be mentioned in particular. Messrs. Edwards also demonstrated several kinds of vacuum pumps, one of which—the 'Hypervac' rotary oil pump—will produce a pressure so low as 0·00005 mm. The Cambridge Instrument Co., Ltd., exhibited many new instruments, those for use in geophysical surveying being of special interest, and described in Mr. Lancaster-Jones's discourse on Jan. 7. The eight pages in the programme describing these instruments are worth studying. The Leakey-Harper drawing machine lent by Sir Arthur Keith may also be mentioned. In addition to the instruments specified in the programme, Messrs. Adam Hilger,

Ltd., showed a Fabry-Perot etalon with variable separation. This is a beautifully made apparatus. The plates are supported on invar in order to reduce temperature effects to a minimum during long exposures. The instrument is suitable for measuring wave-lengths in terms of a standard and observing fine structure in the longer wave-lengths of the spectrum. The Munsell Colour Books, intended to form the basis of a system of colour specification, and X-ray gratings prepared in the laboratories of Prof. M. Siegbahn, were on view, as well as an all-metal quartz spectrograph. Of special interest to teachers was the astronomical model designed by Mr. W. Wilson and exhibited by Messrs. A. Gallenkamp and Co., Ltd., which demonstrates the motion of the earth, moon, and sun. Each separate movement can be shown alone and the bodies can be made to perform hypothetical motions. This should prove particularly valuable for educational purposes, since the reasons for day and night and seasons will be understood at once on seeing movements which do not produce them. Both the M.O. Valve Co., Ltd., and the Mullard Wireless Service Co., Ltd., had a large selection of transmitting, rectifying, and modulating thermionic valves. The M.O. Valve Co., Ltd., was demonstrating an assembly operation in which the supports for the inside of a valve were bent to the required shape by one movement of a handle.

In the section for apprentices and learners started last year some good workmanship was on view. In Class A (Craftsmanship), first prizes were awarded to T. E. Bayley (under eighteen years), of Marconi's Wireless Telegraph Co., Ltd., for a signalling relay, and to H. G. Freshwater, of Messrs. H. Tinsley and Co., for a vibrating galvanometer suspension. This competitor also obtained the Finsbury prize. In Class B (Draughtsmanship), first prizes were taken by W. G. Hill (under eighteen years), of Messrs. H. Hughes and Son, Ltd., for a periscope wind gauge bearing plate, and by E. G. Mansfield, of the General Electric Co., Ltd. (Research Laboratories), for a controller for a motor operated rheostat. It is to be hoped that this section will continue to grow as time goes on, since the importance of good instruments to the physicist cannot be over-estimated.

Two discourses were delivered in the large physics lecture theatre, both extremely interesting and very well attended. The first, by Mr. E. Lancaster-Jones, was entitled "Searching for Minerals with Scientific Instruments". Mr. Lancaster-Jones described the four methods used in locating salt deposits, oil, and other minerals, and mentioned the fact that all the instruments which he had in the room were—with only one exception—of British manufacture. The four types of instrument used are: gravitational, magnetic, seismic, and electrical. In the first of these methods the instrument measures the value of gravity at different points, and from the variation from normal a mound of denser material than the surrounding earth can be easily located. Salt is generally discovered in this way, and its discovery is important, since oil usually occurs with it. In the second method the horizontal intensity of the earth's magnetic field is measured, and the existence of magnetic veins disclosed. The third method is very interesting. An explosion is made at one point, and three sound waves travel to the recording instrument: one through the air, one just beneath the ground, and one penetrates the surface as far as a layer of material of different density below ground and then travels along the top of this layer. The velocities of sound in air and in the two substances are known, the times of arrival of the waves are recorded by the seismograph and, with the distance of the explosion, all the necessary data for finding the position of the mineral deposit are available. The fourth method consists in tracing out lines of equal electrical potential between two electrodes across which an alternating current is passing. These lines have a curved shape when copper or similar material exists below the surface. The lecture was illustrated by experiments and slides.

On Thursday, when the exhibition was open free to the general public, Sir Gilbert Walker gave an interesting account of "Physics in Sport". Sir Gilbert said that the tendency to separate applied mathematics from the happenings of everyday life was to be deplored, and then proceeded to make his audience agree with this statement by giving an explanation of the behaviour of balls. He went on to give some idea of the principles involved in such sports as curling, spear-throwing, and boomerang-throwing. The discourse was illustrated by a selection of slides and experiments, the strange behaviour of a coin when rolled on a billiard table causing much amusement.

Many hours can be spent at an exhibition of this kind and another visit will still reveal something fresh. The secretary is to be congratulated on the success of his organisation. The amount of time and thought devoted to making a success of these occasions is scarcely ever realised by those who enjoy its fruits. E. M. COLLINS.

Annual Meeting of the Science Masters' Association.

THE thirty-first annual meeting of the Science Masters' Association was held at the University, Edgbaston, Birmingham, on Jan. 6-9. The meeting opened during one of the worst fogs on record, but in spite of this more than two hundred members and guests, including the Lord Mayor (Alderman Saunders), were able to find their way to the dinner and the presidential address. Altogether more than four hundred members attended the meetings. The University buildings are admirably adapted for the purposes of such a conference, and the staffs of the various departments of pure and applied science arranged a very fine series of demonstrations in the laboratories. The exhibition of apparatus and books was held in the spacious drawing office, which is an ideal room for the purpose.

The presidential address was given by Sir Charles Grant Robertson, Vice-Chancellor of the University, who referred to the fact that boys and girls and the young university graduate and teacher of to-day fail to realise the immense revolution that has taken place in the world of thought and education during the last fifty years. In that period there has been a scientific renaissance comparable in the quality and scope of its range to the humanistic renaissance of the fifteenth and sixteenth centuries. The result is that the monopoly of the classical humanists has been overthrown and smashed to pieces, resulting in the admission of other subjects into the school curriculum. Sir Charles went on to say that, "confronted with the modern curriculum, Huxley would have insisted that the number of subjects taught is far too large and must be drastically reduced, and for the simple reason that the identification of education with the acquisition of information is an indictable misdemeanour". He (Sir Charles) was profoundly impressed with the ability of undergraduates in the faculties of science, but he often found that they were lacking in general culture. Personally he would like to see the training in science continued for every boy

and girl up to the age when they left school, even if it meant for the specialist in humanistic studies some diminution in the school time allotted to the specialist subjects, just as he wanted to see the humanistic culture continued for the specialist in science. In reference to science scholarships, he would like these to be determined by the joint action of teachers in both schools and universities.

In the course of an address on "A Finite Universe?" the Bishop of Birmingham said that overconfident dogmatism during the nineteenth century produced a reaction which has resulted in a spirit of agnosticism in religion. In the present century this has spread to science, so that, at any rate in their better moments, science teachers are none of them dogmatic, not even the youngest of them. It is now recognised that the bases of our knowledge are probabilities, and these to-day threaten to become the ultimates of the physicist. Absolute truth is beyond us, and superstition is the refuge of fools. We shall be wise men if, knowing our ignorance, we search honestly that our understandings may be enlarged, and if, in our search, we never forget that man's intellectual and spiritual faculties are his supreme endowment. On first reflection we feel that the universe must be infinite in extent. Progress as to our understanding of space is due to the mathematician rather than to the metaphysician. Dr. Barnes referred to the following words of Gauss, written in 1824 in regard to what is now known as non-Euclidean geometry: "I think, in spite of the meaningless word-wisdom of the metaphysicians, that we know too little . . . about the real meaning of space, to stamp anything as absolutely impossible because it appears unnatural to us". He went on to contrast the basic principles of Euclidean and non-Euclidean geometry and the deductions from each as to the properties of space, saying that it is highly probable that our space is curved and not flat, although at present, possibly owing to the limitations of our minds, we cannot get a concrete picture of what this means. In order to test the validity of this conclusion, mathematicians can devise experiments on the nature of the radiation from distant nebulæ, and the tests so far have indicated that the universe is finite and yet unbounded. He referred to Lemaitre's theory of an expanding universe, which has gained the sympathy of astronomers because it seems to offer an explanation of the surprising and perplexing fact that the spiral nebulæ in the depths of space appear to be receding from us with velocities of the order of a thousand miles a second. In conclusion he said that, like Clifford, who was the first man in England to appreciate the significance of Riemann's researches, he found relief from the dreary infinities of flat space in the consoling hope that, after all, the universe may be finite.

A discussion on general science was opened by the chairman, Mr. Fairbrother, of The Cedars School, Leighton Buzzard, who said that general science was proposed by the Association in 1916 as a remedy for what was then called neglect of science. There is a danger that general science should be interpreted as that vague and indefinite type which leads to a nodding acquaintance with many topics of science but to a thorough knowledge of none. Mere snippets are not what the apostles of general science mean to develop. Their aim is to humanise science, to regard man as the central theme of the universe, and to show how man has bent the forces of Nature to his will and how he has made new substances by causing naturally occurring substances and their derivatives to act on one another. General science should cover the whole field of science. Not only should chemistry and physics form an essential part, but also astronomy, physical geography, and elementary biology should be given a place. The teachers of the various branches should be specialists in their own subjects, but the syllabus should be so arranged as to admit of close correlation between one section and another. It must always be remembered that good syllabuses do not necessarily mean good general science, the essence of which lies not so much in the syllabus as in the interpretation of it. Success or failure very largely depends on the outlook of the teacher. It has been suggested that examining bodies do not yet recognise the claims of general science, or give it the dignity of the usual science subjects; but surely that is a matter for the teachers themselves to settle. Let them create the demand and the examining bodies will supply the papers.

The discussion which followed was stimulating and instructive, member after member giving an account of his own course in general science and testifying to the interest aroused in the boys, who are often inspired to continue their studies to greater depths in their own time.

Prof. F. W. Burstall initiated a discussion on "The Science Education of a Boy up to the Age of Eighteen". He said that boys of eighteen who come up to the university have a competent knowledge of science; they can express themselves in clear English and have a fair knowledge of other humanistic studies. When we consider average boys who do not reach university standard, we must divide them into two sections—up to about fourteen and from fourteen to eighteen. Prof. Burstall considers that the young boy can be taught only through his memory, which is the reason why Latin and Greek can be taught him with a considerable degree of success. His view is that the only science taught at this stage should be what is known as Nature study—the description in simple words of the ordinary phenomena of Nature as he observes it in his everyday life. Like all simple subjects, this requires a born teacher to teach it properly. At fourteen the boy's mind is sufficiently developed to enable some science to be taught. Science consists solely of experiment, observation, and deduction, and is therefore by no means a new subject. It has been the study of humanity from the earliest days, when prehistoric man experimented on boring a hole through a flint, and it has been carried on by successive stages to produce our present civilisation. The boy up to fourteen is a young animal who delights in exercising his muscles, who is full of impish mischief and a disinclination to use his mind for any purpose of abstract reasoning. At the same time, he is curious to know how everything works and also the reasons for all the changes he observes in Nature. Prof. Burstall suggested that school science is attractive to the average boy because it gratifies his desire to make something or to change a substance. He urged that the boy should have an outlet for showing his own individuality. Boys differ so much that to attempt to find a curriculum to fit them all is bound to fail. Boys who are stupid in school are only so because they have never had a chance of displaying their faculties. He said that not too much emphasis should be placed on examinations, which, dealing as they do almost entirely with questions of fact, offer a premium to a boy with a good memory and a rapid power of assimilation, but are detrimental to the boy whose mind works slowly.

During the discussion which followed, Prof. H. E. Armstrong expressed his surprise and delight with the discussions he had heard. He was glad to observe that general science is taught in so many schools and that the movement is gaining ground. He disagreed

with Prof. Burstall in regard to the boy up to fourteen; up to that age Prof. Armstrong considers the boy to be intelligent—it is afterwards that his faculties became blunted.

Mr. Cameron, Director of Education for Oxford City, gave an account of the work of the Commission on Educational and Cultural Films. At the request of the Commission, the Science Masters' Association has already appointed a sub-committee to view and criticise films on scientific subjects, and two of those passed by this committee, "The Life of a Plant" and "The Mechanism of a Motor Car", were shown to a crowded meeting. The Association unanimously decided to give the Commission financial support.

Mr. J. Young, in the course of a lecture on "The Lunar Landscape", showed many beautiful slides from photographs taken by his students; he outlined the research which is in progress on the nature and features of the moon's surface.

Prof. A. W. Nash gave an address on "The Work of the Physicist and Chemist in the Petroleum Industry", which emphasised the value of applied science. There are only two Departments of Oil Technology in the country, one at Birmingham and the other at the Imperial College of Science in London. These work in the closest correlation, each tackling different aspects of the petroleum problem

Prof. W. N. Haworth lectured on "Complex Molecular Structures", and Prof. Munro Fox showed a series of biological experiments suitable for schools.

E. N.

University and Educational Intelligence.

LONDON.—The following doctorates have been awarded: *D.Sc. Degree in Biochemistry* on G. F. Marrian (University College) for a thesis entitled "The Chemistry of the Oestrin-producing Hormone" (*Biochem. Jour.*, 1929–30). *D.Sc. Degree in Geology* on R. G. Hudson (University College) for a thesis entitled "The Lower Carboniferous (Dinantian) of the Craven Reef Belt" (*Proc. Geol. Assoc.*, 1930). *D.Sc. Degree in Physiology* on P. Eggleton (University College) for a thesis entitled "The Significance of Creatine-Phosphoric Acid in the Mechanism of Muscular Contraction" (*Jour. Physiol.*, Oct. 1930). *D.Sc. Degree in Statistics* on J. O. Irwin (University College) for a thesis entitled "Researches in the Theory of Sampling" (*Biometrika*, 1927; *Metron*, 1930).

LIVINGSTONE COLLEGE, Leyton, E.10, which gives courses of instruction to missionaries in the elements of medicine, has issued the annual report and statement of accounts for the year 1929–30. Many former students testify to the value of the instruction they received at the College. Income for the year has more than balanced expenditure, and the accumulated deficit has been reduced. The deficit, however, still amounts to £758, and structural repairs and replacement of worn-out equipment, deferred from year to year, have now become urgent. A sum of £800 is required to put things in order, and donations are asked for, and may be sent to the Principal, Dr. Tom Jays.

TEACHER-TRAINING principles and methods have been exhaustively investigated during the past two years by a special committee of the Teachers' Training Syndicate of the University of Cambridge. The resultant recommendations, recently adopted by the University, emphasise the importance of practical work and of guarding against the tendency of courses in the theory of teaching to produce doctrinaires with but little aptitude for dealing with the ordinary problems of school life. It is interesting in this connexion to read the article published in the November issue of *School Life* on "Training Teachers on the Job". This expounds the principles on which the University of North Carolina bases its preference for 'in-service' training as compared with training conducted wholly or mainly within a college of education, and describes some of the methods in use. A staff of itinerant instructors is employed exclusively on weekly circuits, one day being given by an instructor each week to the members of his classes employed in each of the instructional centres in his circuit. He observes throughout each morning all phases of their work and in the afternoon meets them for instruction, which his observations enable him to adapt to individual and group needs. While admitting that some courses, such, for example, as those in the history of education or the physiology of the nervous system, can probably be conducted more effectively in residence in the university college of education, the rest—methods and materials in the various subjects, curriculum construction, investigation of educational problems, individual differences, educational measurements, diagnosis and treatment of failures, and the psychology of learning—can, it is claimed, be given with much greater immediate effect and permanence when taught by the 'in-service' method.

THE British Broadcasting Corporation has secured the services of many men and women who are eminent specialists in the worlds of art, science, economics, languages, philosophy, and so on, for its several series of broadcast talks from January to April of this year. Judging from the pamphlet published in connexion with these series, radical changes in the composition of each series have been made. For example, the series of talks on "Marriage: Past and Present" consists of five lectures by Prof. B. Malinowski and Dr. R. Briffault. They will take the form of a debate, Prof. Malinowski giving the first talk on "The Present Crisis in Marriage and the Historical Background". The second will be given by Dr. Briffault. Then will follow three talks in the form of a discussion between Prof. Malinowski and Dr. Briffault, concluding with a recapitulatory talk entitled "What can we learn from all this?" by Prof. Malinowski. Such a series has much to commend it; but one drawback is its actual seriate form, which demands regular attention to such talks—and this is often impossible—if full value is to be obtained from them. There are three or four series of talks with a scientific bias, which will be given by single lecturers. Mr. L. F. Gibbon is to talk on "Commerce the Peacemaker", Prof. A. E. Heath on "Thinking Ahead", and Prof. W. Cramp on "Faraday and his Contemporaries". This last is clearly chosen because this year marks the centenary of Faraday's discovery. The other series of scientific interest are to take a still different form. Each talk in the series will be given by a different person. One series, "What is Science?" seems to have no common basis; the reason for putting them in one group seems to be that the listener is invited to co-operate with the speaker in making investigations. This is an experiment in what the B.B.C. refers to as "co-operative science". Such an attempt is deserving of commendation; but its value may be lessened by the fact that it is based upon the belief that science is now so professional and associated with such forbidding technique that the amateur scientific worker has almost disappeared and with him the journeyman's interest in science. However this may be, the B.B.C. is to be congratulated on its attempts to stimulate general interest in science by its varied and original programme.

Societies and Academies.

LONDON.

Linnean Society, Jan. 8.—E. J. Salisbury: A study of *Ranunculus parviflorus* L., with special reference to its morphology and ecology. The floral structure has been studied in its entirety in 725 flowers, and in a considerably larger number with respect to special features. The most frequent number of parts in the flower as a whole is 26 (222 examples). This, with other observations, leads to the conclusion that the total number of parts is a number one less than a multiple of three. The structure of the sepals and their variation indicates their origin from leaves, and thus the sepal is the equivalent of the leaf-base. The staminodal nature of the petals is clearly indicated. The petals attain maturity after the stamens, which may be associated with their, phylogenetically, more recent origin. The structures of various tissues all suggest a plant of damp rather than dry habitats. This is in conformity with the 'atlantic' type of distribution of the species and its southern habitats. Experimental cultures show that the species does not grow so well on dry sandy or calcareous soils as on moist loam.

PARIS.

Academy of Sciences, Dec. 1.—The president announced the death of René Blondlot, *Correspondant* for the Section of General Physics.—P. Villard: The reduction of the oxygen compounds of phosphorus by hydrogen. Phosphoric anhydride and hydrogen commence to react at 700° C., and at about 900° C. both red and yellow phosphorus can be collected. Phosphorus is similarly produced by the action of hydrogen upon sodium, barium, and calcium pyrophosphates.—J. Costantin and P. Lebard: Experimental cultures of healthy and degenerated potatoes in the mountains and in the plains. The experiments described once more prove the difficulty of procuring healthy tubers working at random and without method. Seed potatoes raised in the mountains will propagate disease if the pathological state is not taken into account. The superiority, if it exists, will be shown only if healthy varieties are used.—Jakob Eriksson was elected *Correspondant* for the Section of Rural Economy in succession to the late M. Neumann.—Bertrand Gambier: Anallagmatic invariants of three circles.—Robert Forrer and A. Hoffmann: The splitting up of the Curie points of nickel. The observations described can be interpreted by assuming the existence of two ferromagnetic substances in nickel, each with its own Curie point.—Lucien Amy: The examination of a metal for foreign elements by spectrum analysis. The modification proposed gives a marked increase in strength to the lines of magnesium, calcium, and carbon.—R. Barthélemy: A system of television, including, in particular, an automatic arrangement for synchronisation and setting in phase.—E. Darmois and J. Cessac: Study of solutions of tartrates in fused calcium chloride, $CaCl_2 + 6H_2O$.—Mme. P. Curie: The relation between the emission of long-range α-rays and of γ-rays. The theoretical explanation suggested, although not in good agreement with experiment, may still be of service. New researches are required to determine more accurately the range of the α-rays and the existence and intensity of the groups of γ-rays intervening.—J. and J. F. Thovert: The utilisation of photo-electric cells with glass envelope for researches on radiations of very short wave-length. The glass is coated with a layer of vaseline, gelatine, or collodion with which is incorporated a fluorescent substance.—P. Chevenard and A. Portevin: The mechanism of the reheating of martensite.—F. Bourion and E. Rouyer: The cryoscopic study of paraldehyde in solutions of sodium chloride and barium chloride.—A. Mavrodin: The action of phenylmagnesium bromide on ethyl diethylcyanacetate.—R. Brunschwig and L. Jacqué: The formation of gums in petrols. The colour acquired by a benzol on keeping is not a measure of the gum formation. Gum is formed in benzol by the combined action of light and air.—Octave Mengel: Movements of the Quaternary in the Mediterranean Pyrenees.—P. Gavaudan: Some vital observations concerning the evolution of the vacuome during spermatogenesis of the Characeæ.—N. Lœwenthal: The evolution of the white blood corpuscles in vertebrates.—René Fabre and Henri Simonnet: Contribution to the study of the phenomena of oxido-reduction. Researches on beer yeast. The influence of desiccation. The experiments with beer yeast confirm those made with hepatic tissue: the hydrosulphide derivatives can only be freed from combination as the result of a traumatism which causes the death of the cell.—Mlle. Catherine Veil and Adalbert Van Bogaert: The two heart chronaxies measured selectively according to the direction of the electric current.—H. Laugier, W. Libersohn, and B. Néoussikine: The variations of chronaxy as a function of the position in man.—Régnier and Lespes: The existence of a summer generation in the pilgrim locust, *Schistocerca gregaria*.—L. Mercier: A new type of cancer of the lung in mice. Heredity and grafting.—E. Brumpt: Latent parasitism of *Ixodiphagus caucurtei* in gorged larvæ and fasting nymphs of various Ixodes (*Ixodes ricinus* and *Rhipicephalus sanguineus*).—Georges Fontes and Lucien Thivolle: Tryptophane and histidine are hæmatogen amino acids.—Mlle. S. Mouchet: The formation of the non-pedunculated spermatophores of the decapod Crustaceans.—C. N. Dawydoff: The true nature of *Dogelia malayana*.—Mlle. Odette Tuzet: The fertilisation of the silica sponge *Cliona viridis*.—Maurice Marie Janot and Jean Laurin: Bulbs of *Allium cepa* and hyperglycæmia.

CAPE TOWN.

Royal Society of South Africa, Oct. 15.—E. Reuning: A contribution to the geology of the western edge of Bushmanland. There were morphological conditions on the edge of the plateau immediately anterior to the time of the melting Dwyka ice which, after the subsequent denudation of the Karroo sediments, were re-established, and they still form the major part of the morphological structure of this region. From the time of the oldest determined sediment of the post-Kimberlite period, a practically complete chain of events up to the present is recognisable.—S. H. Haughton: On a collection of fossil frogs from the clays at Banke, Namaqualand. The specimens are part of a large collection discovered in the shales encountered by Dr. Reuning when sinking a shaft on the so-called 'Arnot' pipe on Banke, Namaqualand. There are a number of almost complete skeletons of a fossil frog, to which the name *Eoxenopoides reuningi* is given, A series of stages is described which strengthens the conclusions drawn from living Anura that the whole urostyle is the result of the fusion of a number of vertebræ. Evidence as to the age of the clays containing the fossils is almost entirely circumstantial; they must be at least early Tertiary and may be contemporaneous with, or slightly later than, the Dinosaur-bearing beds of Kangnas, 40 miles to the north.—M. R. Levyns: Note on some recent experiments on the germinating capacity of Rhenoster seed. Germination tests have been carried out annually since 1925. It has been shown previously that seed which refuses to germinate at the time of shedding

will germinate well a year later. Temperatures during the resting period may play an important part in regulating capacity of the seed for germination.—E. Reuning: The Pomona quartzite and oyster horizon on the west coast of South Africa north of the Oliphants River mouth. Ancient phyllites are planed off and covered by a series of deposits which consist of a fossiliferous grit with shark's teeth at the base, followed by a strongly silicified sand and grit passing up into calcified and partly silicified clays. Lying unconformably upon these sands and clays—the equivalent of the Pomona quartzite—are marine deposits, divided into the Main Oyster-horizon below and the *Donax rogersi* beds above. Above these is a terrestrial cover of sand, which has been formed in a discontinuous cycle.—T. Levitt: A report on the Cape Flats femur. A detailed study of the thigh-bone found in a sand quarry on the Cape Flats, in the same circumstances as a skull which has proved to be decidedly primitive. The femur shows primitive human and even simian characters, and belonged to an individual appreciably different from any of the existing human types in Africa and definitely low in the human scale. This finding corresponds to that arrived at independently for the skull.

CRACOW.

Polish Academy of Science and Letters, Oct. 6.—Georges Bouligand: Some applications of the theory of ensembles to infinitesimal geometry.—**Ladislas Natanson**: Certain theorems associated with Fermat's principle.—**W. Swietoslawski**: A differential boiling point apparatus furnished with a fractionating column and its application. This apparatus is specially applicable to the study of the purity of liquids, either pure substances or azeotropic and eutectic mixtures, and has been designed to handle small quantities of liquids. The determination of the amount of water present in an acetone–carbon disulphide azeotropic mixture is given as an example.—**J. Kozak** and **L. Musial**: The action of hydantoin on *o*-nitrobenzaldehyde.—**J. Nowak**: Remarks on the age of the magmatic rocks of the uncovered layers of Cieszyn.—**J. Zerndt**: Megaspores arising from a layer situated at a depth of a hundred metres at Libiqz (Stephanian).—**Z. Grodzinski**: The development of the blood vessels in the fore foot of the tortoise (*Emys orbicularis*).

Official Publications Received.

BRITISH.

Records of the Geological Survey of India. Vol. 64: Quinquennial Review of the Mineral Production of India for the Years 1924 to 1928. By the Director and Senior Officers of the Geological Survey of India. Pp. viii+446+xcvi+6 plates. (Calcutta: Government of India Central Publication Branch.) 9.6 rupees; 15*s*. 6*d*.

Records of the Indian Museum. Vol. 31, Appendix: List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1929. Pp. xx. 5 annas; 6*d*. Vol. 32, Part 2. Pp. 65-214+plates 2-7. 2.12 rupees; 5*s*. Vol. 32, Part 3. Pp. 215-356+plate 8. 2.12 rupees; 5*s*. (Calcutta: Government of India Central Publication Branch.)

Memoirs of the Indian Museum. Vol. 9, No. 5: Revision of the Asiatic Species of the Genus *Corbicula*. 4: The Species of the Genus *Corbicula* from the Sunda Islands, the Celebes and New Guinea. By Dr. B. Prashad. Pp. 193-203+plates 24-26. 1.6 rupees; 2*s*. 3*d*. Vol. 11, No. 1: Studies on Indian Jassidae (Homoptera). Part 1: Introductory and Description of some New Genera and Species. By Hem Singh Pruthi. Pp. 68+5 plates. 5.8 rupees; 9*s*. (Calcutta: Government of India Central Publication Branch.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Vol. 2, No. 4, November. Pp. 133-179+9 plates. (Calcutta.) 6 rupees.

Education, India. Education in India in 1927-28. Pp. iv+72. (Calcutta: Government of India Central Publication Branch.) 1.12 rupees; 3*s*.

Malta. Annual Report on the Working of the Museum Department during 1929-1930. Pp. xviii. (Malta: Government Printing Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 408, December. Pp. 120+xxxii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Proceedings of the Canadian Phytopathological Society. Inaugural Session, December 19 and 20, 1929. Pp. 61. (Ottawa.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1930; with Report of the Director of Fuel Research. Pp. viii+121+3 plates. (London: H.M. Stationery Office.) 2*s*. net.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 41, Part 4, 21st December. Pp. 363-445. (London: Edward Stanford, Ltd.) 5*s*.

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 12. Pp. 66. (London.) 1*s*. 6*d*.

Ninth Scientific Report on the Investigations of the Imperial Cancer Research Fund, under the direction of the Royal College of Physicians of London and of the Royal College of Surgeons of England. Pp. viii+156+39 plates. (London: Taylor and Francis.) 20*s*.

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing, during the Session 1929-30. Pp. 13. (Leeds.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 11, November. Abstracts Nos. 2039-2182. Pp. 379-409. (London: H.M. Stationery Office.) 9*d*. net.

FOREIGN.

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 27, Part 2: Das Ausflocken animalischer Eiweissstoffe, von Georg Grasser; Über gerbende Stoffe und ihre Beurteilung, Untersuchungen über die tierische Haut, Untersuchungen über Gelatine und Haut, Beeinflussung der Metallsalz-Gelatine-Fällung durch Zusatz von Neutralsalzen, Refraktometrische Untersuchung des Chromosäure-Reduktion, von Georg Grasser und Hiroshi Ohoki; Gerbereichemische Untersuchung von Chromosalzen, Kombinationswirkung zweier Gerbstoffe gegenüber Gelatine und tierische Haut, ein Beitrag zur chemischen Erforschung der Kombinationsgerbung, von Georg Grasser und Masatake Ichise. Pp. 227-348. Vol. 27, Part 3: Studies on the Ripening of Rice-Grains. By T. Tadokoro and M. Abe. Pp. 349-387. Vol. 29, Part 2: Die Apoderinen aus dem japanischen Reich. Von H. Kôno. Pp. 37-83+Tafeln 5-6. (Tokyo: Maruzen Co., Ltd.)

Ministerio da Agricultura, Industria e Commercio: Observatorio Nacional do Rio de Janeiro. Boletim Sismologico do Observatorio Nacional, 1926 a 1929. Pp. 74. (Rio de Janeiro.)

Annalen van de Sterrewacht te Leiden. Deel 15, Derde Stuk: Catalogue of 1172 Reference Stars in the Areas 2-115 of the Systematic Plan of Selected Areas. Observations of the Leiden Observatory. By C. H. Hins and J. J. Raimond, Jr. Pp. 41. (Haarlem: Joh. Enschedé en Zonen.)

Methods and Problems of Medical Education (Eighteenth Series). Pp. iv+329. (New York City: The Rockefeller Foundation.)

U.S. Department of Agriculture: Weather Bureau. Instructions to Marine Meteorological Observers. Fifth edition. (W.B. No. 991.) Pp. viii+80+8 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

Japanese Journal of Geology and Geography: Transactions and Abstracts. Vol. 8, Nos. 1 and 2, September. Pp. iii+112+11. (Tokyo: National Research Council of Japan.)

University of California Publications in Zoology. Vol. 35: Vertebrate Natural History of a Section of Northern California through the Lassen Peak Region. (Contribution from the Museum of Vertebrate Zoology of the University of California.) By Joseph Grinnell, Joseph Dixon and Jean M. Linsdale. Pp. v+594. (Berkeley, Calif.: University of California Press.)

Transactions of the San Diego Society of Natural History. Vol. 6, No. 14: Four New Birds from Northwestern Mexico. By A. J. van Rossem. Pp. 213-226. Vol. 6, No. 15: A new Least Bittern from Sonora. By A. J. van Rossem. Pp. 227-228. (San Diego, Calif.)

United States Department of Agriculture. Technical Bulletin No. 214: The Physical and Chemical Characteristics of certain American Peat Profiles. By Irvin C. Feustel and Horace G. Byers. Pp. 27. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUES.

Radiostoleum. Pp. 14. (London: The British Drug Houses, Ltd.)

Lantern Slides, illustrating Zoology, Botany, Geology, Astronomy, &c. (Catalogue E.) Fifth edition. Pp. 104. (Manchester: Flatters and Garnett, Ltd.)

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. (January 1931.) Pp. 130. (London: The British Drug Houses, Ltd.)

Diary of Societies.

FRIDAY, JANUARY 16.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (Clinical Meeting at Red Cross Clinic for Rheumatism, Peto Place, N.W.1), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. T. L. Ibbs and Dr. K. E. Grew: The Influence of Low Temperatures on the Thermal Diffusion Effect.—Dr. J. H. Vincent: Further Experiments on Magnetostriction Oscillators at Radio Frequencies.—S. Butterworth and F. D. Smith: The Equivalent Circuit of the Magnetostriction Oscillator.—Dr. L. C. Martin: The Theory of the Microscope.

BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street), at 5.—Medical Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at University, Liverpool), at 6.—Prof. G. T. Morgan: Organic Syntheses facilitated by Pressure (Hurter Memorial Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—S. F. Dorey: Some Factors influencing the Sizes of Crankshafts for Double-acting Diesel Engines.

COKE OVEN MANAGERS' ASSOCIATION (Midland Section) (at University, Leeds), at 6.30.—H. J. Hodsman: Coke for Domestic Fires.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Major W. Gregson and others: Discussion on Steam *versus* Oil-Engine in the Mercantile Marine.

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at Manchester Literary and Philosophical Society, Manchester), at 7.—T. H. Sanders: Locomotive Suspension and its Influence on Derailments.

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

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7.30.—Dr. B. Moore: Fused Silica in Industry.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—K. W. Willans: Some Problems Surrounding the Reorganisation of an Engineering Works.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (jointly with Tuberculosis Association), at 8.—Discussion: The Management of Pregnancy, Parturition, and the Puerperium in Tuberculous Women. Openers: Dr. G. Marshall and Dr. M. Hiley (Tuberculosis Association); A. Bourne and L. C. Rivett (Obstetrics and Gynæcology Section).

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. G. Grant Allan: Radiology of the Heart.

SOCIETY OF DYERS AND COLOURISTS (London Section).—J. T. Holden: Researches on the Laundering of Fabrics.

SATURDAY, JANUARY 17.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persian Art and Literature (2): The People, the Country, and the Poetry of Persia.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—R. L. Quertier: Air Compressors.

MONDAY, JANUARY 19.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. W. M. Christie: The Renaissance of Hebrew.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—New Types of Survey Instruments: —Instr. Capt. Baker: The 45° Prismatic Astrolabe.—Major G. Cheetham: The Tavistock Theodolite.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. V. Bonney: The Results and Technique of Myomectomy.

BRITISH SOCIETY OF MOTION PICTURE ENGINEERS (at Royal Photographic Society), at 7.—Mr. Lance: Photo Electric Cells.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at University of Birmingham), at 7.—S. G. Brown: Loud-Speakers since their Conception, with Gramophone Pick-ups and Wireless Recording Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—E. M. Payne: The Radio—Gramophone Pick-up.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presentation of London Architecture Medal 1929, and Medals and Prizes, 1931.

HUNTERIAN SOCIETY OF LONDON (at Apothecaries' Hall), at 9.—Dr. A. Lorand: The Problem of Rejuvenation (Hunterian Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Leeds).—W. H. Nuttall: Synthetic Resins.

TUESDAY, JANUARY 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. W. T. Walsh: The Art of Illumination (1).

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—G. H. Dannatt: The Island of Walcheren.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Botany and Biology Section) (jointly with University College Biological Society) (at University College, Leicester), at 7.30.—Prof. J. H. Priestley: The Growth of a Tree.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Ericsson Telephones, Ltd., Beeston).—T. Engblom: The Totalisator.

WEDNESDAY, JANUARY 21.

SOCIETY OF GLASS TECHNOLOGY (at Newcastle-upon-Tyne), at 2.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. B. Hume: The Pathology of Diaphragmatic Hernia.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—J. R. Cowie: Metal-clad Switchgear.

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square) (Annual General Meeting), at 5.30.—Prof. R. R. Gates: Adaptations in Cellular Structure (Presidential Address).

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Caxton Hall), at 5.30.—T. E. Lones: The South Staffordshire and North Worcestershire Mining District and its Relics of Mining Appliances.

BRITISH WOOD PRESERVING ASSOCIATION (at 29 Lincoln's Inn Fields), at 6.30.—Col. Sir G. L. Courthope and others: Discussion on The Preservative Treatment of Estate Timber.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—D. B. Hoseason: The Cooling of Electrical Machines.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—J. Scott MacKenzie: The Generation of Electricity by Non-Statutory Undertakings.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Technical College, Derby), at 7.30.—A. J. Hall: Fine Structure of Artificial Silks in Relation to Dyeing.

ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.40.—Presentation of the Buchan Prize to Dr. C. E. P. Brooks.—R. G. K. Lempfert: The Scientific Work of the Meteorological Office, Cardington (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.30.—M. S. Briggs: Mosques and Minarets —an Introduction to Persian Architecture.

ROYAL SOCIETY OF MEDICINE, at 9.15.—Dr. A. Chaplin: Great Figures in History and Misconceptions remov'd.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section).—Prof. C. H. Desch: Crystal Structure and Chemical Action.

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—Sir Thomas Stanton: The Development of a High Speed Wind Channel for Research in External Ballistics.—G. Cook: The Yield Point and Initial Stages of Plastic Strain in Mild Steel.—P. M. S. Blackett and F. C. Champion: The Scattering of Slow α-Particles in Helium.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. Dingle: The Nature and Scope of Physical Science (1).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. T. Norris and F. W. Taylor: High-Voltage Testing Equipments.—B. L. Goodlet, F. S. Edwards, and F. R. Perry: Dielectric Phenomena at High Voltages.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Squadron-Leader W. R. D. Acland: Deck Flying.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Projection of Films.

INSTITUTE OF RUBBER INDUSTRY (at "Manchester, Ltd.", Manchester), at 7.30.—E. H. Wallace: A Comparison of English and American Technique over the Last Decade.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at College of Technology, Leicester), at 8.—Exhibition of Films—(*a*) Story of Beautiful Colours; (*b*) The Manufacture of Nobel-Glasgow High Explosives.

INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—J. Stewart: Malting Barleys of 1930.

COKE-OVEN MANAGERS' ASSOCIATION (Northern Section) (at Three Tuns Hotel, Durham).—S. Tweedy: The Variations in the Composition of Crude Benzol under Different Carbonising Conditions.

FRIDAY, JANUARY 23.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. W. Tudor Thomas: Successful Grafting of the Cornea in Rabbits.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. N. Gresley: High Pressure Locomotives.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Short Papers on Various Aspects of Lighting.

INSTITUTE OF FUEL (at Institution of Civil Engineers), at 6.30.—Dr. K. Rümmel: The Calculation of the Thermal Characteristics of Regenerators (Melchett Lecture).

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas's Café, Swansea), at 7.—Dr. R. Lessing: Recent Improvements in Coal Cleaning.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.15.—J. K. Dickie: The Coking Industry and its Development in Relation to the Manufacture of Iron and Steel.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—E. W. Thompson: The Progress and Development of Steam Generators.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: The Scattering of Light.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Mining and Industrial Equipments, Ltd., Derby).—J. C. Farrant: Modern Grinding.

SATURDAY, JANUARY 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish Art (1): The Van Eycks.

PUBLIC LECTURES.

FRIDAY, JANUARY 16.

UNIVERSITY COLLEGE, at 5.—G. P. Wells: Comparative Physiology. (Succeeding Lectures on Jan. 23, 30, Feb. 6, 13, 20, 27, Mar. 6, 13, and 20.)

MONDAY, JANUARY 19.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Dr. F. C. Minett: Certain Diseases common to Man and Lower Animals.

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. V. Hill: The Osmotic Pressure of Tissue Fluids.

TUESDAY, JANUARY 20.

UNIVERSITY COLLEGE, at 3.30.—Dr. P. Hopkins: The Need of Psychologists and the Menace from Charlatans.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15—Dr. J. A. Murray: Induction of Cancer by Tar and other Agents. (Succeeding Lecture on Jan. 27.)

WEDNESDAY, JANUARY 21.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 3.—Prof. J. W. H. Eyre: Shell-fish and the Public Health. —At 5.—D. S. Rabagliati: Certain Diseases common to Man and Lower Animals.

KING'S COLLEGE, LONDON, at 5.30.—Prof. A. P. Newton: The Great Age of Discovery (1): The Expansion of the Habitable World.

LONDON SCHOOL OF ECONOMICS, at 6.—Dr. G. P. Crowden: Muscular Work and Fatigue. (Succeeding Lectures on Jan. 28 and Feb. 4.)

BELFAST MUSEUM AND ART GALLERY, at 8.—Prof. Walmsley: Sand Castles.

THURSDAY, JANUARY 22.

UNIVERSITY OF LEEDS, at 8.—L. Ashton: Persian Textile Art.