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The Practical Teaching of Science.

THE resumption by the Board of Education of the publication of memoranda prepared for the Office of Special Inquiries and Reports is to be welcomed. Before the war a constant stream of valuable information on educational progress and experiment at home and abroad issued from this source, and if not much more came of each individual contribution than is expected from the reports of most Government inquiries, these memoranda were, in the mass, sensibly affecting educational thought and practice. The war inevitably checked the stream in its course, and it is one more encouraging sign that we are, however slowly and painfully, returning to a time of peaceful development, or at least preparing for such a return, when we note that the stream has begun to flow again.

The recent appearance of a modest pamphlet, in the familiar green paper covers, entitled "Some Experiments in the Teaching of Science and Handwork in Certain Elementary Schools in London,"[1] is of peculiar value at the present moment. It is true that the experiments described were cut short by the war, but it is important that the conclusions to be drawn from them should be studied now, when not only in elementary and central and secondary schools, but also in the new day continuation schools, we are faced by the problem how best to combine efficiency and economy in the effort to stimulate intellectual development through science, not as an isolated study, but as a branch of the humanities. Before 1914 we had tended to give up the idealistic dream that if all schools were fitted up with laboratories, or had access to laboratories, equipped for the academic study of chemistry and physics, progress was assured. The view was winning acceptance that for perhaps most young people the best approach was through the motor activities, through carrying out in practice the general idea of "teaching science by making things," or, in other words, discovering scientific principles by solving practical problems. The idealist had come to earth, and we may hope that if his head remains in air his feet will continue to feel the ground he walks upon.

In the report which we have now before us the claim is made that the experiments carried out in the higher classes of elementary schools and in central schools, the latter of which take young people on to about sixteen years of age, go to show that a scheme of instruction in science which is based largely on handwork, and makes no excessive demand on theory, is far wider in scope than has hitherto been suspected. But the report only confirms the lessons to be drawn from two earlier reports—the invaluable "Manual Instruction in Public Elementary Schools," issued in 1910, and, on a higher plane of studies, the "Report on Science Teaching in Public Schools," issued in 1909—the most striking scheme in which was one where handwork and brainwork went on together.

The claim now definitely made is one which is entitled to respect because it is enunciated, not by any mere theorist spinning theories as he contemplates the ceiling through a cloud of tobacco smoke, but by skilled observers speaking on behalf of actual practitioners in the art of teaching. The principle involved is commended to the earnest consideration of those who are anxiously thinking out what kind of practical rooms and what sort of laboratories are to be installed in the new part-time day continuation schools for young people between the ages of fourteen and sixteen who spend most of their time in the office or workshop and only a precious seven or eight hours a week in school. They have the choice between text-book instruction supplemented by a modicum of experiment in a formal laboratory and practical instruction in a workshop which is equipped with the essential fittings of a laboratory. They may well come to the conclusion that,

[1] Educational Pamphlet No. 35. Pp. 54. (H.M. Stationery Office.) Price 1s. net.

while for those who have before them years for continuous study the former method is to be commended, with those who have but an hour or two a week in which to quicken their scientific appreciation a sound working knowledge of a far wider range of scientific phenomena, *with a bearing upon daily experience*, can be gained under a system which combines the workshop and the laboratory than by the conventional text-book treatment of science.

Such is the problem before us, and a possible solution, stated in their simplest terms. As regards elementary education, the question is settled so far as Governmental authority is concerned by the requirement of the Act of 1918 that every local education authority must make suitable provision for the practical instruction of older children. If this practical instruction is to have an educational significance beyond the mechanical repetition of manipulative exercises, however useful in themselves, then the illustration, the working out in concrete materials, of scientific principles or formulæ must be the very basis. For the older children in elementary schools, and also on the industrial side of central schools, such a compromise between the laboratory and the workshop is inevitable. In county boroughs and urban districts, where large, well-equipped centres are possible, the laboratory and the workshop may be separate rooms, provided that the intimate relation of one to the other is recognised, so that the problem set and illustrated in the laboratory is worked out at the bench, or, conversely, the process employed in the workshop is dissected and its principle revealed in the laboratory.

This is precisely what is going on in the one new type of school which has been evolved in this twentieth century of ours. Junior technical schools are very different from the preparatory trade schools or pre-apprenticeship schools which they are generally supplanting. Their purpose is to give a young person intending at sixteen to take up an apprenticeship in some branch of the engineering or building trades or professions, even architecture or naval architecture, not only a humanistic training in English subjects (and, for the brighter intelligences, in a foreign language), but also a firm foundation in mathematics, in mechanical drawing, and in the abstract principles underlying that branch of applied science popularly known as "mechanics," on which they may build their careers—some going no further than to become the foremen of industry; others, during or at the end of their apprenticeship, proceeding to university courses and becoming the Kelvins and Moultons of the future.

Even in the sphere of adult education which is opening out before us there is scope for work on these comparatively simple and unambitious lines. The intelligent artisan who awakes to deficiencies in his early education and is anxious to improve his scientific equipment will often find the initiation into natural philosophy easier by way of the laboratory workshop than through the lecture theatre and the merely experimental laboratory. But here the argument must not be pressed too far, for the greatest is he who is able on reaching man's estate to venture into strange seas of thought alone, and the man of science is great who approximates to that higher and more abstract ideal.

Vitalism versus Mechanism.

The System of Animate Nature: The Gifford Lectures delivered in the University of St. Andrews in the Years 1915 *and* 1916. By Prof. J. Arthur Thomson. (In two volumes.) Vol. i. Pp. xi+348. Vol. ii. Pp. v+349–687. (London: Williams and Norgate, 1920.) Price 30*s.* net two vols.

THE subject of the Gifford lectures was intended by the founder to be natural theology regarded as a natural science and treated, just as astronomy or chemistry would be, with entire freedom from any prepossessions whatever. This rather difficult task has been attempted by two biologists, Dr. Hans Driesch in 1907–8, and Prof. J. Arthur Thomson in 1915–16. The first of these lecturers tells us that he set out to follow biology along its own path—that is, from its nineteenth-century "naïve realism" towards its transition to "a branch of the philosophy of Nature," and such a progress he accelerated in no small degree by a method of treatment that was both critical and constructive. It was critical inasmuch as it included a penetrating analysis of the nature of the transformations that occur in living substance, thus leading to the rejection of the notion of a peculiar "vital energy form," and—which is equally important—it involved also a thorough criticism of the "pseudo-psychology" that had been employed in the study of animal behaviour. But it was also constructive in that it developed an old concept—that of "entelechy"—deriving from this a series of "psychoids" which were regarded as factors in organogenesis, metabolism, and behaviour. The Drieschian psychoids are not energetic agencies, but they function, as Leibnitz

suggested in regard to the human soul, like a wise prince among his subjects, or a good father in his household, by directing, suspending, and releasing activities rather than by exerting them.

Now, after this strong and tough fare purveyed by Driesch, Prof. Thomson's book may almost be called "light reading"; clearly it could not have been written from an easy chair, but it can easily be read in such. The aim of a study of animate Nature, Prof. Thomson tells us, "is to state the general results of biological inquiry which must be taken account of if we are to think of organic Nature as a whole in relation to the rest of our experience," and it is just such a survey that he presents to us in a most agreeable manner. There is no inclination to make, or adopt, a system, and the criticism is seldom very penetrating. One is told what is meant, in contemporary literature, by the ideas of "Body and Mind," "Organism and Mechanism," "Adaptiveness and Purposiveness," "Disharmonies and Shadows" that prevent us from seeing, in the organic world, "the True, the Beautiful, and the Good," and so on. But, in the main, the discussion centres round the contrasted hypotheses of mechanism and vitalism.

What is vitalism? There are at least three grades, the author says. First there is a recognition that the physico-chemical processes that go on in inorganic materials cannot explain animal behaviour; knowing only the former, we cannot predict the latter. This is the "very thin edge of vitalism." Next there is the view that some particular "vital force," or mode of energy, operates in living substance, but not elsewhere. Lastly, it has been thought that the organism is the seat of a non-energetic factor, or entelechy. This is "thorough-going vitalism." In addition to these hypotheses there is Mr. E. S. Russell's "methodological vitalism"—a biological fact, such as a migration, is a unique activity which has to be explained. It is not explained by decomposing it into an infinity of physico-chemical reactions, for then the fact itself disappears, and we are left only with a great number of little, partial views or aspects of it, which are, no doubt, expressions of a mechanism of matter and energy, but not the thing itself. We must, therefore, study animal behaviour, not as a series of energy-transformations or even as the result of the operation of mind, but as irreducible data to be dealt with by themselves. This Prof. Thomson regards as the most satisfactory attitude yet suggested, and there can be little doubt about that; it is a method rather than an "ism," and its outcome is investigation.

What is mechanism? As usually understood, the mechanistic conception of life states that the activities of organisms are physico-chemical —and nothing else. The notion comes down to us from Descartes, who recognised nothing in the organic world but matter and its configurations and motions (for, even when he placed the "sensitive soul" in man, he did not regard that as essential to animality). Now, matter, when *our* hypothesis of mechanism was elaborated, meant the chemical atoms; its configurations were chemical compounds, and its motions the expressions of energy-transformations. How to deal with consciousness on this hypothesis was always difficult, but, as a rule, the thorough-going mechanist ignored the condition, and regarded as "realities" only objective things and processes. This was called "monistic panhylism" —which sounds well, at all events.

Whichever of these attitudes one takes up (for a biologist is expected to be either a mechanist or a vitalist) depends on one's education and its media, and also upon one's temperament. Thus Prof. Thomson "confesses to some sympathy with those who ask why there should be all this straining and striving to remove organisms from the domain which includes the stars and precious stones, Northern Lights and dewdrops"; but he does not think that mechanism "exhausts the reality of the earth and the heavens, still less that of the flower in the crannied wall." On the other hand, Prof. D'Arcy Thompson is "not ashamed to uphold" that "the earth itself and the sea, the earth with its slowly changing face and the sea multitudinous with all its tides and currents and great and little waves, constitute a mechanism; the heavens themselves, the sun and moon and all the little stars, are a glorious mechanism." Obviously, having to make the choice induces sentiment. Now it would not be rash to say that the difference between mechanism and vitalism may suggest that between the Homoousians and the Homoiousians, but, like Gibbon when he wrote about the Arian controversies, one fails to trace any "real and sensible distinction" between the "isms" that concern us here. What does one find if he tries to think it all out in the light of strictly modern, physical speculation? Does "determinism" mean anything at all in science? It is "strict" only when we deal with mathematical functionality, and even then is not that just because the human mind, *having made the rules,* expects the answer? Obviously, this "ism" is a method, and not a result. Then, again, it is still very convenient to speak about atoms, etc.; but in pure speculation (which is our field just now) we must get down to bedrock conceptions. *Then* the ultimate data of science are

not even space-time coincidences, and not even the *dx's, dy's, dz's,* and *dt's* (for these can have significance only when they are referred to other *dx's,* etc.), but the relations between these unsubstantial ghosts of reality and other similar ghosts. And are not these relations most obviously the products of the mind? If so, is not our mechanism at the same time also vitalism?

Plainly, then, there is occasion for strong and resolute thinking in biology, as well as in physics, and until that has been done there ought to be an end to these back-number controversies. One fails to find this in Prof. Thomson's book, but, none the less, it is a book that most certainly ought to have been written. It takes stock, so to speak, of the situation of speculative biology at the beginning of a new phase in science, and it does so in a manner that is candid, comprehensive, and most attractive. Even to have compiled the bibliography, for which a host of young biologists will be thankful, is worthy of the gratitude of both students and investigators. J. J.

A Study of Weeds.

Weeds of Farm Land. By Dr. Winifred E. Brenchley. Pp. x+239. (London: Longmans, Green, and Co., 1920.) Price 12*s.* 6*d.* net.

IT is a healthy sign of the broad-minded, practical way in which agricultural research is being conducted that this handsome book on weeds should come from Rothamsted. It is necessary to employ the utmost refinements of mathematical and physical discussion in order to determine the water-retaining power of soil particles, and to make recurring counts of the bacteria and other organisms present in a gram of soil, if the expert is to be furnished with the data he requires in order to advise the farmer on the manuring and cultivation of his soil. But the best of manures will fail of effect if the land is not clean, and agricultural investigators run the danger of performing harmonics on the academic string if they do not constantly vitalise their thinking by watching the farmer at work and learning from him where the real difficulties arise.

Dr. Brenchley's book deals with weeds, and introduces us straightway to a big, and as yet an unsolved, problem—that of competition among living plants. As Rothamsted showed years ago, all the improvements in our agricultural plants, that selection for immense vegetative capacity which makes them such excellent productive machines, have not fitted them in the least to stand competition. When the wheat crop on a part of the Broadbalk field was left unharvested to sow itself and recur to the wild life of struggle, it persisted for only three seasons. By that time the weeds had taken possession of the land, and the wheat could hold its own no longer. A weed is nothing more than a plant which can scratch a living under the stress of competition with cultivated crops and in spite of the wholesale destruction wrought by tillage operations.

Dr. Brenchley begins her book with a description of the devices by which weeds ensure their continuance and distribution. Some, like the poppies, depend on the abundance of their seed; others, like the dandelion, have developed a plume or other device to spread wide their seed; others, again, like the creeping thistle or couch grass, possess a creeping underground stem which will yield a plant from every fragment. This part of the philosophy of weeds is easy; we can see why particular weeds are abundant, but why other equally well endowed plants do not become weeds is less evident. As in other domains of thought, teleology is a fine weapon of argument until someone reverses it. There are other factors in competition we do not in the least understand. Why should certain plants, chiefly European, harmless enough at home, have such a deadly power of spreading and becoming weeds in the worst sense when they are let loose in Australia or America? The prickly pear has rendered millions of acres unusable by man or beast in Queensland; every new country shows some invader in impudent possession, "having the time of its life."

The factors in competition are as yet beyond our summing; some slight reaction to soil or climate may depress or improve the "constitution" of the plant to a degree that is not apparent and certainly not susceptible of measurement, yet that slight change does determine whether the plant can or cannot stand competition. Dr. Brenchley supplies an example in point. Spurrey and sheep's sorrel are perhaps the most useful of indicator weeds—sure signs of soil acidity and lack of lime. Spurrey may be said never to be seen on chalk soils; on the sour Bagshot sands it will overwhelm the wheat. Yet these plants, when grown in pots and plots free from competition, grow better in limed or chalky soils than in their natural medium. The same thing has been observed with the calcifuge leguminous plants.

The latter part of Dr. Brenchley's book is occupied with a discussion of the association of particular weeds with soils, especially arable soils, a question of which she has made the first systematic study, and thereby upset a good many statements that had been put out on insufficient ob-

servation. Many of the results are still contradictory and far from conclusive; in fact, this is a field of applied ecology demanding further study. Within a given climatic zone we ought to be able to associate soil types with weeds, and so prepare a soil map accurate enough for working purposes from surface observations of the arable land flora alone, with quite a limited amount of checking by analysis.

Another question to which Dr. Brenchley devotes a good deal of attention is that of the viability of seeds as bearing on the unexpected flora which often appears on the bared surface of a railway cutting, a newly ploughed field that has been long in grass, or even the spoil heap of subsoil from a well or a ditch. Rank luxuriant charlock almost invariably springs up, yet it is difficult to see either how that somewhat heavy seed could be carried there, or that it could have been dormant in the soil. Charlock has been observed to cover a piece of newly ploughed moorland, broken up for the first time in its history so far as was known, and remote from any other arable land. The oldest inhabitants always know that certain fields will be smothered with charlock if they are ploughed deep, or broken up from grass after a long term of years. Yet the viability of seeds when stored is not great, nor do Dr. Kidd's experiments on the retarding effect of carbon dioxide on germination quite decide the question. Under ordinary conditions a seed continues to respire as long as it is alive; in the long-stored wheats at Rothamsted, for example, the embryo is burnt out, as it were. But under suitable conditions—say, of the carbon dioxide content of the air—can the seed assume a static condition and yet retain its germinating capacity, its life, for an exceptional term of years? Dr. Brenchley's figures for the number of arable seeds that germinated in samples of soil from different depths taken from land which had been down in grass for various periods indicate a progressive dying off of the buried seed, the numbers being comparatively few after thirty years of grass. But the subject would repay further study, especially as regards charlock.

One of the best of Dr. Brenchley's chapters deals with the prevention and eradication of weeds; they may be summed up in good cultivation and a sound rotation; smother crops are only effective to keep, not to make, land clean. Chemical methods have their occasional uses, like spraying with copper sulphate solution for charlock, but no farmer should need them after he has once got his land in order.

Dr. Brenchley's book should find its place in all agricultural libraries; it has the vividness and interest of the record of personal observation and thought that no mere compilation ever possesses. A word of praise should also be given to the illustrations; the photographs of parasitic plants attached to their hosts will be of interest to many botanists, while the drawings are new and characteristic. A. D. H.

Facts and Theories for the Social Worker.

(1) *An Introduction to Sociology: For Social Workers and General Readers.* By Prof. J. J. Findlay. Pp. xi+304. (Manchester: At the University Press; London: Longmans, Green, and Co., 1920.) Price 6*s.* net.

(2) *The Social Worker.* By C. R. Attlee. (The Social Service Library.) Pp. viii+286. (London: G. Bell and Sons, Ltd., 1920.) Price 6*s.* net.

(1) "THE 'unit' in sociology is the group." Throughout this "Introduction to Sociology" the author holds fast to this basal conception, and amid his many excursions into varied fields of study he is constantly turning back to the "group," unfolding its many implications, and by its means striking a path "through the jungle of social questions."

In this treatment of the group conception emerges the author's view that "the political philosophers have been far too prone to present an antithesis between The State and The Individual, whereas the conflict should always be viewed as between The State and The Voluntary Group." The former method gives a false superiority to the State, and begs the question of the place of the other groups in the life of the community. But if we throw over the supreme authority of the State we are left with two alternatives, neither of which seems satisfactory. We may elevate some other group to the highest place; the Syndicalist, for example, would make the group of producers supreme. That way lies no solution, for the association of producers is less representative than the State as it exists at present. We may, on the other hand, with Mr. G. D. H. Cole, attempt to balance the producers' association (The National Guild) by a consumers' association; but even so we are driven to look for a third group with authority over both; and Mr. Cole's *tertium quid* resolves itself into something not unlike our present State. Prof. Findlay does not aim at a final solution of this problem. "A new region," he says, "now awaits to be explored; . . . the various groups which, under the ægis of the democratic State, have developed self-consciousness and power, must now be brought into harmonious relation with each other and with the

State which claims to be their master." But in his discussion there is much that is suggestive and illuminating.

In his chapter on occupation and leisure the author finds the contrast between profession and trade to lie in the fact that the former is based on service, the latter on exchange, and he sees hope for the future in the thought that "society has never accepted the economic basis." Industry must be professionalised. This can be done—it was done during the war—through the trade unions and the employers' associations realising that they exist "to do the work of the trade, to produce the goods."

The book is fresh, alive, and interesting. The author holds that we "must begin with the present: describing and defining what we witness with all the power of abstraction we possess." Hence we find less in this book about the Todas and more about the League of Nations than in most treatises on sociology. Perhaps for an "Introduction" its very facility will prove to some extent a drawback. The simplicity of outline which the beginner demands is lost in the wealth of illustration and in the multitude of apt comments in many spheres of present and past experience. But the system is there if the reader has the wit to come by it; and the student of sociology who reads the book will go back to his task with renewed vigour.

(2) It is not very long since the only picture called up by the term "social worker" was that of an unprepossessing female, of uncertain age, but of undoubted respectability, who periodically descended from her refined atmosphere to view the lives of those strange beings "the poor." But the rapid extension of the sphere of State activity; the devolution of administrative functions to local bodies, and of advisory, and sometimes of executive, functions to workers, voluntary and official, paid and unpaid; the quickening of the social consciousness of the Church; and, perhaps most of all, the awakened self-consciousness of the working classes, no longer content to be experimented upon, but resolved to work out their own solution of whatever social ills they are heir to—all this has made the ordinary citizen aware to a fuller extent than ever before of his social responsibilities. If we are not all "social workers," we have at least come to pay tribute to the value and the difficulty of the services which the "social worker" performs.

Major Attlee in his book explores the wider denotation of the term. He reviews the opportunities for social service, in the charitable society, the prison, the mission, and the Church; in connection with the Poor Law, the Labour Exchange, the Care Committee, the Public Health bodies; and even in the trade union, the friendly society, and the co-operative society. All these are grist to Major Attlee's mill; and rightly so. The social fabric has become self-conscious through and through, and since in this new age these activities must be performed, it is desirable that they should be performed with intelligence and enlightenment. The book is full, racily written, and made alive with interesting first-hand illustration. Not only to the aspiring social worker, but also to those who are old in the service, and to the ordinary citizen, the book should prove a mine of information and a particularly inspiring example of the spirit in which the social worker should pursue his task.

The volume is the first of a series to be entitled "The Social Service Library" and edited by the present author. We look forward with interest to the publication of the other volumes in the series.

Our Bookshelf.

A Dictionary of Scientific Terms: Pronunciation, Derivation, and Definition of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Embryology, Physiology. By I. F. Henderson and Dr. W. D. Henderson. Pp. viii + 354. (Edinburgh and London: Oliver and Boyd, 1920.) Price 18*s.* net.

THE present work contains definitions of about 10,000 terms, including several hundred lately coined expressions, many of which have not hitherto appeared in a dictionary. In a first edition all the attempts at definition are not likely to be happy: "cœlom" is "a cavity of the body derived from the mesoblast"; "cœlomoduct," "the duct leading directly from the genital cavity to the exterior in Cephalopods and in Annulates"; "nephridium," "any excretory organ, usually the excretory organ of Invertebrates"; "micronephridia" is not given, though the obsolete and misleading "plectonephridia" appears; "sclerotome," "a partition of connective tissue between two myotomes"; "notochord" is not given, though "vertebra" is; "acanthin," "a substance like chitin, strontium sulphate, forming the skeleton of the Radiolarians"; "nanoplankton," "microscopic plankton"; "entelechy," "the realisation of forms in plant and animal life which have the power of reproducing their kind."

Alternative pronunciations are frequently given, as "different centres of learning have different types of pronunciation"; but one may seriously question the admissibility of many of these—*e.g.* of accenting "abdomen" and "gluteus" on the first syllable, or "popliteal" on the second, or "madreporite" and "mediastinum" on the third; while the only pronunciations given for "lorica," "vesica," and "posticous" (on the first

syllable) are frankly impossible. To neglect the established "rules of the game" in this matter is merely to encourage anarchy. "Anlage" should be accented on the first syllable.

The preparation of a dictionary of so many different sciences and subsciences is a formidable undertaking for two authors; the writers have, however, attained a considerable measure of success.

The Evolution of a Coast-line: Barrow to Aberystwyth and the Isle of Man, with Notes on Lost Towns, Submarine Discoveries, etc. By W. Ashton. Pp. xvi+302. (London: Edward Stanford, Ltd.; Southport: W. Ashton and Sons, Ltd., 1920.) Price 10*s.* net.

THE author gathers every possible kind of evidence to prove that there has been a widespread downward tendency in the land levels of the western coast of Britain, which has continued from a beginning, one gathers, after Neolithic times. He has read widely and with profit, though not always with discrimination, but his book will be of value to students, especially if they also have Sinel's "Geology of Jersey" to consult alongside it. The coast is considered section by section with, frequently, a popular geological introduction. The author works out a conjectural map of some ancient coast-lines, such as that of Cardigan Bay, which he suggests was once all lowland, and the land of the famous story of the Lowland Hundred or Cantref y Gwaelod retold by T. L. Peacock in "The Misfortunes of Elphin." In this he is almost certainly right in the main, though some of the scraps of evidence quoted are conjectural, and it is doubtful whether enough is allowed, either in this section or in others, for the consolidation, with the lapse of time, of the boulder clay which formed the main part of the lost lowlands. It is rightly stated that there has been distinct loss of land within historic times, but protection at the public expense is difficult, because the public does not appropriate land gained from the sea, and this, in the last thirty-five years, has been more than seven times the land lost. Even on the west coast gains have counterbalanced losses. The reproductions of old maps and prints are a valuable feature of the book.

Has the North Pole been Discovered? By Thomas F. Hall. Pp. 539+maps, charts, etc. (Toronto: Richard G. Badger.) Price 2.50 dollars.

THE Peary-Cook question still arouses controversy in the United States, and the author of the book before us, a former captain in the American Merchant Service and a past member of the Nebraska Legislature, has elaborately cross-examined the various narratives by Peary and his colleagues. He concludes that there is no conclusive evidence that either of the two claimants reached the North Pole. He states that he began his investigation with full faith in Peary; if so, his feelings have been so strongly roused that his statement is marked by the appearance of bitter personal bias. He maintains that the speeds claimed by Peary in his last marches are impossible, that Peary's photographs are shown by incompletely obliterated shadows not to have been taken in the latitudes claimed, and that Peary's different narratives are inconsistent and contradicted on essential questions by those of his negro companion, Henson. The author also claims that recent ascents of Mount McKinley show that Cook must have achieved the ascent of that mountain.

Whether the author's criticisms of Peary are fundamental, or based merely on honest errors in the narratives, on inconsistencies due to haste in publication, and on photographs which were prepared as book illustrations, and not as evidence, will doubtless be ultimately settled by the opinion of competent and impartial American geographers.

The Mystery of Life as Interpreted by Science. By R. D. Taylor. Pp. 176. (London and Felling-on-Tyne: The Walter Scott Publishing Co., Ltd., 1919.) Price 3*s.* 6*d.* net.

MOST readers of NATURE seek enlightenment on "The Mystery of Life as Interpreted by Science"; but whether they will find it in the little book which Mr. R. D. Taylor presents under this title is open to question. All life is psychic in its essential being, and every atom is "a psychic" endowed with super-consciousness defined as native cognition, determinative and directive, inbred in the structure of every atomic centre. This super-consciousness is the law of its being. In accordance with this law every atom radiates attractional emanations into the related atom of next lower radial potency, and coincidently receives radiations from the next higher. The "radial-attractional law of gravitation," which is not only the act of tending towards a centre, but is also coincidently the act of developing towards a source (and thus includes all human aspirations), is the theme of a book the metaphysical implications of which call for no further notice here.

Directions for a Practical Course in Chemical Physiology. By Dr. W. Cramer. Fourth edition. Pp. viii+137. (London: Longmans, Green, and Co., 1920.) Price 4*s.* 6*d.* net.

IN the present edition of this laboratory manual the arrangement and method of treatment adopted in previous editions have been retained, while the subject-matter is also largely the same as that in the edition reviewed in NATURE of March 25, 1915. Two additions have been made—a simple experimental arrangement for demonstrating cell-respiration, which was devised by Dr. Drew, is described, and a section has been added on the balance between acids and bases in the organism. In the latter a brief account is given of the elementary facts of the physical chemistry of acids and bases, and simple experiments by which they can be verified are described.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Heredity and Acquired Characters.

IN his letter headed "Heredity" published in NATURE of November 25 Sir Archdall Reid has not done justice to himself or to your readers. He endeavours to gain attention once more for a jocose misrepresentation of the meaning of the term "acquired characters," and in order to do so neglects to mention the fact that in NATURE, vols. lxxxviii. and lxxxix. (1911 and 1912), the matter was very fully treated in letters from himself and others, including two from me (vol. lxxxix., p. 61 and p. 167). It is the simple fact that in those volumes Sir Archdall Reid had his fling in attempting to mystify your readers with a facetious misrepresentation of the proper use of the term "acquired characters." The fictitious nature of the case presented by him was exposed at that time, and he adds nothing to it to-day. It would be sufficient to refer your readers to that correspondence, the mention of which is avoided by Sir Archdall Reid on the present occasion, were it not difficult for many people to obtain the volumes in which it occurs.

I may, therefore, state here that Sir Archdall Reid's joke or trick consists in ignoring the special and definite significance which has been given (originally, I believe, by Wallace) to the term "acquired characters," namely, that of an English equivalent or code-term for Lamarck's words "les changements acquis." He, on the present occasion, as in 1911, deliberately and professedly treats the statements of accredited writers concerning "*acquired characters*" as though they were using those two words in what he calls their "natural sense," and not (as they themselves declare they are using them) in the special Lamarckian sense as a "code-term." He thus creates confusion and mystification. He declares that *every* character which makes its appearance in the course of development from the egg-cell to the end of life is in the natural sense of those words an "acquired character," and he charges writers who maintain that "acquired characters" are not transmissible with making a statement which is "purely nonsensical." "There is," says Sir Archdall Reid, "absolutely no meaning in the Neo-Darwinian statement that acquired characters are not transmissible. It is like a declaration that five miles weigh five pounds." To that the obvious reply is: "If you, without any warrant, alter the established signification given by the Neo-Darwinian to the chief term in his statement, you can, of course, convert it into nonsense, and your proceeding is merely farcical."

Though many readers of NATURE are undoubtedly acquainted with Lamarck's "Philosophie Zoologique" and the careful definition given by him of what he meant by his words "les changements acquis," it is desirable to cite here what Lamarck said, since Sir Archdall Reid, in order to give an air of sincerity to his little joke, poses as an ignoramus, and possibly others really do not bear in mind Lamarck's statements. Sir Archdall Reid says (November 25): "I daresay I am wrong, but I should be glad to learn just how I am wrong." Further, he writes: "If it be thought that I am mistaken as to all this, can anyone tell us in precise terms what in the world the Lamarckian controversy was *about*?" It is difficult to suppose that Sir Archdall Reid has not read his Lamarck, and still more difficult to believe that he has forgotten the letters published in NATURE in 1911 and 1912, where he was plainly told "just how he is wrong," and also what the Lamarckian controversy was, and is, about. In any case, I will now quote what Lamarck wrote about "les changements acquis" and state what the Lamarckian controversy was, and is, about. Lamarck enunciated in his "Philosophie Zoologique" (Martin's edition, vol. i., p. 235) two laws, the first of which postulates the production of departures in shape and structure of the organs of an animal from the shape and structure normal to the species in normal conditions—when the animal is subjected to what were hitherto unusual conditions; whilst the second asserts that the changes thus acquired ("acquired characters" of English writers) are transmitted in generation to offspring. The limitations given by Lamarck's own words must, of course, be carefully observed. Lamarck writes:

"PREMIÈRE LOI.—Dans tout animal qui n'a point dépassé le terme de ses développements, l'emploi plus fréquent et soutenu d'un organe quelconque fortifie peu à peu cet organe, le développe, l'agrandit et lui donne une puissance proportionnée à la durée de cet emploi; tandis que le défaut constant d'usage de tel organe l'affaiblit insensiblement, le détériore, diminue progressivement ses facultés, et finit par le faire disparaître.

"DEUXIÈME LOI.—Tout ce que la nature a fait acquérir ou perdre aux individus par l'influence des circonstances où leur race se trouve depuis longtemps exposée et, par conséquent, par l'emploi prédominant de tel organe, ou par celle d'un défaut constant d'usage de telle partie; elle le conserve par la génération aux nouveaux individus qui en proviennent, pourvu que les changements acquis soient communs aux deux sexes, ou à ceux qui ont produit ces nouveaux individus."

Those are Lamarck's two laws. The first is universally admitted to be a correct statement of observed fact in numerous cases, though it is not to be accepted as formulating a primary or fundamental property of living matter.

The second law—stating that "les changements acquis" (for which words, in the exact sense in which Lamarck used them, the English term "acquired characters" was many years ago adopted and established as an equivalent) are preserved by generation to the new individuals born from the parents which have acquired those changes in accordance with the first law—has been challenged by many naturalists and accepted by others. Lamarck makes it abundantly clear that the characters transmitted to a new generation—with which he is concerned—are *changes* in form and structure acquired by the parents as a result of *more frequent and sustained use* of some organ or of *constant disuse* of such organ resulting from the influence of circumstances to which their race has been for a long time exposed. It would have rendered misapprehension more difficult had the term "acquired changes" been adopted instead of "acquired characters" as the English equivalent of "changements acquis." The distinctive attribute of the acquired characters so indicated and defined is that they are departures (either increase or decrease) from the usual or normal size, form, or structure of this or that part, arising in an organism "which has not yet passed the limit of its [individual] development" when that organism is submitted to novel conditions. They are *novelties* which arise under *novel* conditions, departures from the normal which occur when the environment ceases to be—*in certain important par-*

ticulars—that which is associated with the normal form of the species.

The "Lamarckian controversy" about which Sir Archdall Reid affects to be ignorant was, and is, as to whether the changes of structures set up in the manner indicated in Lamarck's first law are ever transmitted by generation to progeny. It has been demonstrated that such changes do occur, but no satisfactory evidence of their transmission by generation to progeny has been produced. It is admitted that, so far as we know, such a transmission is *possible*, and, in the period at which Lamarck wrote, the assumption that such transmission occurs was a reasonable one. But hitherto all attempts to give convincing demonstration of its occurrence have failed, though such attempts have been, and still are, made by able biologists.

Before concluding this letter, may I direct the attention of readers of NATURE to the correspondence on this subject which was started by Sir Edward Fry in 1894 (vol. li., p. 54), to which I contributed a long statement? Sir Edward, owing to his lack of acquaintance with Lamarck's writings, was genuinely misled by the term "acquired characters," then less familiar than it is to-day. E. RAY LANKESTER.

December 8.

IN NATURE of November 25 there appears a long letter from Sir Archdall Reid on the subject of heredity. In this letter he seeks to show that the whole controversy about the inheritability of acquired characters—perhaps *the* controversy of most vital importance in biology—is a mere "pother" about "words full of sound and fury, signifying nothing." "All the characters of the individual," he assures us, "are innate, acquired, and inheritable in exactly the same sense and degree."

Sir Archdall Reid must have a singularly poor opinion of the intelligence of his co-workers in the field of biology if he thinks that they have wasted, and are still wasting, their time in a meaningless controversy. The list of such "wasters," moreover, must include the honoured name of Darwin himself, who had a very clear idea of what was implied in the term "inheritance of acquired characters," only he termed it the "inheritance of the effects of use and disuse."

The fact is that the whole of Sir Archdall Reid's letter rests on a mere play with words. I recollect reading of a lawyer who, in defending a client on a charge of slander, maintained that "villain" was a perfectly harmless epithet, since logically and etymologically it only signified a servant employed on a farm.

Sir Archdall Reid begins by stating that all characters are acquired in response to external conditions, since there are no characters, but only potentialities, in the formless germ, and these potentialities will not be realised unless conditions are favourable. Did Sir Archdall Reid imagine that this was doubted by any biologist? Is it not, on the contrary, so elementary and self-evident that every biologist, in discussing genetic questions and assuming an irreducible minimum of intelligence in his hearers, takes it for granted?

If, however, Sir Archdall Reid thinks that such an assumption is unjustifiable, let me try to make the issue a little clearer.

The egg of any animal will only develop its innate possibilities as manifested in the features of the adult animal if the surroundings are favourable, but the development results in a definite type. If the surroundings are unfavourable the type may not come to fruition, but there will be an obvious attempt to attain it; the egg of the shrimp, for instance, never shows any tendency to develop into the same form as the egg of a fish. There is, of course, for every egg a particular combination of circumstances which is especially favourable and may be termed the normal environment, and the normal life of the animal and the function of its organs consist in answering the demands made upon it by this environment.

If, now, the environment be altered to such a moderate extent that the animal is still able to respond to it, then the use of certain of the animal's organs and their growth will be altered. On that point all are agreed; the difference between opposing schools of biologists begins when the question is raised as to what will be the characters of the offspring of the altered individual.

The Neo-Darwinian or Weismannian school maintains that the germs produced by the altered animal will be precisely like the germ which gave rise to that animal. If they develop in the normal environment of the species they will give rise to individuals conforming to the normal specific type; if they develop in the same circumstances as their immediate parent they will show similar divergences from the specific type.

The Lamarckian school, on the other hand, contends that the germs of the altered animal *become themselves slightly altered*, so that if they are allowed to develop in the normal specific environment they may still in their earlier stages of growth show a trace of the altered structure of their parent; and, on the other hand, if they are allowed to develop in the same circumstances as their parent they will manifest the altered structure acquired by the parent *more rapidly and in stronger degree than did the parent.*

I have already had occasion to direct the attention of readers of NATURE to the fact that certain experimenters on the Continent claim to have established the truth of these two essential postulates of Lamarckism. This claim may be ill-founded or well-founded—that is a matter for argument—but no reasonable Neo-Darwinian would fail to admit that if the claim proves to be well-founded the Lamarckian position will be established.

Sir Archdall Reid states that, "apart from variation, like exactly begets like when parent and child develop under like conditions." Leaving aside for the moment the quibble about the word "variation," the Lamarckian contention is that like does not "exactly beget like," but that the influence of conditions on the character of the individuals composing a species *is cumulative from generation to generation.* There is a rapidly accumulating body of evidence in favour of this view; for a piece of evidence to which my attention has recently been directed I am indebted to my friend and colleague, Prof. Dendy. It is as follows: The peach in Europe is a deciduous tree. Transplanted to Réunion it has become an evergreen in the lowlands of that island, but has remained deciduous in the highlands. If a seed be taken from the evergreen tree and grown in the highlands it will still in the first generation give rise to an evergreen tree, although its ancestors were undoubtedly deciduous.

Finally, I should like to say that the sense in which I understand the word "variation," and the sense in which I think it is understood by the majority of my co-workers, is a divergence from the normal appearing among the offspring of a normal individual *when the normal environment remains unchanged*, and in that sense it should be used by Sir Archdall Reid. E. W. MACBRIDE.

Imperial College of Science, South Kensington, London, S.W.7. December 8.

The Energy of Cyclones.

IN NATURE for December 2, p. 436, Sir Napier Shaw remarks: "There can be no doubt, I suppose, that solar and terrestrial radiation are ultimately responsible for the kinetic energy of the winds." If we include other possible radiations from space and the effects of high-velocity cosmic matter striking the upper limits of the atmosphere, few will fail to agree. Not many years ago the theory mentioned by Mr. J. R. Cotter (NATURE, November 25, p. 407), 'that the energy of a cyclone is derived from the heat-energy of the earth's surface,' would have been considered as most probably correct. However, Mr. W. H. Dines, with the aid of about 250 soundings of the upper air with self-registering balloons, proved that the lower central parts of cyclones are actually cooler and denser than the surrounding parts. That his conclusion is of general application so far as western Europe is concerned the daily Upper-Air Temperature Charts issued by the Meteorological Office show.

Fig. 1 shows the distribution of temperature in cyclones found by Mr. W. H. Dines, and in the face of such a distribution it appears to be impossible to attribute their growth and disappearance to the heating and cooling of the troposphere. Local heating of the atmosphere near the earth's surface does cause up-rushes of air, resulting in thunderstorms, etc., but they never seem to result in cyclones.

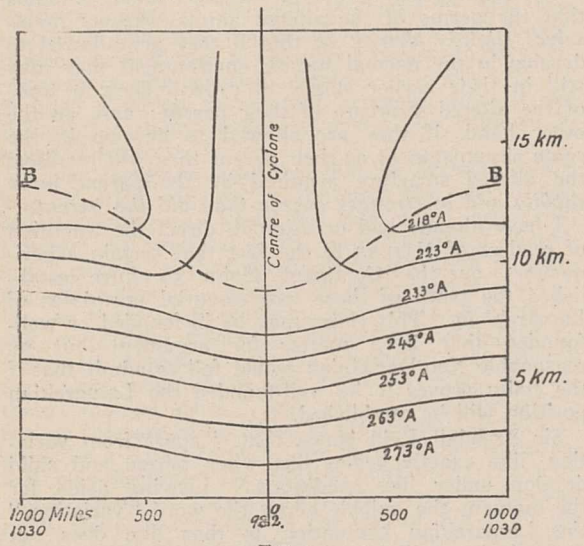

FIG. 1.

In view of the actually determined distribution of temperature in cyclones being as shown in Fig. 1, I suggested (*Phil. Mag.*, July, 1915, April, 1916, and March, 1918) that the upper, as well as the lower, limits of the atmosphere become irregularly heated, and that the general and local winds of the earth result from the interaction of the movements set up by these two layers of heated air. Referring to Fig. 1, it will be noticed that the line of division BB between the stratosphere and the troposphere is lower at the centre of the cyclone than at its margins, and that the temperature at the centre of the depression is lower than near the margins. So marked is this lowering of temperature that, in spite of the lower pressure, the central air is denser than that surrounding it, and there is, consequently, no tendency for the column of air to rise. On the other hand, above BB the temperature of the stratosphere at the cyclonic centre is higher than it is at the margins at similar levels, and the pressure at the centre being lower as well, there is a strong lifting power exerted upon the troposphere by the stratosphere. So long as such lifting action is in operation the cyclone persists.

With regard to the general circulation upon which the travelling cyclones are superimposed, all the registering balloon ascents yet made indicate that the temperature conditions of the greater cyclonic circulations of the polar areas are similar in nature to those of the smaller ones; nor is there as yet any evidence suggesting that the conditions of decay in cyclones differ in anything but degree from their conditions of growth.

Sir Napier Shaw has pointed out that rain and many other weather conditions are very often due to the "embroidery" of the cyclone rather than to the rising air in the centre of the cyclone itself. The Daily Weather Charts show that, especially near the margins, the effect of the oncoming or growing cyclone, impressing its circulation upon already existing winds, is often to cause damp, warm air-currents to mount over dry ones, and thus to produce rain and cloud. Mr. W. H. Dines (NATURE, November 18, p. 375) may be quite correct, therefore, in holding that cyclones do not result from warm air of the troposphere flowing over cold air near the earth's surface; and Lt.-Col. Gold (*ibid.*, November 11, p. 345) may be equally correct in believing that rain is often due to such conditions obtaining in cyclones. However, such movements are secondary phenomena, and may add some energy to an already existing cyclone, for the reasons given by Sir Oliver Lodge (*ibid.*, November 25, p. 407).

The formation of a cyclone, as Sir Napier Shaw (*ibid.*, December 2, p. 437) states, shows that "the region covered by a cyclone has simply lost a certain part of the air which it normally possesses. In one example I estimated the loss as equivalent to 40,000 cubic km. at sea-level. Beyond all doubt or question air had gone; it was not piled up in anticyclones fore and aft, as we used to think the convected air of our cyclones must be; it was gone clean away." According to my conception, the upper limit of the atmosphere is often heated locally by radiant energy or high-velocity matter from without. Heated protuberances are thus formed at the upper effective limit of the atmosphere. The air of these protuberances then flows away in all directions, leaving cyclonic conditions below the area where the protuberance was formed.

R. M. DEELEY.

Tintagil, Kew Gardens Road, Kew, Surrey,
December 4.

Name for the Positive Nucleus.

MAY I ask in what way "the hydrogen nucleus or unit of positive charge," for which Sir Oliver Lodge (NATURE, December 9, p. 467) provides us with a choice of brand-new names, "proton, ambron, merron, uron, prime, centron, and hylon," differs from our very old friend "hydrion," the familiar hydrogen ion of the physical chemist? The point occurred to me when Sir Ernest Rutherford suggested the new name "proton" for it in Section A of the British Association this year. Its new hypothetical *rôle* as "the brick of which all atoms are built up, electrons acting as cement," although probably more acceptable to chemists than the curious inversion of this which afforded to a past generation of physicists such peculiar æsthetic and intellectual gratification, ought not to be allowed to obscure the fact that there is nothing hypothetical or protonic about the particle itself. In 1920 hydrogen ion, as the common constituent of that very common class of

substances called acids by the chemist, surely does not need a choice of seven brand-new names. In fact, one Faraday did some very important work indeed in the subject generations before the modern hydrophobic school, with its inveterate aversion to "anything wet," had arisen. FREDERICK SODDY.

The Stereoscopic Appearance of Certain Pictures.

DR. EDRIDGE GREEN'S explanation on p. 375 of NATURE of November 18 does not go quite far enough. It is true that a picture in correct drawing and perspective will be correct only for one eye, but the eye must be situated at a certain point which is geometrically defined by the elementary rules of perspective. A photograph taken by a pin-hole camera or with any good lens is in true perspective. It should be viewed at the same angle as that with which it was taken; in other words, it should be viewed from a distance equal to that of the pin-hole (or a certain point in the lens combination) from the plate.

Photographs and illustrations are generally viewed at too great a distance. With an angle of view of 55° the eye should be at a distance approximately equal to the longest dimension of the picture. If this is considerably less than 250 mm. to 350 mm. (say 10 in. to 14 in.) a lens must be used, not for magnification—which is a disadvantage in the case of coarse-grained process blocks—but to enable the eye to be used at approximately the right position. Exactness is not necessary, as the eye is so easily pleased. An ordinary reading-glass may be used for the illustrated papers, but it must be held close to the eye. The result is sometimes very striking. Photographs of complicated instruments or of complicated machinery in a factory, which are scarcely intelligible when viewed in the ordinary way, stand out almost as solid as with a binocular stereoscope. Partly because photographs, illustrations, and pictures are generally viewed with both eyes, and partly because the distance is usually much too great, accurate perspective representation, as a rule, produces no stereoscopic illusion whatever.

A. P. TROTTER.

Ajaccio, Corsica, December 3.

Luminosity by Attrition.

THE following workshop observations may throw some additional light on luminosity by attrition, the subject of recent correspondence in NATURE:

Blocks of optical glass are cut into slabs by means of a soft steel circular saw, the edge of which is usually charged with diamond-dust, a copious flow of a lubricant such as petrol, paraffin, or soapy water being employed.

Within the block of glass at the line of contact with the saw there is often visible a blue-tinted white light, limited to the acting portion of the edge of the saw. The light is not thrown downwards in the direction of motion, as in the case of a shower of sparks or of an ordinary flame.

The bluish-white light is most apparent when the cutting is forced, when the saw is blunt, and when an insufficient amount of diamond-powder is used. When the saw is working well the light can only be seen with difficulty by excluding extraneous light.

There is no evidence of any temperature cracking over the cut surfaces, and I know of no instance in which the petrol or paraffin has been ignited even when the saw is cutting at the extreme edge of the glass in contact with the air.

When carborundum is used instead of diamond-powder—the carborundum, however, being injected with compressed air and a water lubricant employed—a dull reddish light appears. It is difficult to say if this reddish light is accompanied by any characteristic heat cracks, as the cutting action with carborundum is more complicated, there being a secondary side abrasion at the surfaces of the saw which might obliterate minute heat-cracks.

JAMES WEIR FRENCH.

Anniesland, Glasgow, December 8.

Tragic Death Feint of a Snake.

ON Sunday morning, May 30, about 10 o'clock, I noticed a common western hog-nosed viper, about 20 in. in length, basking on the lawn in the warm sunshine. I approached the serpent in company with a friend to make some investigation of it, and only to interfere with it enough to keep it from crawling away. The creature went through the usual feint of being a dangerous snake that is peculiar to this species, and quickly began to coil and recoil and to hide its head under its body. After it had done this a short time it turned on its back, but continued to writhe as though injured severely. Gradually it assumed a position simulating that of a dead snake lying on its back, with its mouth completely inverted and bleeding. This was done in such a way that the head appeared to be completely mashed or severed. The exudate of blood from the entire surface of the mouth was perfect. It was the most complete and well-carried-out feint of a tragic death that I have ever witnessed, and all without the least torture or stroke of any kind from me. I only detained the snake by placing my foot in front of it and turning it back once at the beginning. We left the creature in this apparently killed condition, only to see that it disappeared in a very short time.

My observation of this genus Heterodon (hog-nosed viper), which is not a viper at all, has shown me that it always puts up the tamest kind of bluff before hiding its head, but never before have I observed this complete performance with a bloody exudate from the inverted mouth. I am convinced that it will not often be carried out thus completely unless the conditions of season, the weather, and the development of the snake are just right. In other words, I think that it must be a peculiarity of some maturity of growth, and that the full vigour of a warm day in late spring or early summer must enter into it.

W. E. BARTLETT.

Belle Plaine, Kansas, U.S.A., November 22.

The Alkaloids of Senecio jacobæa.

IN the Notes in NATURE of November 4, p. 321, reference is made to "*Senecio jacobaea*, the source of the disease in sheep in Nova Scotia." It should read "cattle" instead of "sheep," for although injurious to sheep it has not been fatal to them as it has been to cattle. The "Pictou cattle disease" has in some quarters led to change of the common name "St. James ragwort" to "cattle-kill"—a term analogous to "lamb-kill" for *Kalmia glauca* and *K. angustifolia*, supposed to be poisonous to young sheep.

The alkaloids of *Senecio jacobaea* were, under the auspices of the Nova Scotia Institute of Science, planned to be investigated by the late Dr. Eben MacKay, of the University of Dalhousie, on the chemical side, and by Prof. C. L. Moore on the biological side. A. H. MACKAY.

Education Office, Halifax, Nova Scotia,
November 22.

Instruments for the Navigation of Aircraft.

By G. M. B. DOBSON.

THE design of instruments to aid the navigation of aircraft, like all other branches of aeronautics, has been greatly accelerated by the war, though many of the instruments required are only now reaching their final stages of development, and instruments to effect navigation—as distinct from pilotage by the aid of landmarks—were scarcely used during the war.

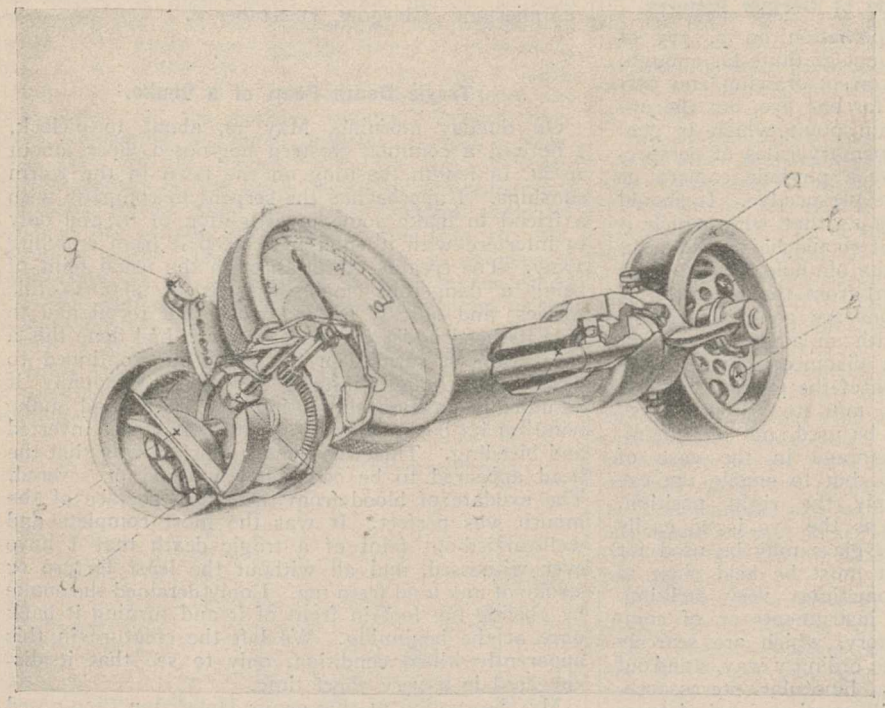

FIG. 1.—R.A.E. gyro turn indicator Mark V. *a*, gyro wheel; *b*, *b*, oblique holes for air-drive; *c*, shaft carrying gyro wheel communicating motion to pointer; *d*, cam on shaft *c*; *e*, controlling spring; *f*, cam altering tension of spring *e*, worked by lever *g*.

Before and during the earlier stages of the war the errors of the magnetic compass as used on aeroplanes were the subject of much discussion, and numerous designs were tested with the view of overcoming its defects, which are, unfortunately, really inherent. The gyroscopic turn indicator has now solved this problem by taking over some of the original duties of the compass. Provided the aeroplane be flying straight, the compass shows the direction of flight correctly, but as soon as a turn is started it immediately becomes untrustworthy. It must be remembered that in a cloud the pilot of an aeroplane has no means of knowing whether he is turning to right or left, or flying straight. Thus previously the compass was used both to keep a straight course and to obtain the bearing of that course. The gyroscopic turn indicator—originally due to a suggestion by Prof. J. B. Henderson—is now available in several forms, all of which work well, and enable a pilot to turn and straighten out again while in a cloud almost as easily as in clear air. With the presence of this instrument the compass is required only for showing the direction of flight during the time the aeroplane is flying straight.

The gyroscopic turn indicator depends for its action on the precession of a rotating gyroscope against suitable controlling springs, when its axis of rotation is changed. One simple form is shown in Fig. 1. The gyro wheel seen on the right is

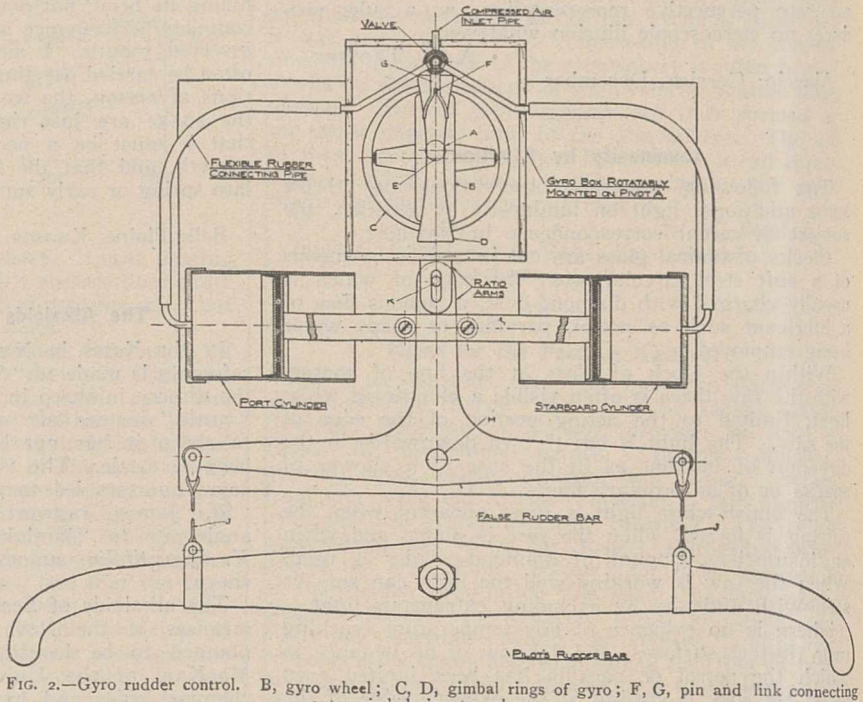

FIG. 2.—Gyro rudder control. B, gyro wheel; C, D, gimbal rings of gyro; F, G, pin and link connecting outer gimbal ring to valve.

mounted outside the aeroplane, and spun at 10,000 to 15,000 revolutions a minute by the relative wind. The central cylindrical portion passes inwards through the side of the aeroplane and carries the dial, which is in front of the pilot. By means of a cam marked *f* the tension of the control spring *e* can be varied at will over a large range, and thus the sensitiveness of the instrument can be changed to suit different machines or different atmospheric conditions.

Another gyroscopic instrument which has been designed during and since the war is the gyroscopic rudder control. This is intended to relieve the strain on the pilot during a long flight by controlling the aeroplane's direction. With it the pilot need only check the course once every five to ten minutes. The instrument consists of a gyroscope hung freely in gimbals and carefully balanced. With good workmanship such a gyroscope will keep its direction within a degree in ten minutes. Any movement of the aeroplane relative to the gyroscope immediately operates a valve controlling a pneumatic servomotor, which puts over the rudder so as to turn the aeroplane back to its original course. It is also fitted with a simple "follow-up gear," so that the deflection of the rudder is proportional to the amount the aeroplane is off its true course. The apparatus is shown diagrammatically in Fig. 2. The gyroscopes are about 3 in. in diameter, and spun at about 15,000 revolutions a minute by compressed air.

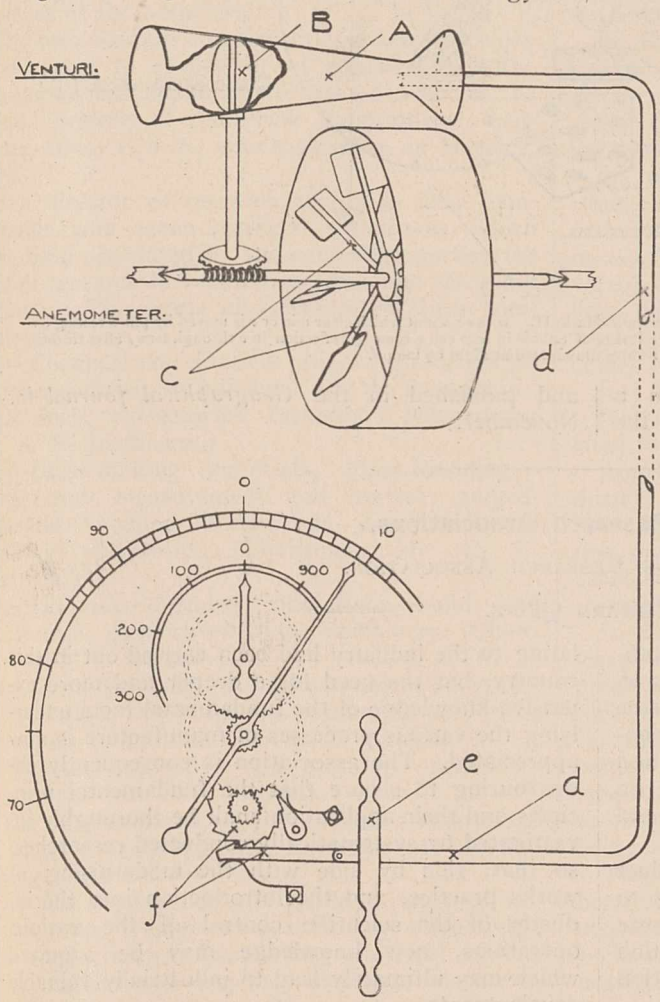

FIG. 3.—R.A.E. pneumatic air log. A, Venturi tube exposed to wind; B, disc in exit cone revolved by wind mill C; *d*, pipe connecting throat of Venturi to diaphragm *e*; *f* ratchet and wheel.

Until recently the only method of finding the distance an aeroplane had travelled through the air was to note the length of time flown and the average reading of the air-speed indicator. The latter reading, being dependent on the density of the air, must be corrected for the density at the height flown, as well as for a small error due to interference of the air-flow by the neighbouring parts of the aeroplane. To eliminate this trouble, an air log was designed, which should record continuously the actual distance travelled through the air. This is shown diagrammatically in Fig. 3. A windmill type of anemometer is employed, since this has the advantage that it needs no correction for change of density. As the windmill must necessarily be fixed on an exposed part of the aeroplane, it must be made to transmit its indications to the pilot. This is conveniently arranged by mounting a Venturi tube alongside the windmill. The exit of this Venturi tube is alternately opened and closed by a rotating disc, say once every 1000 revolutions of the windmill. The pressure at the throat of the Venturi tube is thus alternately above and below atmospheric pressure, and a pipe led from the Venturi tube to the indicator transmits these alternations of pressure, which operate the counting gear through the agency of a small diaphragm. The addition of a small adjustable baffle behind the windmill allows the interference error to be eliminated once for all for any aeroplane.

The use of ordinary sextants in the air is largely ruled out by the fact that the true horizon is nearly always obscured by haze. The top of this layer of haze is generally nearly horizontal, and has, therefore, sometimes been used instead of the real horizon. As, however, it may occasionally be inclined to the horizontal by a degree or more, such results are untrustworthy.

The use of bubble sextants has been attended by greater success than was at first expected. On aeroplanes the mean of six readings will generally give the altitude of the sun or star correctly within about ten or fifteen minutes of arc. On airships much better accuracy seems possible. The design of bubble sextants for use in the air is largely a matter of making them convenient to use. The image of the sun and bubble must move together across the field if the instrument be tilted, and the size of the bubble must be adjustable. The general

principle of a bubble sextant is shown diagrammatically in Fig. 4. By means of a lens and prism (not shown), which are fixed above the bubble lens, the horizon can also be seen in the field of view, as well as the bubble, so that the instrument may be used as an horizon sextant if required.

The problem of the rapid calculation of sextant observations appears to have been solved completely by the cylindrical slide-rule due to Mr. Bygrave. With a slide-rule about 7 in. long results can be obtained in three or four minutes' time which are accurate to within about three minutes of arc. With larger patterns greater accuracy in obtained.

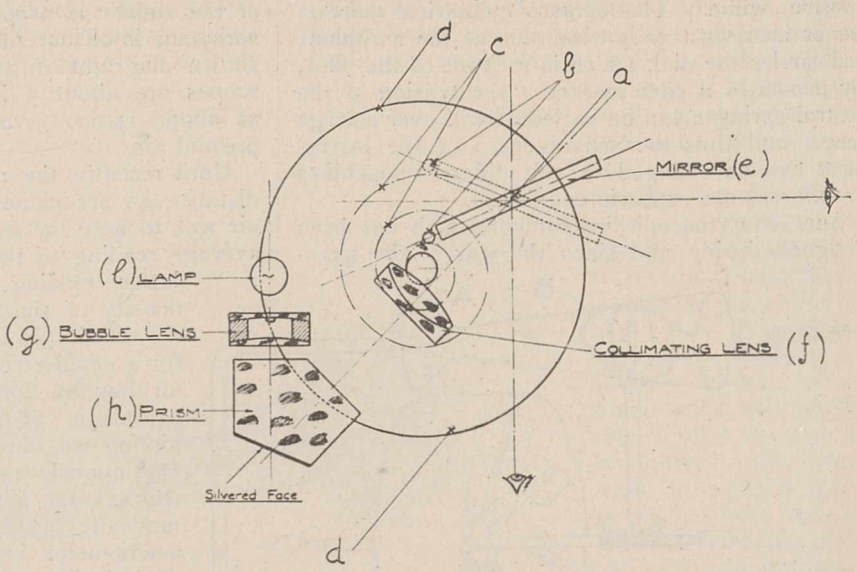

FIG. 4.—R.A.E. bubble sextant Mark II. *a*, axis about which clear mirror *e* is moved by pin *b* resting on cam *c* fixed to drum *d*. Image of bubble in lens cell *g* seen by reflection in *e* through lens *f* after further reflection in prism *p*. Bubble illuminated at night by lamp *l*.

The accompanying illustrations are from a lecture on "The Design of Instruments for the Navigation of Aircraft," read to the Royal Geographical Society by the author on May 10 last, and published in the *Geographical Journal* for November.

Industrial Research Associations.

VI.—The Glass Research Association.

By Edward Quine.

THE Glass Research Association has been established for investigation into the problems of the glass industry in accordance with the scheme of the Committee of the Privy Council for Scientific and Industrial Research. The association received its Certificate of Incorporation on August 11, 1919, and held the first general meeting on October 14 following.

The objects of the association are to conduct scientific and technical investigations relating to glass and its manufacture, and to disseminate among members technical and other information bearing on these subjects and on the production of articles made wholly or partly of glass.

The rate of development of the glass industry in this country is largely influenced by difficulties in the matter of technique, works organisation, production and equipment, and, in order that the industry may attain a high degree of efficiency, it is necessary for investigations to be directed towards overcoming these difficulties, in addition to investigations of fundamental principles and search for new knowledge. To ensure that greater economy in production and more satisfactory products may be obtained, improved methods must be introduced, and the works practice of the industry brought into line with the advanced methods found operative in other countries. Until recent years no comprehensive research work relating to the industry had been carried out in this country, but the need for a deeper and more extensive knowledge of the fundamental facts underlying the various processes of manufacture is now appreciated. The association is consequently endeavouring to secure that the fundamental principles and their application shall be thoroughly investigated by systematically conducted researches, so that, side by side with the modernising of works practice, and the introduction into the industry of the scientific control of the various operations, new knowledge may be acquired which may ultimately lead to industrially valuable developments.

The investigations of the association cover the problems of all sections of the glass industry other than those of optical glass, research work in which is being undertaken by the British Scientific Instrument Research Association.

The membership of the association is limited to British corporations and British subjects carrying on business in connection with the manufacture of glass, and other trades and industries allied therewith or accessory thereto. Individuals ineligible for membership or not desiring admission as members, who are interested in the glass industry and willing to subscribe to the objects of the association, may be admitted by the council as

associates. At present there are 135 members and seventeen associates.

The management of the association is vested in the council with an executive committee; the council consists of a majority of elected members together with a limited number of members co-opted because of their special knowledge and experience, and members nominated by the Department of Scientific and Industrial Research. The chairman of the first council is Mr. George E. Alexander, whose support and direction have been largely responsible for the successful establishment of the association.

The organisation and direction of research work is entrusted to a director of research, and the association has appointed to this post Mr. R. L. Frink, formerly of the Frink Laboratories, Lancaster, Ohio, U.S.A., who took office on March 1, 1920.

The director of research works in close consultation with seven research committees, which have been appointed by the council to survey the field of research in relation to glass and the glass industry. The terms of reference of these committees are :—

(1) Chemical and physical properties of glass (at all temperatures). (Chairman : Dr. W. Rosenhain.)

(2) Fuels, refractories, furnaces. (Chairman : Mr. S. N. Jenkinson.)

(3) Glass-making materials, glass-founding—temperature measurement and control; annealing and finishing other than decorative and marking operations. (Chairman : Mr. C. C. Paterson.)

(4) Glassware-forming operations—hand and mechanical; glassware-making machinery. (Chairman : Mr. J. Forster.)

(5) Lamp-working. (Chairman : Mr. F. Cossor.)

(6) Design, lay-out, and equipment of glass factories. (Chairman : Mr. R. S. Biram.)

(7) Glass decorative and marking operations. (Chairman : Mr. E. J. Purser.)

The programme of research covers a wide range of subjects, including investigations into the following problems :—

(1) The dependence of fusibility, range of viscosity, colour transparency, brilliancy, refractivity, heat conductivity, expansibility, electrical conductivity, tensile and crushing strength, hardness, brittleness, elasticity, working properties in the blow-pipe flame, resistance to chemical action, and devitrification upon the chemical composition of the glass.

(2) The examination and treatment of clays and bricks, the composition and methods of manufacture of refractory materials, the firing of pots, and investigations in regard to refractory materials.

(3) The design, construction, and operation of furnaces, tanks, pot arches, lehrs, kilns, glory-holes, etc.

(4) The relative value and efficiency of coal, coke, oils, tar, and other combustible mixtures, gas and gas-producers for various types of furnaces and lehrs, and the investigation of electrical methods of heating.

(5) The most suitable raw materials by means of which to introduce certain chemical elements in the best and most economical forms.

(6) Methods of batch mixing.

(7) Measurement and control of temperature during founding, chemical and physical changes during founding, determination of most suitable rates of charging and founding different types of glass, effect of furnace gases upon the various types of glass during founding; methods of aiding the fining process.

(8) Examination and improvement of the methods and conditions under which molten glass can be conveyed to the forming apparatus; moulds and their treatment; mechanical processes of forming glass.

(9) Investigation of annealing temperatures, rates of annealing, effect of annealing on physical and chemical properties; methods of detecting and measuring strain.

(10) Cracking off, grinding, etching, enamelling, decorating, graduating and marking, lamp-working machinery, and other mechanical processes of finishing.

(11) Ventilation of works.

(12) Efficiency and health of operators as related to industrial operations.

Apart from the general problems of the industry, members of the association may, on terms to be decided by the council, have special information given to them by the director or staff of the association, or may have special investigations or researches made for them.

In March, 1920, the association secured the lease of 50 Bedford Square, W.C.1, and these premises have been equipped as offices and laboratories, in which eight research assistants are carrying out intra-mural investigations. Difficulties have been met with regard to the equipment of these premises, thus causing much delay in the work; but now the required equipment is being rapidly assembled.

The full activities of the association have as yet been of short duration, but during this period it has consummated agreements and arrangements with certain of its members whereby it has been made possible to construct an experimental tank furnace for the development of certain types of glasses, and a method of their formation into chemical, table, lighting, and other classes of ware, which, it is hoped, will effect not only a great economy in cost of manufacture, but also increase the production. The construction of a new type of lehr is also contemplated under a similar arrangement, and it is hoped that the results of this work will assist in solving, or even solve completely, many of the technical problems in the annealing of various classes of ware at a greatly reduced cost in construction and operation, and at the same time place annealing under more scientific and positive control. Moulds for forming glassware, their composition, construction, and methods of

use are being studied, and the results will shortly be experimentally applied in the works of members.

A number of improvements and inventions, for some of which applications have been made for patents, are being completed, and will in due course be placed in operation. These improvements and inventions include a method of cooling tank-furnace walls, an instrument for indicating and recording viscosity of glasses under practical working conditions, temperature-control apparatus, furnace-controlling instruments, paste for moulds, etching and acid polishing solutions, instruments for classification of colour values of glasses, and others of minor importance.

It has been the policy of the association so far as possible to utilise existing facilities in scientific institutions, and in accordance with this policy the National Physical Laboratory is proceeding with researches on behalf of the association, and it is contemplated that during the coming year the volume of researches at this institution will be considerably increased. Investigations are also proceeding at the Department of Glass Technology, University of Sheffield. Negotiations are progressing with universities and institutions which are specially equipped and adapted to investigate specific problems on behalf of the association.

The association is completing a working agreement with the British Refractories Research Association whereby large-scale researches into the fundamental principles underlying the manufacture of refractories for the glass industry and their industrial application will be carried out by the British Refractories Research Association working in consultation with a joint committee formed of members of both associations and the Directors of Research.

Working arrangements have been made with the British Scientific Instrument Research Association whereby problems common to both associations will be investigated jointly, this association co-operating with the British Scientific Instrument Research Association to the fullest possible extent.

The council has considered the advisability of conducting research investigations into psychological and physiological problems affecting organisation and productive operations of the industry, and, believing that such investigations will be of great benefit both to the operatives and to the manufacturers, has referred this matter to the appropriate research committee for action.

Apart from work to be undertaken by associations and scientific institutions and at factories of members on behalf of the association, arrangements have been made for men of science who have specialised in certain branches of scientific investigation as applied to this industry to undertake researches.

Extensive investigations on "The Bloom and Dimming Effect upon Lamp-working Glass" have been made on behalf of the association by Mr. J. H. Gardiner. A first report has been received which has led to fruitful suggestions for further investigations, which are proceeding. A valuable contribution has been made to the association by Messrs. F. Twyman and A. J. Dalladay upon "Methods of Differentiating Cords in Glass," and further work is being done on this subject in the laboratories of the association.

A vast amount of work lies before the association, and, while realising the limitations of universities in their relation to industrial research and appreciating their services to industry in furnishing both ideas and trained investigators, the council is, in its endeavours to solve such of those problems of the glass industry as lend themselves to investigations along academic lines, anxious for the close co-operation of those universities and scientific institutions having equipment and facilities available, and it is hoped that as its work progresses the association may become the centre of scientific and industrial research into problems of the glass industry for the Empire.

The Quantum Theory.

PROF. MAX PLANCK was awarded the Nobel prize for physics this year, and his address [1] on the occasion of receiving it makes extraordinarily interesting reading. He describes in some detail the way in which he was led to the discovery of the quantum, and to anyone engaged in research the description will be very encouraging, for it shows through what darkness the mind of a great discoverer must grope, and what false tracks he will follow, before he sees the light of the truth. At the time of his discovery few physicists would seem to have appreciated the fundamental importance of the unknown relation connecting the energy of radiation with its wavelength and temperature, perhaps because this relation can be obtained only by a denial of some of the chief articles of their scientific creed. Thus the late Lord Rayleigh had already stated correctly the radiation formula as it ought to be—and as it is for the longer wave-lengths; but he does not appear to have attempted to explain its hopeless failure in the region of the visible spectrum and beyond. The rival formula was that of Wien, far less sound theoretically, but giving good agreement with observation in the visible spectrum.

Planck started on Kirchhoff's idea that if he could find the emission and absorption for a single ideal radiating substance, the true radiation formula would result. He naturally worked on dynamical principles, and inevitably got a result equivalent to no result at all, for it led to the

[1] "Die Entstehung und bisherige Entwicklung der Quantentheorie." Von Max Planck. Pp. 32. (Leipzig: J. A. Barth, 1920.) Price 4 marks.

impossibilities of Rayleigh's formula. He next turned his attention to the thermodynamical aspect, and this illustrates at its best the groping process, for in fact thermodynamics does not contain the answer at all; and yet this track guided him to the right solution. He was led to study a certain thermodynamic function (the reciprocal of the second differential of the entropy with regard to the energy!), and was struck by the fact that, with Wien's formula, it was proportional to the energy itself—a fact that is really quite accidental. For Rayleigh's formula it was proportional to the square of the energy, and Planck was happily inspired to combine the two forms into one. The result gave him the true formula. It remained to find a theory to account for it.

In the course of his efforts to get this theory, Planck turned to the deeper meaning that is attributed to entropy on the kinetic theory, which connects it with probability, and once this was tried it gave the result more simply than might be expected. For in considerations of probability one is bound to work with discrete quantities, and not with continuous; and so one must adopt the idea of atoms of energy for the calculations, though with the ultimate intention of making them infinitely small. But this intention is frustrated, because the formula is obtained without going to the limit at all. This was how Planck arrived at his theoretical explanation of the radiation formula, and by comparison with experiment he was enabled to deduce two universal constants. From the first were obtained the earliest really good values for the charge of the electron and the associated constants. The second, he confesses, perplexed him a good deal, and indeed it would have been surprising if it had not. It was the quantum.

The remainder of the address is occupied with the later history of the quantum, and it is scarcely too much to say that this is simply the history of modern physics. Of all its applications, photo-electric effect, specific heats of solids at low temperatures, specific heats of gases, etc., he not unnaturally gives pride of place to Bohr's spectrum theory. The address concludes with some speculations as to what may be the solution of the almost impossible difficulties with which we are faced. The success of the quantum theory has been, and continues to be, so enormous that it often appears as if writers had forgotten that the whole present system of physics is based on a perfectly definite set of mutually contradictory axioms. So it is particularly interesting to hear some views on this question by one of the great authorities. Unfortunately, Planck does not seem nearer the solution than are the rest of us, for in one place he throws out the discouraging suggestion that the quantum theory is now in the state in which Römer left the theory of light, so that we may expect to have to wait a long time for the Maxwell of the subject to appear and reconcile the seemingly irreconcilable.

Obituary.

SPENCER PICKERING, F.R.S.

BY the death of Percival Spencer Umfreville Pickering at Harpenden on December 5 English science loses one of its most original and attractive personalities. His death was not unexpected; for more than a year his friends had known that Pickering was in a precarious condition, holding on to life by little more than his courage.

Pickering was born in 1858 of good family, and educated at Eton and Balliol. His earliest paper was published while still an undergraduate, and it is not uncharacteristic that it was polemical, directed against one of his dons, and concerned with a basic compound. But his real activity began with his appointment as professor of chemistry at Bedford College in 1881. He began to work upon the constitution of double and basic salts, and passed on to determinations of thermal phenomena accompanying the formation and solution of salts. Naturally enough, this work led to a general consideration of the process of solution, especially as it was about this time that the Van't Hoff theory of osmotic pressure and the dissociation into ions of salts in aqueous solutions was beginning to revolutionise the conceptions of chemists. Pickering would have none of this theory; his work lay at the other end of the scale among strong solutions and powerful electrolytes, and he saw solution as a process of association with formation of hydrates. In a voluminous paper published by the Chemical Society in 1889 he examined with an extraordinary wealth of detail the density, conductivity, heat of dissolution, heat capacity, and expansion of mixtures of sulphuric acid and water, demonstrated breaks of continuity in the graphs representing these properties, and isolated definite hydrates to match the breaks.

Controversy with the supporters of the ionic hypothesis grew intense, for Pickering was turning out an enormous volume of experimental work, and was standing for his hydrate theory almost *Athanasius contra mundum*. Between 1889 and 1896 he printed no fewer than fifty-six papers on solution with the Chemical Society alone, many of them of great length, and involving a vast number of exact determinations, all of which were done single-handed and without assistants. The tide was, however, running against Pickering; he and Ostwald were looking at different sides of the shield; but, though Pickering's work has since fallen into its proper place, at the time it lacked that pragmatic justification of leading to discovery which made the dissociation hypothesis so generally acceptable to the chemists of the day. In disgust Pickering forsook chemistry, the rapid flow of papers ending abruptly in 1896.

Pickering, however, as a younger man had, in order to regain his health, put himself to work as a labourer on the Experimental Farm at Rothamsted, and thus acquired an interest in the application of science to the problems of the cultivator. He had as early as 1894 designed a series of experiments upon the growth of fruit, and had persuaded the Duke of Bedford to set up a trial garden at Ridgemount in Bedfordshire. Results soon began to appear and to arouse dissent; not easily did the practical fruit grower, accustomed to old grass orchards, accept the doctrine of the injurious effect of grass upon tree growth. This subject occupied Pickering to the end of his days; the complexity of the problem grew with extended knowledge; but Pickering maintained his first explanation that the grass roots excrete something specifically poisonous to fruit trees. Much other ground was broken—the effects of pruning, methods of planting and preparing the soil for planting, manuring, insecticides—there is no part of the fruit grower's routine on which Pickering did not inaugurate investigation.

The conclusions published from year to year and gathered together into a final volume, "Science and Fruit Growing," in 1919, have been the occasion of much controversy. The unsuitability of soil and situation, and some defects in management in the early years, hindered their acceptance, but the Woburn trials will remain as the most substantial contribution of the last hundred years to the study of fruit-tree development, one full of stimulus to new workers. His work on spray fluids led Pickering back to chemistry and his earliest interests—basic salts; after a ten years' silence papers began to reappear on such questions as the basic copper salts of Bordeaux mixture, on emulsions (with his strange discovery of a method of solidifying paraffin), and on quadrivalent copper salts.

In his horticulture, as in his chemistry, Pickering was essentially the amateur of genius; he often seemed to be careless of, and even but moderately equipped with, the knowledge that was common form, academic or practical. But he had a disconcerting habit of making discoveries which contradicted that common form. Either from policy or from temperament, he never disguised these antagonisms; where another man might have looked round to find hints and anticipations in previous experience, Pickering would say roundly, "All men who have hitherto expressed opinions on this point have been entirely wrong," even in such a matter as the way to plant a fruit tree. He loved truth, and he pursued it all his life like an artist, for the interest it had to himself; there was also something of the artist's disdain in the way he presented it to the world.

Never in robust health, an accident that deprived him of the sight of an eye probably helped to keep him out of general society, nor had he any of the ordinary man's amusements. At one time he used to walk a great deal with his inseparable companion, his wife, but he seemed to get most pleasure out of the company of a few friends in his Harpenden garden, and it is there, among his fruit trees, or indoors at his piano, that one will remember Spencer Pickering, handsome, imperturbable, a fine and rare presence among men.

A. D. H.

William Arthur Haward.

William Arthur Haward, who accidentally met his death on Monday, December 6, whilst making some final experiments in an important investigation upon gaseous combustion under high initial pressures, upon which he had been engaged during the past two years as a Salters' research fellow in the Imperial College of Science and Technology, was passionately devoted to the cause of scientific research. There is every reason to believe that, had his career not been thus so tragically cut short, he would at no distant date have achieved great distinction as a scientific discoverer. Even during the research which he was completing at the time of his death he had, by most skilful experimental work, discovered a series of facts which pointed to an important new fundamental development in the science of combustion. Indeed, the actual experiment upon which he was engaged when the accident occurred was intended to test a new theory which had been suggested to account for some of his remarkable experimental results. In due course, when the results of his research are published, the importance of them to science will at once be apparent. He undoubtedly laid down his life in the cause of science.

The various stages in Haward's all too brief, but very distinguished, career were as follows: Entering the Royal College of Science in October, 1912, he took the associateship two years later, and also his London B.Sc. degree with first-class honours in chemistry. He thereupon commenced a course of post-graduate study and research in the department of chemical technology, under the direction of Prof. W. A. Bone. It was soon apparent that he was unusually gifted as an experimentalist, for he made some remarkable experiments upon certain aspects of surface combustion, which have yet to be published. During two of his summer vacations, in the years 1915 and 1916, he made investigations under the direction of Dr. R. V. Wheeler at the Eskmeals Home Office Experimental Station upon (1) the propagation of flame in mixtures of hydrogen and air, and (2) the uniform movement of flame in mixtures of acetylene and air, the results of which were embodied in two papers that were published in the joint names of himself and two others (who had assisted him) in the Trans. Chem. Soc. for 1916 and 1917.

In June, 1916, Haward was elected to a Beit research fellowship tenable at the Imperial College, but this was relinquished some six months later in order to join the chemical staff of H.M. Explosives Factory, Gretna, where he remained until shortly after the armistice. He then obtained a Salters' research fellowship, with which, at his

own desire, he undertook the particular investigation which he was completing at the time of his death. Though a man of gentle disposition, and very modest in his demeanour, Haward undoubtedly was conscious in the right way of his experimental powers, which excited the daily admiration of those whose privilege it was to watch their rapid development. He had in a marked degree the instinct of the true artist, which was never satisfied with anything less than the best. He was twenty-six years of age, and was married only fifteen months ago.

ANOTHER Kew veteran has passed away in the person of JOHN READER JACKSON, who died on October 28 at his house at Lympstone, near Exmouth, Devon, aged eighty-three. Mr. Jackson was born in 1837 at Knightsbridge, but his family removed about 1843 to Canterbury, where he received his early education, returning in 1851 to school in London. Through the influence of Prof. Thomas Bell, then president of the Linnean Society of London, he was given charge of the museums at Kew, then in process of development under Sir William Hooker, and for nearly twenty years he discharged his duties single-handed, until in 1879 he received the help of an assistant. His work left him but little time for literary diversion, but we owe to him not a few contributions in applied botany in various journals, as in those of the Linnean and Pharmaceutical Societies, the *Technologist*, *Gardeners' Chronicle*, and the like. Mr. Jackson brought out a new edition of Barton and Castle's "British Flora Medica" in 1877, and in 1890 appeared his excellent "Commercial Botany of the Nineteenth Century." He was elected an associate of the Linnean Society in 1868, and was the senior on the list at the time of his death.

WE regret to record the death of DR. CHARLES INFROIT, late head of the radiological service at the Salpêtrière Hospital, Paris. The death of Dr. Infroit adds one more to the list of victims to X-ray dermatitis. A pioneer in the subject of X-rays in medicine, he was injured through over-exposure to the rays at a time when these dangers were not fully appreciated. Despite the disabilities by which he was handicapped, he made numerous contributions to the literature of the subject of radiology, especially from the diagnostic side. So recently as last year a paper appeared by him on the subject of concretions in the lung simulating the presence of a foreign body. A joint communication with Pascalis upon the surgery of the bones of the head appeared in the *Journal de Chirurgie*, 1912. Dr. Infroit designed and put into use a localiser of foreign bodies, which was used very considerably during the war; details of this instrument and the results obtained by its use may be found in the *Bulletin de l'Académie de Médecine*, 1915.

NEWS has just been received of the death of HOFRAT ALEXIUS MEINONG, on November 27, after a short illness, at the age of sixty-seven. Professor of philosophy at the University of Graz, to which he was appointed in 1889, Meinong was well known to philosophical students throughout the world by his important contributions to a special branch of study which he named "Gegenstandstheorie." His earliest published work was "Hume Studien," 2 vols., 1877. His principal work, and that by which he is best known, is entitled "Ueber Abnahmen," published in 1902, and a second edition of which appeared in 1910.

WE regret to announce the death, on December 13, at seventy-two years of age, of DR. ALEXANDER MUIRHEAD, F.R.S.

Notes.

THE position of scientific men employed in the Government service has long exercised the minds of scientific workers. The responsibility for the National Physical Laboratory and for the Geological Survey has been handed over to the Department of Scientific and Industrial Research. Kew is still under the Ministry of Agriculture and Fisheries. The Government Chemical Laboratory and the British Museum, with its Natural History Branch at South Kensington, remain distinct institutions for which the Treasury is responsible. All these institutions are largely concerned with the preservation and routine examination of specimens, testing, and the standardisation of methods, and do not serve solely for research. The Ministry of Agriculture has farmed out its research work to institutions such as Rothamsted, the Imperial College of Science and Technology, Cambridge and Oxford, etc.; it still retains, however, on its fisheries side a Research Division. Dissatisfaction has long been felt at the positions, rates of pay, and prospects of promotion in all these offices. Scientific men claim that the positions offered to them should be at least equal in rank, in prospects, and in pay to those offered in the regular Civil Service. The matter came up for discussion at the meetings of several Sections of the British Association at Cardiff. It was referred to the council of the Association, which has now unanimously passed the following resolution and forwarded it to the First Lord of the Treasury:—"That the council considers that no scheme of payment of professional scientific men in the service of the State is satisfactory which places them on a lower level than that of the higher grade of the Civil Service." It is clear that the Treasury must agree with this resolution if the services of scientific men of the first grade are to be obtained for research purposes.

IN addition to revolutionising the methods of wireless telegraphy and rendering possible the practical development of wireless telephony, the thermionic

valve promises to have a far-reaching effect on long-distance line telephony in furnishing a telephonic relay of remarkable powers. On long lines considerable difficulties are caused by attenuation of the current-waves and distortion of their form in transmission. Sufficient audibility could be obtained only by going to commercially impracticable expense in the provision of copper in the line, and sufficiently true reproduction of the wave-form for recognisable speech could be reached only by loading the line with artificial inductance to counteract its natural capacity. It is true that various forms of telephone relay have been experimented with from time to time in the endeavour to diminish the amplitude of the current-waves necessary to an extent which would bring the cost of copper within reasonable limits, and at the same time to lessen the troubles due to distortion, but until the advent of the thermionic valve no instrument was found which combined the requisite ratio of amplification with truthfulness of reproduction. A set of thermionic telephone repeaters working on an artificial cable circuit is being demonstrated at the office of the Western Electric Co. at 62 Finsbury Pavement, E.C.2, which represents the state of development arrived at by this company in conjunction with the American Telegraph and Telephone Co. It is interesting to notice in the next column of the *Times* to that in which appears the announcement of this demonstration an account of another example of the use of the thermionic valve in a wireless telephone demonstration between Geneva and London organised by the Marconi Co.

THE following are the lecture arrangements at the Royal Institution before Easter of next year:—Prof. J. Arthur Thomson, a course of lectures on The Haunts of Life, adapted to a juvenile auditory, to begin on December 30; Sir Gerald P. Lenox-Conyngham, two lectures on The Progress of Geodesy in India; Sir James G. Frazer, three lectures on Roman Life (Time of Pliny the Younger), London Life (Time of Addison), and Rural English Life (Time of Cowper); Dr. Arthur Keith, four lectures on Darwin's Theory of Man's Origin; Dr. W. A. Herdman, three lectures on Oceanography; Mr. F. Balfour Browne, two lectures on Mason Bees and Wasps; Dr. G. C. Simpson, two lectures on The Meteorology of the Antarctic; Dr. Percy C. Buck, three lectures on The Madrigal, with musical illustrations by the English Musical Singers; Prof. A. Fowler, three lectures on Spectroscopy; and Sir Ernest Rutherford, three lectures on Electricity and Matter. The Friday evening meetings will commence on January 21, when Sir James Dewar will deliver a discourse on Cloudland Studies. Succeeding discourses will probably be given by Sir Frank Benson, Dr. A. D. Waller, Dr. F. W. Aston, Mr. Solomon J. Solomon, Dr. John Buchan, and Sir Frederick Bridge, among others.

THE meeting of the American Ornithologists' Union in Washington, D.C., on November 8–11, was one of the largest in the history of the union. The election of officers for 1921 resulted as follows:—*President:* Dr. Witmer Stone, Philadelphia. *Vice-Presidents:* Dr. G. B. Grinnell and Dr. J. Dwight, New York. *Secretary:* Dr. T. S. Palmer, 1939 Biltmore Street, Washington, D.C. *Treasurer:* Mr. W. L. McAtee, Biological Survey, Washington, D.C. The single vacancy in the council was filled by the selection of Dr. W. H. Osgood, of Chicago. The programme of nearly forty papers, five of which were illustrated by motion pictures, covered a wide range of subjects relating to North American birds, and also included papers on the birds of Argentina, Nicaragua, Peru, Europe, and Madagascar. In connection with the meeting an exhibition of drawings, paintings, and photographs of birds by American artists, supplemented by a series of prints showing the development of zoological illustration as applied to birds from the earliest times down to date, was arranged in the division of prints in the Library of Congress.

IN the House of Commons on December 8 Sir Philip Magnus asked the Prime Minister:—"Whether, having regard to the urgent necessity of securing for laboratory and other purposes a sufficient supply of the different kinds of glass used in the manufacture of optical and other instruments, and having regard to the importance of encouraging the production in this country of such glass, he will arrange for the introduction at an early date of a Bill prohibiting for a time, except under special licence, the importation of such varieties of glass and of such scientific instruments as may or can be produced in this country?" Sir Philip Lloyd-Greame, who replied, said that the President of the Board of Trade had stated during the debate on December 7 that the Government intends to introduce the Bill dealing with key industries, other than the dye industry, as the first measure next session.

THE four hundredth anniversary of the discovery of the Straits of Magellan is to be celebrated this month. According to the *Scientific Monthly* for November the festivities will centre in Santiago and Punta Arenas, where the occasion will be marked by the inauguration of several important public works, including port improvements, lighthouses in Smith Channel, and the laying of the foundation-stone of the University of Punta Arenas. Great Britain, Spain, Portugal, and the nations of America are to be invited to join Chile in the commemoration of the anniversary.

THE *Times* of December 15 publishes a communication from its Paris correspondent describing a paper read before the French Academy of Sciences on the use of X-rays for the examination of old paintings, and the message refers to a picture by an old Dutch master in which a woman had been painted in over the picture of a monk. There is, however, nothing new in the report given in the *Times*, and this particular application of X-rays was described and illustrated in NATURE of February 26 last (vol. civ., p. 699).

IN a letter published in NATURE of September 30 Mr. C. S. Garnett gave an account of some interesting mineral deposits which had been investigated by him in Derbyshire. It is now announced that three miles south of Matlock, near Wirksworth, Mr. Garnett has discovered a new deposit of fluorspar which is reported to be a mile in extent and 30 ft. in thickness.

THE thirty-third annual Report of the Bureau of American Ethnology for 1911–12, published in 1919, shows no evidence of the effects caused by the war on many scientific societies in Europe. The activities of American anthropologists continue unabated, and the format of the report, with its abundant illustrations, is fully up to the pre-war standard. One of the most important investigations carried on by the Bureau is the transcript by Mr. F. W. Hodge, the Ethnologist-in-Charge, of a series of inscriptions recorded by the early Spanish explorers on El Morro, or Inscription Rock, in the Zuni district, which have an important bearing on the early history of the Pueblo tribes. Opportunity was taken to explore an interesting Pueblo site in the Jemez Valley. It was the custom of the inhabitants to throw large stones into the graves of the dead, thus destroying the pottery deposited with the remains. Numerous fragments discovered will enable these jars to be reconstructed. It is satisfactory to learn that the progress made by Mr. W. H. Holmes in compiling his "Handbook of Archæology" has been satisfactory.

THE *Museums Journal*, recently compelled to double its price, has managed to set against this an increase in the number of pages and plates and the enlistment of high authorities in its staff of reviewers. The improvement seems particularly marked in the domains of art, archæology, and cultural anthropology. The educational use of museums has been much discussed of late by the Museums Association, and the December issue of the journal contains an article, "The Child and the Mummy," by Mr. Peart, Director of Education for the City of Winchester, who suggests ways in which the dead objects in a museum may be made more alive for younger pupils. He would permit some handling, would add colour to backgrounds and labels, would connect the demonstration with knowledge already possessed by the child, and would lay stress on the human associations of each specimen—the romance of collecting and so forth. In the same issue Mr. Charlton Deas pleads for "an Imperial Department of Illustrated Public Information"—the home propaganda of war-time continued in peace.

THE report on the Government Museum at Madras for 1919–20 has just been received. The new superintendent, Dr. F. H. Gravely, announces a large number of additions to the archæological collections, chiefly in the form of copper-plate grants. Among these the most interesting is a set of thirty-one found in an underground chamber at the temple of Tiruvēlāngādu, Chittoor district, and recording the grant to that temple of the village of Palaiyanūr by King Rājēndra-Chōla in A.D. 1016. A sword-fish, *Histiophorus brevirostris*, 5 ft. 1 in. in length, has lately been procured. The specimen 4 ft. 4 in. long mentioned by F. Day ("Fauna of British India," Fishes, vol. ii., p. 133) has disappeared from the museum, and it would be interesting to know where it now is.

THE Wistar Institute of Anatomy and Biology (36th Street and Woodland Avenue, Philadelphia) issues abstract library cards, of standard size for card-catalogues, of all papers appearing in the *Journal of Morphology*, the *Journal of Experimental Zoology*, the *American Journal of Physical Anthropology*, and the six other periodicals which it publishes. Since the abstracts are distributed to subscribers before the appearance of the complete papers, they serve for preliminary notices as well as for permanent records. Individual investigators may find them useful, and societies compiling bibliographies in these sciences would save themselves trouble and expense by taking the complete series.

THE *Meteorological Magazine* for November states that forecasts can be obtained by communication with the Meteorological Office by telegraph or telephone to cover a period of twenty-four hours, also the state of the weather in various parts of the United Kingdom or the Continent. The Office is open day and night, including Sundays. The discussions of recent work of foreign meteorologists held at the Meteorological Office, South Kensington, which take place fortnightly during the winter months, and have continued since 1905, are now noticed in the magazine, and, indeed, for the first time in the public Press. The opening discussion this season was on "New Methods of Forecasting," based on two papers by Prof. Bjerknes. A record of 35,030 metres (22 miles) was alleged to have been established by a balloon at Pavia on December 7, 1911, but doubt is now thrown on the results, and it is suggested that the barograph was not working properly, which renders it probable that the greatest height attained was 18,900 metres—little more than one-half of the alleged height.

A NEW geographical journal has appeared in Italy. *L'Universo* is published every two months by the Istituto Geografico Militare in Florence, and is devoted mainly to researches in astronomy, geodesy, and cartography, but contains several articles on regional geography. The issues which have appeared maintain a high standard, and are well illustrated with plates and coloured maps. An article in No. 2 (March–April) gives a useful account of the Topographical Service of the Turkish Empire, and is illustrated with specimens and keys of the maps of various scales.

THE Meteorological Service of the Dominion of Canada is issuing a series of monthly weather charts. Each chart shows the mean temperature, the difference from the average mean temperature, and the total precipitation of the month throughout southern Canada. The highest and lowest temperatures at various stations are given in tabular form. Weather and agricultural reports for nearly 100 stations are added. There are also notes on the probability of gales on the Great Lakes in the month of publication.

THE problem of determining the forces which will act on a part of an actual aeroplane when in flight by observations on a model in a wind-tunnel is a very difficult one. An attempt at a solution of part of the problem has been made at the Bureau of Standards at Washington by Mr. H. L. Dryden, to whose work Scientific Paper No. 394 of the Bureau

is devoted. By measuring the distribution of pressure on the surface of a cylinder with its axis at right angles to the wind-stream in a tunnel, Mr. Dryden shows that the decrease of pressure at the back of cylinders of small diameter is greater in proportion than the increase in front, and that, in consequence, the distribution of velocity is not similar about cylinders which are "dynamically similar"—that is, for which the product of the diameter, the speed, and the reciprocal of the dynamical viscosity of the wind has the same value. After showing that the size of the wind-tunnel, the effects of the guards, and of the gap between them and the cylinder cannot explain the difference, Mr. Dryden concludes that it is due to some unknown property of the air in the vortex motion behind the cylinder. He proposes to test this by taking photographs of this portion of the moving air.

THE second Report of the British Scientific Instrument Research Association, covering the work of the association from July 1, 1919, to June 30, 1920, is interesting reading. It is a striking example of the importance of applying scientific research and knowledge to the comparatively small things in life. The staff of the association, whilst preparing for a number of important researches, has been carrying out a series of investigations which, whilst small in themselves, are of importance to the scientific instrument industry. A polishing powder and some abrasives have been developed which have desirable properties, and which, it is hoped, will be manufactured commercially in this country. A research into tissue-papers has resulted in a specification which will enable opticians to obtain paper in which optical glass may be wrapped without tarnishing the glass. The association has produced a solder, fusing at a temperature of 195° C., capable of being used with aluminium, and this in itself is no small achievement. The report impresses the reader that every effort is being made to get into close touch and co-operation with other research organisations, such as the National Physical Laboratory, and at the same time the requirements of the users of scientific instruments are being continually studied. The future work of the association will be eagerly awaited by all makers and users of scientific instruments.

THREE papers on notched-bar impact tests were read at the Institution of Civil Engineers on November 30. The paper by Messrs. T. E. Stanton and R. G. C. Batson gives particulars of a series of tests made at the National Physical Laboratory with the view of investigating (*a*) the effect on the work of fracture and the consistency of the results obtained of a variation in the angle and sharpness of the notch in 10 mm. by 10 mm. specimens, and (*b*) the sensitivity of the various types of **V** notch in revealing faulty heat treatment. It was found that the shape of the bottom of the notch has an important effect, and the work of fracture has least value when the angle at the bottom of the notch is as nearly zero as can be obtained. Variations in the results of individual tests are not inherent in the method of test, but are due to a lack of homogeneity in the material. M. Charpy has found that by taking extraordinary care in heat treatment to ensure homogeneity it is possible to obtain a degree of uniformity in the results of notched-bar tests which is higher than any other mechanical test to which the material can be subjected. The National Physical Laboratory tests indicate that the 10 mm. by 10 mm. specimen developed by the Aeronautical Inspection Directorate, having a 45° notch with a radius of 0·25 mm. at the bottom, is as effective in the detection of faulty heat treatment as the Charpy specimen. Other tests on the dimensional effect with specimens of varying sizes indicate that the value of the impact test, as at present understood, lies not in discriminating between the impact resistances of different materials, but as a means of ensuring that the impact strength of any given material is at its highest. The paper by Messrs. R. H. Greaves and H. Moore also deals with notch radii, and that by Messrs. R. M. Jones and R. H. Greaves discusses tests made with the view of investigating the effect of overstrain.

THE use of wire-rope conveyors of the class having more than one rope has hitherto been restricted. This is owing to the fact that it has been the practice to attach the ends of the slats or their mechanical equivalents to separate ropes. Since it is not possible to splice separate endless ropes so that they shall all be of exactly the same length, strains are set up in the working which are fatal to success. This objection has been obviated in the Roe cable conveyor—described by Mr. G. F. Zimmer in *Engineering* for November 19—by fixing one end only of the slats or transverse carrier-bars to one endless rope, and the other end merely rests upon the other rope or ropes without being attached thereto. Thus two or more endless ropes of differing lengths may be used to provide a satisfactory support for the conveyor slats. In the conveyor illustrated in the article the total length is 1800 ft., and the difference in altitude between loading and unloading points is 15 ft. Ten brake-horse-power is required to drive the conveyor under full load at 150 ft. per minute. It is of interest to note that the invention owes its existence to the requirements of the War Office.

SOME particulars of the canal now under construction by the Hydro-Electric Power Commission of Ontario, Canada, are given in *Engineering* for December 3. The canal, which is said to be the largest for water-power purposes in North America, is about 8·5 miles long, and involves the removal of about 19,000,000 cubic yards of earth and rock. Water will be taken along the Welland River for about 4·5 miles from Chippawa, and thence through the canal proper to Queenston at the edge of the cliff marking the limit of the Niagara River Gorge. The power-house will be located at Queenston, where the net head available will be 305 ft. The actual difference in level between Lakes Ontario and Erie is 326 ft., and the present power plants at Niagara utilise heads of 150 ft. to 200 ft., which is the height of the falls alone. The additional fall in the new scheme is obtained by using a site beyond the rapids. The canal is designed to carry sufficient water to generate more than 400,000 h.p.

THE Journal of the British Science Guild for November contains an account of the annual meeting held in June last, when addresses were delivered by Lord Sydenham (the retiring president), Lord Montagu of Beaulieu (his successor), and others. Since then the Guild has lost by death its founder, Sir Norman Lockyer, and a past-president, Sir William Mather. In the account of the administrative activities of the Guild attention may be directed to the contribution by Dr. J. W. Evans, chairman of the Committee on the Utilisation of Science in Public Departments. Some interesting evidence of the results of undue centralisation in various Departments has been collected, and the need for a Royal Army Scientific Corps, with which should be associated a special research institution, is strongly emphasised. It is interesting to observe that the Admiralty now possesses a Scientific Research Department, and a specially contributed account of this new organisation appears in the Journal. Among recent papers on the Guild's objectives reference may be made to "The Human Factor in Industry," by Mr. Alexander Ramsay. An account is given by Prof. C. S. Myers of the work of the Institute of Industrial Psychology, which he represents as a *liaison* member on the Guild's executive committee. It is stated that the catalogue of British scientific and technical books in preparation by the Guild is now complete, and contains about 6000 titles. The scheme of forming provincial groups of the Guild appears to be making progress, the first local committee having been already set up in Aberdeen, with Prof. Alex. Findlay as secretary.

A COMPREHENSIVE and valuable catalogue (No. 408) of works relating to South Africa has just been circulated by Mr. F. Edwards, 83 High Street, Marylebone, W.1. It contains upwards of 700 titles. Many of the volumes are rare and difficult to obtain. Among the items offered for sale is the Godlonton correspondence—Sir Harry Smith: "A Collection of Fifty-one Autograph Letters, Signed, to the Hon. R. Godlonton," mostly marked "Private" or "Confidential," and wholly unpublished. The catalogue is one to be seen by librarians and others interested in the development of South Africa.

PROF. J. F. DOBSON, professor of Greek in the University of Bristol, and Dr. S. Brodetsky, lecturer in applied mathematics in the University of Leeds, have nearly completed their translation of the "De revolutionibus orbium celestium" of Nicholas Copernicus. The translation will be accompanied by a Life of Copernicus and some account of his influence and the history of the views connected with his name.

Our Astronomical Column.

TIDAL FRICTION AND THE LUNAR ACCELERATION.—Mr. G. I. Taylor contributed a paper to Phil. Trans., A, vol. ccxx., on tidal friction in the Irish Sea, from which it appeared that fifty Irish Seas would provide sufficient dissipation of energy to account for the secular acceleration of the moon. Dr. H. Jeffreys returns to the subject in Phil. Trans., A, vol. ccxxi., examining the various seas where such action is probable, and obtaining details of tides and currents from Admiralty publications. The seas that contribute most are largely enclosed, but an opening is required sufficient to admit the tide. The Mediterranean, Red, and Baltic Seas are thus excluded. Bering Sea is by far the largest contributor. It is concluded that two-thirds of the total action takes place there. The Yellow Sea, Malacca Strait, and the American North-West Passage come next. The famous tides of the Bay of Fundy contribute somewhat less than the Irish Sea.

The total rate of dissipation of energy is $2{\cdot}2\times10^{19}$ ergs per second. Taking the excess of the moon's secular acceleration above the portion due to diminution of eccentricity of the earth's orbit as 9″ per century per century (equivalent to $4\frac{1}{2}$″ on the usual erroneous method of measuring by space gained instead of velocity gained), the equivalent dissipation is $1{\cdot}4\times10^{19}$ ergs per second. It is noted, however, that several of the data used were spring-tide values. Allowing for this, the agreement is quite as good as could be expected. It is the first time that a satisfactory estimate of the tidal friction has been made, and the author notes that it seems capable of satisfying all the quantitative demands made on it. He had previously expressed doubts on this point, but he had not then realised that the land-locked seas, not the open ocean, were the chief contributors.

Dr. Jeffreys also notes that the diurnal tides have a slight effect on the obliquity of the ecliptic, reducing it to $1/e$ of its original value in about 10^{10} years. The effect within historic times would be quite inappreciable.

THE SOLAR SPECTRUM FROM 6500 Å. TO 9000 Å.—Vol. vi., No. 3, of the Publications of the Allegheny Observatory contains an investigation of the red and infra-red region of the solar spectrum made by Mr. W. F. Meggers using plates stained with dicyanin and a large plane grating lent by the Johns Hopkins University; it was ruled by Prof. J. A. Anderson, and has 15,000 lines to the inch. The spectra of the opposite limbs of the sun were photographed in juxtaposition, the Doppler effect thus produced serving to distinguish solar and telluric lines. A large number of the latter are assigned (some tentatively) to water-vapour. The region 6500 to 7300 overlaps Rowland's table, the two tables being printed side by side. This region contains 473 solar lines and 596 telluric lines, while the region 7300 to 9000 contains 495 solar and 838 telluric lines. The infra-red spectra of many of the elements are still uninvestigated, but more than half of the solar lines in this region have been identified. In particular, the evidence for the presence of potassium in the sun is strengthened; besides the line at 4044 already known, lines are found at 7664 and 7699. The former partly overlaps a strong line in the A band of oxygen (telluric), but the Doppler effect permits it to be seen separately. There is a general absence of elements with high atomic weights; in explanation of this a sentence is quoted from Abbot's "Sun" (p. 253) stating that these elements would probably lie at too low a level for their lines to be seen at the limb. Seven elements (rhodium, ruthenium, palladium, gallium, europium, helium, and oxygen) are added to the thirty-six solar elements in Rowland's list. Oxygen is shown by the lines 7771, 7774, 7775, and 8446 (doublet); these lines have Doppler displacements.

Anthropology at the British Association.

ON the whole, the proceedings of Section H (Anthropology) at the Cardiff meeting may be counted as successful. The number of papers presented was fewer than usual—several contributors were obliged to withdraw at the last moment—nor did they all offer the opportunity for discussion which normally has been a prominent feature in this Section. There were, however, a number of communications of importance, and the attendances were good, notwithstanding the comparatively small number of members at the meeting.

Turning to the consideration of the chief communications in detail, attention may be directed to Prof. F. G. Parsons's paper entitled "The Modern Londoner and the Long Barrow Man," which was mainly a criticism of conclusions arrived at by the president of the Section (Prof. Pearson) and the late Dr. Macdonell. In a paper published some years ago the latter had given it as his view that the modern Londoner approximated to the type of the Long Barrow man. Prof. Parsons had examined skulls of Londoners of the eighteenth and nineteenth centuries, the Rolleston and Thurnham Long Barrow skulls, and numerous Anglo-Saxon and Mid-European skulls. As a result he maintained that when the modern Londoner departs from the Anglo-Saxon type it is in the direction of the Alpine folk rather than in that of the Long Barrow folk. An interesting fact which had emerged in the course of the investigation was that broad-headedness appeared to be on the increase in the modern population.

Prof. H. J. Fleure summarised the results of his investigation of the Welsh physical type. He finds that there are nine distinct physical types in Wales, and that, generally speaking, the Welsh people show more long-headedness and more dark pigment and are of shorter stature than the English, but that both are a complex mingling of different breeds.

A paper of great importance in the elucidation of problems of the early ethnology of the Mediterranean area was offered by Mr. L. H. Dudley Buxton. His communication "On the Physical Anthropology of Ancient Greece and Greek Lands" was based upon a study of the cephalic index, stature, upper facial index, and pigmentation of the modern population, and a comparison with the scanty early material available. The mean cephalic index varies from 79·20 in Crete to 87·51 among the Bektash of Lycia. The modern Greeks are slightly more brachycephalic than the ancient inhabitants of the same places. In Crete it would appear that there had been an immigration or extension of long heads in early times, which was later supplanted by a mixed round- and long-headed population. Tentatively he concluded that (1) the cranial index shows sufficient variety to suggest ethnic admixture; (2) this admixture has not been evenly distributed, and local and distinct sub-races have been formed; and (3) the admixture is early, possibly Neolithic in Leukas, and Bronze age (or earlier) in Cyprus or Crete. In regard to stature, large numbers are available from Crete and Cyprus only, but the same conditions appear to make for heterogeneity; the modern stature appears to be slightly greater than the ancient; but, owing to the small numbers represented, caution is needed in ascribing high or low stature to any race in the area. At both boundaries of the Greek world there are two racial types of comparative homogeneity; the intermediate people, who present local divergences, are very variable. The Greeks are a combination, probably early, of Alpine and Mediterranean stocks.

Miss Tildesley, in a communication on the Burmese skull, established by means of a co-efficient of racial likeness that the Burmese skull is closely akin to the Malayan and less closely to the Chinese, while being widely removed from the Caucasian type.

In Ethnography Dr. W. H. R. Rivers, in a communication on the statues of Easter Island, suggested that these may represent the hypertrophy of one element in an association similar to that found in San Christoval, where stone images represent the dead chief buried in the pyramidal structure with which the images are associated. The presence of this hypertrophy in Easter, Pitcairn, and Lavaivai Islands suggested that immigrant workers in stone thus obtained a means for the expression of religious and artistic impulses to which the fuller life of the larger islands of Polynesia and Melanesia gave other outlets. The crowns of red vesicular tufa, he held, represented hats rather than hair, either natural or in the form of wigs, as has been suggested, and might be compared with the hats which are prominent symbols of the dead in Melanesian societies which practise the ghost cult.

Capt. L. W. G. Malcolm dealt with the anthropogeography of the Cameroons, and in particular with that of the area in which the Bantu-speaking peoples came into contact with the Sudanese; and Prof. E. H. L. Schwarz described certain elements in the culture of the Ovambos, to which he endeavoured, upon somewhat slender evidence, to find analogues in the customs of early historical races which were in contact with Africa.

A very successful afternoon session was devoted to primitive music, with special reference to Wales. Dr. H. Walford Davies, in a paper on "Euphony and Folk Music," pointed out that the pentatonic scale, the simplest known form, which recurs all over the world, epitomises the simpler tone-relationships, and is the basis of the Dorian mode, in which so much of the British folk-music is written. Dr. J. Lloyd Williams, in describing Welsh national music, pointed out that while a considerable body of the music shows the influence of the harp, in vocal music, of which an unexpected wealth had recently been discovered, a considerable proportion was in the Dorian and other modes. Of traditional lyrics the best were the very numerous penillion; these, and the singing of penillion according to North Wales style, constitute unique features in Welsh song.

Archæological papers furnished the most interesting section of the programme. Prof. W. M. Flinders Petrie described recent discoveries of the British School in Egypt, which included a series of tombs of every variety of type of the First to Third Dynasties; the tomb of the royal architect of King Senusert II., whose gold uræus was found in his pyramid; and a large alabaster jar with a magic inscription to provide all offerings required. Three inscriptions of the Twelfth Dynasty, in alphabetic signs, show that the prehistoric system of personal marks had by that time grown into regular writing, independent of any Semitic system.

Mr. P. E. Newberry, in his communication "Early Egypt and Syria," suggested that the parent culture of the early civilisations of the Nile and the Euphrates should be sought in Syria. The ox, the sheep, and the goat were introduced into Egypt through Syria, and the crook and the flail, the royal insignia of dynastic Egypt, were both of Western Asiatic origin, the former being the crook of the goatherd, and the latter, it was suggested, an instrument used by goatherds for gathering ladanum from the cistus bush, which was not found in Egypt. The cults of

the *neter*-pole and the *ded*-column, both of which were originally coniferous tree-trunks, must have been of Syrian origin. The traditional home of Isis and Osiris was between Byblos and Damascus, and there the vine and wheat and barley grew wild. The Egyptian house was obviously derived from a wood-built dwelling, and both Egypt and Babylon are known to have drawn their timber from the Lebanon area.

Mr. R. Campbell Thompson, in a paper on "Prehistoric Dwellers in Mesopotamia," maintained that a proto-Hamitic section of the Mediterranean race which migrated at an early time into Arabia was the forerunner of the Semitic peoples.

Mr. S. Casson described the recent excavations at Mycenæ of the British School of Archæology at Athens, which had been carried out in the light of a reconsideration of Schliemann's discoveries. The Grave Circle, as well as a stratified platform of earth outside the Acropolis, the site of a part of Mycenæ in the period 2000–1500 B.C., showed traces of a Bronze-age civilisation, and even of Neolithic remains. It seemed certain that there was a continuous mainland civilisation stretching back at least to the beginning of the second millennium B.C. In the replanning of Mycenæ by the later kings, such as Atreus, by whom the Lion Gate and the Acropolis wall were built, the burial-ground of their forerunners was enclosed by the Grave Circle. This was used as an ossuary, outlying graves being cleared and their contents placed within the circle.

Mr. Joseph S. S. Whitaker's paper on "Recent Anthropological Research at Motya" described the remains brought to light on the Island of San Pantaleo, on the north-west coast of Sicily, which is undoubtedly the site of the ancient Phœnician colony of Motya, and, owing to its complete and sudden overthrow in 397 B.C., probably shows more remains of an old Phœnician town than any other known site. Excavation has revealed that the island was originally fortified by a wall all round, and the north and south gateways have been discovered. The north gate consists of an outer gateway formed of two apertures, recalling the Athenian Dipylon Gate, and a second, twenty-two metres behind it, of six apertures in pairs. In a cemetery—the first to be discovered—the prevailing method of disposal of the dead was incineration, although in the later cemetery on the adjacent mainland inhumation was chiefly practised. One burial-place belonging to the last period contained only the remains of animals, mostly ruminants, in single urns. An interesting mosaic pavement showed a combination of Phœnician picture-panels and Greek decorative borders.

Signor G. Bagnani dealt with the results of recent archæological investigations in Rome, some of which had not hitherto been described, including the Roman basilica at Porta Maggiore, the tomb on the Via Ostiense, and the tombs found under the Church of San Sebastiano.

Dr. T. Ashby, in a joint communication by himself and Mr. Robert Gardner, described further observations of the Roman roads of Central and Southern Italy, in particular of the Via Valeria, through the Abruzzi, the Via Latina, and the Via Cassia, through Etruria. An attempt to trace the Via Herculia between Venusia and Potentia was unsuccessful.

Mr. G. H. Garfitt's paper on a recent discovery of rock sculptures near a stone circle in Derbyshire described cup- and ring-markings and two sculptured stones found near the circle on Eyam Moor. On the latter are represented a deer-horn pick and a plough. A comparison with dolmenic sculptures in Brittany suggests an association with the Ægean goddess of fertility, whose cult may thus have extended to Derbyshire. Mr. MacRitchie brought forward evidence to show that early references to Greenland must be taken to denote some European country, probably the area between West Sweden and the Urals, and indicated the bearing of this conclusion on European ethnology. Mr. Kidner described certain round barrows in the New Forest which do not conform to the three standard types; and Mr. Willoughby Gardner described his recent excavations in the Dinorben hill-fort near Abergele, which had fully confirmed previous conclusions as to the character and construction of the fort.

An afternoon session was devoted to an expedition to the site of the Roman city of Venta Silurum at Caerwent under the guidance of Dr. T. Ashby, who was in charge of the excavations carried out with the assistance of the Association on that site some years ago. As a preliminary to the excursion Dr. Ashby also gave the Section an account of the results of these excavations. E. N. F.

Smoke Abatement and Housing Schemes.

A SUPPLEMENT to the *Lancet* of November 20 contains the annual report of the Advisory Council on Atmospheric Pollution for the year April, 1919–April, 1920. The number of stations sending in full returns is nineteen, of which fifteen are divided between London and Glasgow, the other four being Malvern, Rothamsted, Southport, and St. Helens.

It will be seen that the number for the whole country is very limited, and some of the dirtiest industrial centres, where a comparison of the conditions of the atmosphere from year to year might be of some advantage to the local authorities, are entirely unrepresented. This arises, no doubt, partly from the complete indifference shown in many localities to the smoke nuisance, and partly from the troublesome and tedious analytical method of estimating atmospheric impurities. Something in the way of an automatic recorder or an apparatus not requiring much supervision would probably induce many places which at present send in no returns to adopt the system.

It should be pointed out that the Council fully recognises this desideratum, and the report shows that a considerable amount of research has already been carried out with no little success in simplifying the apparatus for recording both solid and acid impurities. That the prevalence of the latter impurity is the main factor in the disintegration of the stonework of many of our ancient monuments has been proved beyond question, and some check on the quantity is a matter of great importance.

It is to be presumed that it is no part of the Council's business to advance the cause of smoke abatement apart from the registration of statistics, yet it seems to us that a systematic propaganda against smoke pollution might form a useful adjunct to its other activities.

Under the new housing schemes emanating from the Ministry of Health an opportunity is offered for the erection of houses in such a way as to diminish considerably the output of smoke, and, in fact, under the auspices of the Ministry a Committee was summoned to inquire into and report on the subject. The report of this Committee was issued some months ago, but it appears from a statement made in the House of Lords by Lord Newton, chairman of the Committee, that neither the Department for which it was prepared, nor the local authorities for the benefit of which it was issued, appear to have paid any attention to its practical application.

We would suggest, therefore, that the various

schemes referred to in the report, and generally approved by competent persons, should be taken up by the Advisory Council on Atmospheric Pollution, who should bring it before the notice of the public in the form of active propaganda. It seems useless to make yearly records of air pollution when no serious steps are being taken, publicly or privately, to diminish the evil. J. B. C.

Work of the Analytical Laboratory, Cairo.

SEVERAL features of more than passing interest are shown in the undermentioned report.[1] Covering as it does the period of the war, it chronicles work—such as the making of special incendiary bombs and chemical igniters for flares—which is rather unusual for the analytical laboratory, but is an indication of versatility in time of need. Passing, however, to more normal activities, with a bare mention of the excellent routine work done, it is interesting to note that research has taken a definite place in the programme of the department; the authorities are evidently alive to the importance of encouraging the application of chemistry to arts and manufactures. Thus an investigation of Egyptian crude petroleum has been made, the results of which have proved that good yields of Diesel fuel-oil can be obtained from this source, besides the customary petroleum spirit and kerosene, and a pitch which will be invaluable for road-making. A Government refinery to deal with this crude petroleum is to be erected at Suez.

An inquiry into the possibility of cement manufacture in the Sudan was also undertaken. As a result a cement factory is now being constructed at Makwar, where 50,000 tons of cement per annum will be made; the fuel difficulty has been overcome by using a mixture of locally made charcoal and imported coke.

Among the chemico-legal cases dealt with was an interesting one in which a claim was made against the Government for land valued at about 16,000,000*l*. Unfortunately for the claimant, however, it was found that out of the 168 documents on which the claim was based no fewer than 163 were forged.

It is noted that an entirely new method of assaying gold has been devised, whereby the Assay Office was enabled to cope with a very considerable increase of work resulting from the new assay law, which provides for the compulsory hall-marking of gold and silver. The report indicates useful work and steady progress.

The Problem of Soaring Flight.[2]

THE source of energy used by birds in soaring flight is not yet clearly known. Attempts have been made to achieve this form of flight artificially, and, according to Gustav Lilienthal, a flight of 500 metres up wind, in which a height of 40 metres was attained, has been made by a man-carrying glider not provided with a motor, but having wings constructed on the pattern of those of a soaring bird.

The extraordinary regularity with which cranes, when flying in a group, keep their distances from one another affords a proof that such soaring flight is either due to undiscovered wing-movements or to some condition of the air which is widely and uniformly distributed. The observation that certain dragon-flies, and also flying-fishes, employ soaring flight has led to discoveries that throw a new light on the subject. Dragon-flies can adjust their abdomens and hind-legs, and flying-fishes their pelvic fins, in such a way that these organs act as a brake to check speed when flying. The brake is used in certain conditions in continued flight to keep their speed at a required minimum. This use of an air-brake yields a proof that these instances of soaring flight are not due to undiscovered wing-movements. Dragon-flies habitually avoid ascending currents when in soaring flight so long as the sun is shining. If isolated clouds are crossing the sky these insects collect in the neighbourhood of a convenient ascending current, entering it whenever the sun is obscured, and gliding beyond its range so soon as the sun comes out. That soaring flight is not due to the lifting effect of lateral gusts is proved by the fact that the flying-fish when at highest speed carries its wings inclined so that the wing-tips are on a lower level than the body. In this case, if lateral gusts were operative, their only effect would be to drive the fish under water.

Certain facts suggest that turbulent motion is, in some unknown way, the source of the energy of soaring flight. But light objects, such as feathers or aerial seeds, may be seen floating in the air in the neighbourhood of soaring birds, and exhibiting only slow and equable movement. What form of turbulent motion can be imagined that enables a bird weighing 10 lb. or more to glide without effort to a height of 2000 metres or to travel horizontally for indefinite distances at a speed of 50 miles an hour, and yet is unable to disturb the course of a piece of thistledown? Thus the facts of the case appear to offer insuperable difficulties to all theories that have hitherto been put forward as an explanation of soaring flight.

University and Educational Intelligence.

CAMBRIDGE.—The proposal to admit women to membership of the University on equal terms with men was rejected on December 8 by 904 votes to 712. The next step, presumably, will be a vote on Report B, the alternative proposal offered by the recent syndicate. This is, in effect, a suggestion on the part of the University that it would welcome the foundation of a separate University for women at Cambridge, and would extend to it the same facilities for educational purposes as are at present offered to the members of Girton and Newnham Colleges. This proposal does not in any way meet the greater number of the difficulties that were raised in connection with the rejected scheme, in particular the question of numbers and accommodation. It has already been rejected by the women's colleges, which have declared that they have no intention of taking action in the matter of forming a separate University even if Report B is passed. Already three of the six signatories of Report B have, in a sense, abandoned it for some scheme which shall more nearly meet the women's needs, a scheme the details of which have yet to be worked out. It does not look as though the adoption or rejection of Report B by the University will bring the problem nearer to an agreed settlement. In the interests of the University as a whole, and of the women's colleges in particular, an early settlement must be reached, and it looks as though the next move must lie with "the party of thirteen," who have in view a scheme which will give the women the full privileges of membership of the University without any control over the men's education. If they take early and effective action they may be able to justify

[1] "Report on the Work of the Government Analytical Laboratory and Assay Office, 1913–1919." (Ministry of Finance, Egypt.)

[2] Abstract of a paper by Dr. E. H. Hankin and F. Handley Page read before the Cambridge Philosophical Society on November 22.

the vote of last Wednesday; otherwise, this vote must bring a reaction which may, in due course, sweep much farther than the original proposals.

Mr. J. Gray, fellow of King's College, has been elected Balfour student.

LONDON.—Mr. F. R. Fraser has been appointed for a period of four years as from October 20 last to the University chair of medicine tenable at St. Bartholomew's Hospital Medical School. In 1912 Mr. Fraser was appointed assistant in medicine at the Rockefeller Institute for Medical Research in New York, and two years later instructor in clinical medicine at Columbia University. During the war he served with the R.A.M.C., and on demobilisation was appointed assistant director of the Medical Clinic and assistant physician at St. Bartholomew's Hospital. He is the author of publications on electrocardiographic changes and acute poliomyelitis.

OXFORD.—Mr. R. T. Gunther, fellow and tutor of Magdalen College, has been elected by that college to a research fellowship in order to continue his researches on land levels in the Mediterranean. A science tutorship at Magdalen will thus become vacant, and it will certainly be acceptable to biologists in Oxford if another biologist be elected to succeed Mr. Gunther. Magdalen College has long been favourably distinguished for the support it has given to scientific study and research, especially in subjects connected with the sciences of life.

PROF. J. C. IRVINE, professor of chemistry in the University of St. Andrews, has been approved by the King, on the recommendation of the Secretary for Scotland, as Principal of the University in succession to the late Sir John Herkless.

APPLICATIONS are invited by the council of Bedford College for Women, Regent's Park, for a scholarship in sociology tenable at the college for two years, and of the yearly value of 80*l*. Candidates must be women holding a university degree or its equivalent. The latest date for receiving applications is January 15.

THE Association of Science Teachers will hold a general meeting on Tuesday, January 4, at University College, London, when the presidential address will be delivered by Miss M. B. Thomas, Girton College, and a lecture on vitamines will be given by Dr. J. C. Drummond, reader in physiological chemistry, University College. The hon. secretary of the association is Miss E. M. Ridley, 10 Gresley Road, London, N.19.

THE Salters' Institute of Industrial Chemistry has awarded five fellowships for post-graduate study in the laboratories indicated:—Mr. A. H. Adcock (Liverpool University), Mr. J. A. Gentle (Oxford), Mr. S. J. Saint (Reading), Mr. C. B. Taylor (Imperial College of Science and Technology), and Mr. Donald Turner (Sheffield). Scholarships have been awarded to Messrs. M. D. Forbes and G. M. Lowe (Imperial College of Science and Technology), A. W. Pritchard and F. W. Turner (East London College). Forty-five grants in aid have been awarded to chemical assistants occupied in factories in or near London to facilitate their further studies

ANNOUNCEMENT has been made that four fellowships of 1000 dollars each have been established through a co-operative agreement between Yale University and the Bishop Museum of Honolulu, Hawaii. The fellowships are available for graduates of any institution, but are primarily designed for students who have already attained the degree of doctor of philosophy. Preference will be given to applicants who desire to carry on research in anthropology, botany, zoology, geography, or geology in Hawaii or other parts of Polynesia. Detailed information may be obtained from the Dean of the Graduate School, Yale University.

THE annual meeting of the Mathematical Association will be held at the London Day Training College on Tuesday, January 4. The programme includes the following papers and discussions:—Relativity, Prof. A. S. Eddington; Aeroplane Mathematics, Dr. S. Brodetsky; The Teaching of Mathematics to Boys whose Chief Interests are Non-Mathematical, the Rev. S. H. Clarke; Some Unsolved Questions and Topics for Research, Prof. E. T. Whittaker; Results of Visits Paid to Lycées of Paris and other Centres, and the Study of Education there, particularly from the point of view of Mathematics, Miss E. M. Read. January 17, 1921, will be the fiftieth anniversary of the first recorded meeting of the association.

PROF. DONNAN gave an interesting address on "The Finance of Research at Universities" at a meeting convened by the London branch of the National Union of Scientific Workers at University College on December 9. He said that scientific research must be financed mainly out of Treasury funds, and as the Treasury is influenced greatly by public opinion, it behoves scientific workers to create the right atmosphere. The Government, no less than the general public, is apt to overlook the fact that there are three equally important factors in the creation of wealth. Two of these, new knowledge and trained men to apply it, are the right products of the universities; increased production is not merely a question of the hours of labour of the manual worker. The nation has already reached a time of financial stress which will probably continue for another five years. Hitherto the Government has treated educational institutions as charities, to be given doles in times of prosperity, to be ignored at the call for economy. Unhappily, this attitude is unchanged, and the prospect of universities receiving the necessary financial assistance from the Treasury for research workers is a poor one unless the Department of Scientific and Industrial Research realises in time that this is the more productive field for cultivation, and unless those best equipped and best entitled to benefit by grants, viz. the junior teaching staffs, are aided to undertake research work instead of being forced by inadequate salaries to make ends meet in other ways. Prof. Donnan concluded by paying a tribute to the work of the Department of Scientific and Industrial Research in fostering industrial research associations, but expressed the doubt as to whether it would not have been the more profitable investment to have started with the university research workers.

ANYONE who understands the best possibilities of the kinematograph, or has seen some of the instructive films now available, must realise that the instrument may be made a very valuable educational aid. In scientific instruction, for example, the slowing down of ultra-rapid pictures enables movements to be analysed most clearly; or, on the other hand, a film may show in a few minutes the life-history of a plant or animal, and thus synthesise changes which may extend normally over several months. Whatever can be said in favour of the use of pictures in text-books can be applied with far greater force to the motion picture, for movement impresses itself upon the mind much more deeply than still-life. This is particularly true of geographical subjects, the aim of which is to give pupils clear ideas of the characteristics of countries and peoples in various parts of the world. It has hitherto been difficult to obtain

instructive films of this kind for exhibition except by applying to a number of different firms. The Macmillan Educational Film Co., Ltd., 32 Charing Cross, S.W.1, has now, however, made a collection of educational and scientific films which they are able to offer for hire. We have before us a list of such films relating to geographical, industrial, Nature-study, and other subjects, and a copy can be obtained by anyone upon application to the company. There are also lists of suggested programmes—one of a varied kind, and another in which geographical subjects are appropriately grouped together. It may be hoped that local education authorities will avail themselves of such assistance as is afforded by these lists to give a new character to kinematograph displays in local picture-houses. In the United States thousands of schools make use of the moving picture for educational purposes, and there is a great opportunity for its wise employment here when existing prejudices have been overcome.

Societies and Academies.

CAMBRIDGE.

Philosophical Society, November 22.—Prof. Seward, president, in the chair.—F. A. **Potts**: A note on vital staining. In studies which have been made on the penetration of neutral red into the living body of the soil nematode Diplogaster it is found that most of the stain makes its way through the mid-gut and none through the skin. In the mid-gut a zone of granules arranged peripherally round the lumen of the gut takes up the stain particularly.—W. F. **Lanchester** and A. G. **Thacker**: Preliminary note on the superior vena cava of the cat. Thirty cats were dissected to observe the point of entrance of the internal jugular, which in every case except one fell into the external jugular. Observations were also made on the length of the superior vena cava in twenty-one adult cats, and the length appeared to be varying round more than one mean.—Miss M. D. **Haviland**: Preliminary note on a Cynipid hyperparasite of Aphides. Charips (Cynipidæ) is a hyperparasite of Aphides through Aphidius (Braconidæ). The female pierces the Aphidius larva while the latter is lying inside the living Aphid, and deposits an egg within its body. The first-stage larva of the Cynipid is hypermetamorphic, with a thick chitinous skin and tail, but during development, which takes place within the Aphidius, the larva gradually assumes the form usual among parasitic Hymenoptera. Shortly before metamorphosis the hyperparasite leaves its host, the remains of which it devours, and its tracheal system becomes functional. It afterwards pupates within the cocoon previously woven by the Braconid.—Dr. E. H. **Hankin** and F. Handley **Page**: The problem of soaring flight (see p. 518).—Sir George **Greenhill** and Dr. G. T. **Bennett**: The rotation of a non-spinning gyrostat.—E. V. **Appleton**: A method of testing triode vacuum tubes. A dynamic method of measuring the slope of the principal voltage-current characteristic of a three-electrode thermionic tube is described.—W. B. **Frankland**: The astronomical bearing of the Einstein theory.—Dr. W. **Burnside**: The representation of the simple group of order 660 as a group of linear substitutions on five symbols. Except in the cases of two and of three variables, the explicit forms of groups of linear substitutions have been given only in a few cases. Thus it is hoped that the explicit forms in the case referred to may be of interest. The existence of a cubic three-spread, in space of four dimensions, admitting a group of 660 collineations into itself may be compared with the more familiar case of Segre's cubic three-spread which admits a group of 720 such collineations.

MANCHESTER.

Literary and Philosophical Society, November 2.—Sir Henry A. Miers, president, in the chair.—Dr. W. J. **Walker**: The polytropic curve and its relation to thermodynamic efficiency (with a note on the theory of the uniflow steam-engine). An inquiry made into the reason for the diminution of internal-combustion engine efficiencies when the value of n in the equation, pv^n=constant, for the compression line is reduced by water injection or other means.—W. H. **Pearson**: Notes on a collection of Hepatics from the Cameroons, West Coast of Africa. The collection, made by Mr. W. G. Travis from logs of ebony in the Liverpool docks, contained the following species: *Aneura Travisiana*, n.sp., Pears.; *Lophocolea Newtoni*, St.; *Mastigolejeunea . . . ?*; *Homalolejeunea excavata* (Mitt.), Sp.; *Ceratolejeunea Saxbyi*, n.sp., Pears.; and *Cheilolejeunea Principensis*, St. The type-specimens are in the Manchester Museum.

SHEFFIELD.

Faraday Society and Institute of Metals (Sheffield Section), November 19.—Afternoon session, Prof. C. H. Desch in the chair.—Dr. L. **Aitchison**: Electroplating for the prevention of corrosion. The paper dealt more especially with the protection of iron and steel and their alloys. The conditions for proper protective coatings were defined and the value of the various protective coatings was discussed with relation thereto.—W. A. **Thain**: Some applications of electrodeposition in aeronautical engineering. Three cases of the electro-deposition of copper were considered, viz.: (1) As a protection against carburisation in case-hardening practice; (2) as a means of increasing heat conductivity; and (3) as a means of building up a definite constructional detail.—B. **Carr**: The electrodeposition of cobalt. From a bath containing 4½ lb. of cobalt sulphate crystals, 5½ oz. of boric acid, and 2½ oz. of sodium chloride per gallon, and used at 34° C., excellent hard, adherent deposits of cobalt were obtained, provided that these were not too thick, with 150 and 72 amperes per sq. ft. for periods of immersion not exceeding 2 and 4 minutes respectively. The deposit is exceedingly resistant to atmospheric corrosion, and superior to nickel in the rapidity of deposition and hardness.—W. E. **Hughes**: The use of colloids in the electrodeposition of metals.—S. **Field**: The commercial electrolysis of zinc sulphate solutions. Commercial electrolysis aims at the maximum extraction of zinc with a minimum of energy. The greater the extraction the smaller the volume of liquor which circulates through the extraction plant, and the smaller the proportion of zinc which demands repeated purification. A limit to this extraction is set by the cost of increased energy necessary to take out zinc from dilute liquors. Current efficiency is dependent upon a number of factors, including current density, amount of zinc present, temperature, and the presence of impurities.

Evening session, Mr. E. A. Smith in the chair.—W. R. **Barclay**: Electro-silver plating and its technical development. This paper dealt with the history of technical investigation and research into the electro-deposition of silver so far as the more practical aspect of electro-plating is concerned. Emphasis was laid on the necessity for careful co-ordination of the factors of metal and free cyanide content to that of current density. It was shown that though considerable latitude is allowable in practice, the best results and highest efficiency lie within fairly well

defined limits. It was pointed out that silver solutions in existence more than sixty years still continued to yield excellent results, and that, generally, old solutions yielded better deposits at higher current densities than those newly made up from pure materials. This was due in a great measure to the presence of substances other than the simple double cyanide of silver and potassium, especially potassium carbonate.—G. B. **Brook** and L. W. **Holmes**: The chemical composition of old silver-plating solutions, with observations on their working properties. The paper dealt with a large number of solutions varying in age from one to fifty years, furnishing historical, chemical, and physical data with regard to each, and correlating the composition with the working properties in actual works practice.—F. **Mason**: A new maximum current density in commercial silver-plating. With a free cyanide content in excess of that usually advised, and with potassium carbonate in considerable quantities, not only can the current density be increased enormously, but the deposit is of an exceptionally fine texture and takes a high finish.—G. B. **Brook**: The crystalline structure of electro-deposited silver.—S. **Field**: The deposition of gold-silver alloys. A series of experiments has been carried out in order to trace the influence of varying conditions on the composition of the gold-silver alloys deposited in the well-known "green gold."

DUBLIN.

Royal Dublin Society, November 23.—Dr. F. E. Hackett in the chair.—Prof. H. H. **Dixon** and Nigel G. **Ball**: A determination, by means of a differential calorimeter, of the heat produced during the inversion of sucrose. The heat of inversion of sucrose in presence of invertase was determined by means of a differential calorimeter in which the temperature was measured with a sensitive thermocouple. Two vacuum flasks were employed, in one of which the reaction took place, while the other was used as a control, one junction of the thermocouple being in each flask. The enzyme solution was contained in a capsule of paraffined paper immersed in the sugar solution to secure that both were at the same temperature. In the control flask a similar arrangement was used, but the enzyme solution had been previously heated to 100° C. These capsules could be ruptured without opening the flasks. The temperature effects of dilution of the sucrose were eliminated by these arrangements. Stirring was effected by shaking the flasks. A value for the heat produced during the inversion of sucrose by invertase was obtained which agrees closely with that previously given by Brown and Pickering, the mean of the results being 3·83 calories per gram-molecule.

PARIS.

Academy of Sciences, November 22.—M. Henri Deslandres in the chair.—A. T. **Schloesing**: The separation of two salts having a common ion. In the preparation of ammonium nitrate from sodium nitrate and ammonium bicarbonate an aqueous solution of sodium nitrate and ammonium nitrate is obtained, from which the latter salt has to be extracted. Solubility curves of mixtures of these two salts have been worked out and are given in the paper and the mode of applying these to the problem is indicated.—E. **Imbeaux**: New systems of electric towing on canals. The haulage difficulties on canals with numerous locks, such as those of the Marne, Rhine, and the Sarre coalfields, are summarised, and a description is given of the systems at present in use.—E. **Ariès**: The heat of evaporation of a liquid at low temperatures. Reply to a note of M. G. Bruhat.—T. **Varopoulos**: Algebroïd functions and increasing functions.—J. **de Lassus**: The essential properties of pneumatic transmission in a closed cycle.—J. **Andrade**: The last perturbations of isochronism.—W. **Margoulis**: A new method of testing aerodynamic models in gas currents. In existing apparatus serious errors may arise, as it is impossible to observe the conditions required by the law of similitude. The author suggests the replacement of air by carbon dioxide at high pressures and temperatures, and gives formulæ showing the resulting reduction in the horse-power of the motor necessary for moving the gas.—Lord **Rayleigh**: The light diffused by argon. Remarks on a recent paper by M. J. Cabannes.—C. **Matignon** and M. **Fréjacques**: The transformation of ammonia into urea. The problem of the economical transformation of ammonia into urea is of undoubted technical interest, since it contains 47 per cent. of nitrogen as against 35 per cent. of nitrogen in ammonium nitrate, and it behaves as an excellent manure. An account is given of studies on the conversion of ammonium carbamate into urea.—A. **Muguet** and J. **Seroin**: The age of the autunites of Portugal. These minerals are of recent formation, and were formed between 1250 and 1900 years ago. The figures are based on the determination of the ratio of radium to uranium in the minerals.—G. **Denizot**: The stratigraphical position of the Montabuzard limestone.—A. **Rolland**: The existence of formations of ground called *rideaux* in Cantal.—R. **Souèges**: The embryogeny of the Urticaceæ. The development of the embryo in *Urtica pilulifera*.—A. **Chevalier**: The variations of the buds of cultivated trees and shrubs as a cause of decadence of old varieties.—J. **Barlot**: New colour reactions utilisable for the diagnosis of mycological species. The colour reaction with potash solution serves to distinguish between the poisonous *Mycena pura* and the variety *amethystina* of *Laccaria laccata* (edible). The same solution gives different colour reactions with *Gomphidius glutinosus* and *G. viscidus*.—P. **Dangeard**: Metachromatine and the tannic compounds of the vacuoles.—W. **Mestrezat** and Mlle. Marthe **Paul-Janet**: The comparative evaluation of the total nitrogen in urine by the methods of Dumas and Kjeldahl. The Kjeldahl method applied to urine gave only from 98·5 per cent. to 90·3 per cent. of the nitrogen found by the Dumas method.—A. **Damiens**: The toxicological detection of poisons containing bromine. An application of the methods described in previous communications for the detection and estimation of traces of bromine in animal tissues.—G. **Bohn** and Mme. A. **Drzewina**: Variations of sensibility to soft water of the Convoluta, according to the physiological states and the number of animals under experiment.—L. **Joubin** and E. **Le Danois**: Biological researches on the thermometry of the Atlantic off Ushant during the summer of 1920. The data obtained are represented on two diagrams, showing the distribution of temperatures in a section W.-N.W. through Ushant.—C. **Lebailly**: The conservation or disappearance of the virulence of apthous milk in the course of the manipulations following treatment. If the contaminated milk is allowed to stand for cream long enough for an incipient lactic fermentation to take place the virus is attenuated or destroyed, and young animals fed on such milk during an epidemic have either remained healthy or have had only a mild attack. When the milk is collected in large creameries and the cream quickly separated mechanically, the skim milk rapidly spreads the fever.

ROME.

Reale Accademia dei Lincei.—(Communications received during the vacation.)—G. **Fano**: Surfaces of the 4th order with infinite discontinuous groups of birational transformations, ii.—C. **Crema**: Deposits of bauxite in the Apennines, Istria, and Dalmatia (with illustration of section).—C. **Artom**: Biology and systematics of the genus Artemia, ii.—M. **Genna**: Nutrition of *Anopheles claviger*. The male feeds only on sweet juices, but the female also requires to suck blood before it can lay its eggs. The processes of digestion of the two kinds of food are not only different, but they take place in different organs in the female.

(Vol. xxix. (2), i., ii.)—S. **Pincherle**: Iterated function of a rational integral one, ii.—G. **Fubini**: Projective differential geometry.—E. **Artini**: Cassiterite and titanite of Baveno. The former mineral was represented by a small crystal 5 mm. long and 4 mm. broad, being a multiple twin crystal found by G. Codara in the granite mines, and a few fragments discovered on a later visit. Of titanite the author possesses three small purplish crystals. Both minerals are new to the granite of Baveno.—C. **de Stefani**: Siliceous fossil sponges of western Liguria. These were found mainly in crystalline schists, but also in Triassic limestone, between Genoa and Savona. The majority are Hexactinellidæ dichyoninæ, and the structure was well preserved both in microscopic sections and in specimens treated with acid.—G. **Marletta**: Abelian varieties.—P. **Nalli**: A functional equation.—M. **Pascal**: Resultant pressure on an aeroplane wing, ii. A continuation of the previous hydrodynamical problem of two-dimensional stream-line motion in an incompressible fluid. The present paper proceeds to calculate the lift.—L. P. **Eisenhart** (of Princeton University): Congruences of spheres of Ribaucour which admit of a finite deformation.—R. **Serini**: Theory of the circular plate electric condenser.—E. **Adinolfi**: Centres of absorption of coloured solutions. The author describes a method in which the absorption spectra are observed in solutions of variable density, using a cylindrical receiver which acts as a lens.—R. **Ciusa** and L. **Vecchiotti**: Nitro-derivatives and nitrohydrazones, ii.—M. **de Angelis**: Crystalline form of nitrodibromoacetanilide.—M. **Gortani**: The Permo-Carboniferous and Permian formations in the Caracorum chain.—V. **Novarese**: The Cambrian of Iglesias.—G. de A. **d'Ossat**: Chalk and American vines. The effect of chalk in giving rise to chlorosis in vines already forms the subject of abundant literature. The present experiments appear to negative the empirical results previously obtained, while they suggest that methods adequate for the requirements of practical viticulture may be comparatively easy to carry out in working.—V. **Bambacioni**: Fibrillar structures of Nemec. The protoplasmic cords present in the cells of the radical apices in most plants do not present the complex structure described by Nemec, but in *Aspidium aculeatum* structures are observed comparable with his fibrillæ.—C. **Artom**: Biology and systematics of the genus Artemia, iii.—C. **Jucci**: Differentiation of caste in the society of termites, i. The neotenics.—E. **Artini**: Presence of chrysoberyl in the dolomite of Campolongo (Canton Ticino).—G. **Marletta**: Abelian varieties, ii.—P. **Nalli**: A functional equation.—E. **Adinolfi**: Influence of dissociation on permanganate. As in the previous paper mentioned above, researches on absorption centres can advantageously be made with solutions of concentration rendered variable by diffusion. Permanganates of potash and of lime have the same absorption spectra, and dissociation has no influence on the absorption spectrum of the potash compound.—V. **Cuttica**: Thermic analysis of the system of nitrate of thallio-nitrite of thallium. In view of the thermic behaviour of fused mixtures of $TlNO_3$ and $TlNO_2$, the author excludes the formation of complexes. The two salts form a continuous series of mixed crystals and the transformation to the solid state is referable to Roozeboom's second type in the classification of binary systems with polymorphic transformations.—G. **Cusmano**: Catalytic reduction of *o*-nitroazoxybenzol.—C. **Jucci**: Differentiation of caste in the society of termites, ii. The neotenics.—M. **Boldrini**: Sexual differences of weight in the human body and organs. A table showing the relations between the medians, the probabilities of transvariation, the relations between the arithmetical means, and the intensities of transvariation for numerous series of weights of male and female individuals and organs. The table furnishes a summary of the observations of Frascani, Demoor, Benedict, Bischoff, Bean, Boldrini, and others, the subjects observed including new-born infants from Pisa, Brussels scholars, white and black Americans, Germans (both living and dead), Romans, and a few French and others.

CAPE TOWN.

Royal Society of South Africa, October 20.—Dr. J. D. F. Gilchrist, president, in the chair.—Dr. J. D. F. **Gilchrist**: Observations on living fish brought by H.M.S. *Challenger* from tropical East Africa to Cape waters. In January, 1919, H.M.S. *Challenger* brought six species of fish from Dar-es-Salaam, Port Amelia, Mnazi Bay, and Zanzibar, which were transferred to the tanks of the Government Marine Station at Simon's Bay. They throve very well until April 25, when they all died within a few days of each other. At this date there was a sudden fall in the temperature of the water. The significance of this occurrence in connection with the distribution of fish in South Africa is discussed. Some observations were made on the sleeping habits of *Balistes aculeatus*.—L. **Simons**: Detection of induced β-ray emission from substances exposed to Röntgen rays by a photographic method. A narrow beam of Röntgen rays from a Coolidge tube impinging on a film of red lead laid down on paraffin wax gives a marked effect on a photographic plate placed opposite up to a distance in air of about 2 cm. from the red lead. If a photographic plate replaces the red lead, a similar, though less intense, effect is shown on the opposite plate. This excited radiation was almost stopped by the thinnest mica and paraffin wax. β-rays seem to be more important than secondary X-rays in producing a photographic impression.—J. R. **Sutton**: A contribution to the study of the rainfall map of South Africa. The monthly and annual rainfalls for 567 stations in South and East Africa are given, and the results shown graphically in thirteen maps. The isohyets form a system which moves to and fro across the equator, following the sun with a lag of a month or more. Corresponding with the general movements of the main isohyetal system are the winter rains of the south-west, which advance inland as the summer rains retreat and *vice versa*. The paper concludes with a short bibliography of special studies of South African rainfall.—J. R. **Sutton**: Some notes on ancient ideas concerning the diamond. Various prosaic "motives" for some of the legends and stories about the diamond current in ancient times are suggested. It is argued that Pliny, when he spoke of *adamas* as a name given to a crystal of gold, was probably referring to the outside appearance of the crystallisation.—F. G. **Cawston**: Experimental infestation of fresh-water snails. Infestation of *Limnaea natalensis* was caused by Fasciola from a sheep's

liver, also infestation of *Physopsis africana* by water containing the miracidia of *Schistosoma haematobium*; here the mature cercariæ were found six weeks later.—R. D. **Aitken**: The water relations of the pine (*Pinus pinaster*) and silver-tree (*Leucadendron argenteum*). The conductivity of the wood for water, rate of transpiration, total area of leaf-surface, and sectional area of wood have been determined for similar twigs of pine and silver-tree. Under the experimental conditions pine leaves exerted a much greater suction force, calculated in one instance to be about four times that exerted by the silver-tree leaves. The latter are less able to resist drying than pine leaves, in which the rate of transpiration very rapidly diminishes when the twig is not supplied with water to a much lower level than in a silver-tree twig under identical conditions.—J. W. C. **Gunn**: The action of *Eucomis undulata*. *E. undulata* contains a large amount of a saponoglucoside, soluble in water and 90 per cent. of spirit. It is a powerful hæmolytic agent. Absorption of the extract from the stomach and intestines and from the subcutaneous tissues is very slow; intravenous injections are actively poisonous, and produce symptoms like other saponin bodies.—T. J. **Mackie**: A study of the *Bacillus coli* group, with special reference to the serological characters of these organisms. The paper is a detailed record of investigations on the *B. coli* group with reference to their (1) biological classification, (2) serological characters, and (3) mutations. The biological characters of 246 strains of gram-negative, aerobic, non-sporing, and non-liquefving glucose-fermenting bacilli (not including specific pathogens of this class) were studied. Four main subgroups could be recognised: (*a*) Gas-producing, indol-forming, and non-inosite-fermenting. (*b*) Gas-producing, non-indol-forming, and non-inosite-fermenting. (*c*) Gas-producing and inosite-fermenting. (*d*) Non-gas-producing (anaerogenes types). The serological characters studied were (1) the agglutination and (2) complement deviation reactions of immune sera to certain of the commoner varieties. These observations proved of great interest from the purely immunological point of view, and also threw some further light on the biological relationships of the various types of coliform bacilli. The comparative resistance of various types to brilliant green was correlated with the grouping determined by cultural and serological tests. Mutations among these organisms were investigated, and afforded some explanation of the great diversity of cultural types and of the high degree of specialisation in the serological characters of individual strains.—E. **Newbery**: Note on over-voltages. Over-voltage appears to be a function independent both of the gas liberated and of the metal in question, and completely determined by valency alone. Whether the valency of the gas is involved or not is still an open question, since all gaseous ions used were monovalent. The over-voltage compounds probably carry excess electrons, and the addition of each electron produces a definite increment in the single potential, which increment is dependent only upon the number of free valency electrons present in the atom of the electrode or ion of the over-voltage compound.

Books Received.

Manual of Tropical and Subtropical Fruits: Excluding the Banana, Coconut, Pineapple, Citrus Fruits, Olive, and Fig. By W. Popenoe. (Rural Manuals.) Pp. xv+474+xxiv plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 30*s*. net.

The Principles of Preventive Medicine. By Prof. R. T. Hewlett and Dr. A. T. Nankiwell. Pp. viii+536. (London: J. and A. Churchill.) 21*s*. net.

Root Development in the Grassland Formation: A Correlation of the Root Systems of Native Vegetation and Crop Plants. By Prof. J. E. Weaver. (Publication 292.) Pp. 151+plates. (Washington: Carnegie Institution.)

The New Physics. By Dr. A. C. Crehore. Pp. xii+111. (San Francisco: *Journal of Electricity*.) 2 dollars.

Physics of the Air. By Prof. W. J. Humphreys. Pp. xi+665. (Philadelphia: J. B. Lippincott Co.) 5 dollars.

The Physico-Chemical Properties of Steel. By Prof. C. A. Edwards. Second edition. Pp. xii+281. (London: C. Griffin and Co., Ltd.) 21*s*. net.

The Platinum Metals. By A. D. Lumb. (Imperial Institute Monographs on Mineral Resources.) Pp. ix+63. (London: J. Murray.) 3*s*. 6*d*. net.

Das Naturbild der Neuen Physik. By Prof. A. Haas. Pp. v+114. (Berlin and Leipzig: W. de Gruyter and Co.) 4.05 schill.

The Northern D'Entrecasteaux. By D. Jenness and the late Rev. A. Ballantyne. Pp. 219. (Oxford: Clarendon Press.) 12*s*. 6*d*. net.

The Progress to Geography. Edited by Dr. R. Wilson. Stage iii.: Myself and my Country: A Study in Civic Geography. Pp. 224. 3*s*. 6*d*. Stage iv.: The British World. Pp. 256. 4*s*. (London: Macmillan and Co., Ltd.)

Recent Advances in Organic Chemistry. By Prof. A. W. Stewart. Fourth edition. Pp. xvi+359. (London: Longmans, Green and Co.) 21*s*. net.

Department of the Interior. United States Geological Survey. Bulletin 597: Geology of Massachusetts and Rhode Island. By B. K. Emerson. Pp. 289+x plates. Professional Paper 96: The Geology and Ore Deposits of Ely, Nevada. By Arthur C. Spencer. Pp. 189+xv plates. Professional Paper 99: Chemical Analyses of Igneous Rocks. Published from 1884 to 1913 inclusive. By H. S. Washington. Pp. 1201. Professional Paper 111: The Ore Deposits of Utah. By B. S. Butler and others. Pp. 672+lvii plates. (Washington: Government Printing Office.)

La Chimie et la Vie. By G. Bohn and Dr. A. Drzewina. Pp. 275. (Paris: E. Flammarion.) 7.50 francs.

Laboratory Manual of the Technic of Basal Metabolic Rate Determinations. By Dr. W. M. Boothby and Dr. I. Sandiford. Pp. 117. (Philadelphia and London: W. B. Saunders Co.) 24*s*. net.

Advanced Lessons in Practical Physiology for Students of Medicine. By Dr. R. Burton-Opitz. Pp. 238. (Philadelphia and London: W. B. Saunders Co.) 18*s*. net.

A Course of Practical Physiology for Agricultural Students. By J. Hammond and E. T. Halnan. Pp. 106. (Cambridge: At the University Press.) 4*s*. 6*d*. net.

Girolamo Saccheri's Euclides Vindicatus. Edited and translated by Dr. G. B. Halsted. Pp. xxx+246. (Chicago and London: The Open Court Publishing Co.) 10*s*. net.

The Early Mathematical Manuscripts of Leibniz. Translated from the Latin Texts published by Carl Immanuel Gerhardt, with critical and historical notes by J. M. Child. Pp. iv+238. (Chicago and London: The Open Court Publishing Co.) 7*s*. 6*d*. net.

The Reversal of Halphen's Transformation. By H. E. J. Curzon. Pp. 15. (London: Constable and Co., Ltd.) 1*s*. net.

Dead Man's Plack and an Old Thorn. By W. H.

Hudson. Pp. vii+205. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co.) 7s. 6d. net.

Optical Methods in Control and Research Laboratories. Pp. 30. (London: Adam Hilger, Ltd.) 1s. 6d. net.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. (In 3 vols.) Vol. ii.: Thermodynamics. Third edition. Pp. viii+454. (London: Longmans, Green and Co.) 15s. net.

Department of Scientific and Industrial Research. Advisory Council. Report of the Lubricants and Lubrication Inquiry Committee. Pp. 126+3 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

Department of Scientific and Industrial Research. Food Investigation Board. Special Report No. 4. Interim Report on Methods of Freezing Fish, with Special Reference to the Handling of Large Quantities in Gluts. Pp. 50+4 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Benzol: Its Recovery, Rectification, and Uses. By S. E. Whitehead. Pp. xiv+209. (London: Benn Bros., Ltd.) 12s. 6d. net.

An Educated Nation. By Basil A. Yeaxlee. (The World of To-day.) Pp. 80. (London: Oxford University Press.) 2s. 6d.

Never Grow Old: How to Live for more than One Hundred Years. By Dr. L. H. Goizet. Pp. 191. (New York and London: G. P. Putnam's Sons.) 10s. net.

Zoology: An Elementary Text-book. By Sir A. E. Shipley and Prof. E. W. MacBride. Fourth edition. Pp. xx+752. (Cambridge: At the University Press.) 20s. net.

Countryside Rambles. By W. S. Furneaux. Pp. lvi+186. (London: G. Philip and Son, Ltd.) 3s. 6d. net.

Psychology and Mystical Experience. By Prof. J. Howley. Pp. xi+275. (London: Kegan Paul and Co., Ltd.; St. Louis, Mo.: B. Herder Book Co.) 10s. 6d. net.

Mineralogy: An Introduction to the Study of Minerals and Crystals. By Prof. E. H. Kraus and Dr. W. F. Hunt. Pp. xiv+561. (New York and London: McGraw-Hill Book Co., Inc.) 27s.

Geology of the Non-Metallic Mineral Deposits other than Silicates. By A. W. Grabau. Vol. i.: Principles of Salt Deposition. Pp. xvi+435. (New York and London: McGraw-Hill Book Co., Inc.) 30s.

Diary of Societies.

THURSDAY, DECEMBER 16.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—H. Ricardo: Possible Developments in Aircraft Engines.—A. J. Rowledge: The Instalment of Aeroplane Engines.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—E. J. Prior: Some Sources of Error in Alluvial Boring.—R. E. Palmer: Some Observations on Mining by the Opencast or Stripping Method.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion: Report on the Heating of Buried Cables.

CONCRETE INSTITUTE, at 7.30.—H. J. Deane: Special Applications of Reinforced Concrete in Docks, with Special Reference to the Reinforced Concrete Gates at Tilbury Docks.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at 28 Victoria Street), at 8.—T. E. B. Whiting: Carburation.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Sir R. Robertson: Lecture: Some Properties of Explosives.

RÖNTGEN SOCIETY (in Physics Lecture Theatre, University College), at 8.15.—The Reduction of Radiographic Exposures to 1/25th and Less by Means of a New Type of X-Ray Plate. Part I. by Dr. L. Levy and D. W. West. Part II. by T. Thorne Baker.

HARVEIAN SOCIETY OF LONDON (at 11 Chandos Street, W.), at 8.30.—Dr. C. M. Wilson, Dr. C. Buttar, and Others: The Future of the Poor-law Infirmary.

FRIDAY, DECEMBER 17.

SOCIETY OF MEDICAL OFFICERS OF HEALTH (at 1 Upper Montague Street), at 5.—Lt.-Col. H. R. Kenwood: Presidential Address to the Navy, Army, and R.A.F. Hygiene Group of the Society.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. W. J. Walker: Thermodynamic Cycles in Relation to the Design and Future Development of Internal-combustion Motors.

JUNIOR INSTITUTION OF ENGINEERS (at Royal United Service Institution), at 7.30.—Lord Weir of Eastwood: Some Reflections on our Industrial Situation (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—Col. R. J. Stordy: The Breeding of Sheep, Llamas, and Alpacas in Peru, with a view to supplying Improved Raw Material for the Textile Trades.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Adjourned Discussion: Radio-Therapy.—Dr. R. Morton: Recent Developments in Deep Therapy.—Dr. L. Martindale: Technique of X-ray Therapy of Fibroids.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at London School of Tropical Medicine), at 8.30.—Laboratory Meeting.

SATURDAY, DECEMBER 18.

PHYSIOLOGICAL SOCIETY (at St. Thomas' Hospital), at 4.

MONDAY, DECEMBER 20.

SURVEYORS' INSTITUTION, at 7.—H. S. Logsdon: Rating as affected by Recent Legislation.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—Prof. T. P. Nunn and Prof. H. Wildon Carr: Discussion on Prof. Alexander's "Space, Time, and Deity."

ROYAL SOCIETY OF ARTS, at 8.—A Chaston Chapman: Micro-organisms and Some of their Industrial Uses (Cantor Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Meeting) (at 28 Victoria Street), at 8.—W. H. Wardall: Cylinder and Piston Wear.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—F. Debenham: The Future of Polar Research.

TUESDAY, DECEMBER 21.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting of Fellows.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. D. J. Reid: Further Developments in Systematic Exposure in Photomicrography.

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