NATURE

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The Pasteur Institute.

FRANCE is occupied this week with the celebration of the centenary of Pasteur's birth. We, in Great Britain, have made but a poor thing of the occasion. It is true that we have praised Pasteur, and published our recognition of his work; but there has been nothing to show that he takes a foremost place in our national imagination. That is the worst of being an island. We are very proud of Shakespeare, but we are slow to admit foreigners into his company; yet our national gratitude toward Pasteur, so far as it is possible to compare men so unlike, ought to be even more certain than our gratitude toward Shakespeare. It is strange and disgraceful that we have not yet set up a monument to Pasteur in London. Indeed, we have not even inscribed his name on any building to remind everybody of our national debt to him.

Things have been done better in France. It is possible that the worship of Pasteur has gone too far, in the "filming" of him. This film was exhibited at the Jubilee meeting at the Sorbonne, on December 27 last. There are really three films: one to popularise some scenes of Pasteur's life, and two for the more exact teaching of schools and institutes. *L'Illustration* for March 31 gives a delightful account, with many pictures, of these films. Doubtless we shall see them in England. Meanwhile, some of us have seen Pasteur "staged," and admirably acted by M. Guitry.

Men and women of science may or may not stand the test of acting; but they are not intended for "filming." Take some names at random—Newton, Darwin, Lister, Kelvin: films "featuring" them would be nightmares. Besides, the whole meaning and beauty of their work would be left out. Their work began in them, but did not stop there; it became the work of their followers; it took many shapes, and was extended into many new fields of thought and of action. So with Pasteur's work: he founded his kingdom in every country of the world; his influences are everywhere; and that saying of his, in the last year of his life, "Tant de choses encore à travailler," stands for the immeasurable extension of his kingdom.

We have received Dr. Calmette's report, "L'œuvre de l'Institut Pasteur pendant la guerre." This valuable report is published by the Association "pour l'extension des études pastoriennes." An English translation has been issued. The immediate purpose of this Association, which was formed in 1922, is to collect funds to help students to work on the lines which Pasteur laid down. Twenty-six members of the Pasteur Institute died on active service during the war. The cost of living is a great difficulty in the way of students who are longing for good work. The Association proposes to enrol members, whose subscriptions shall provide

scholarships and endowments of research. We cannot think of a better way of using these funds. We are asked also to say that the Association has a store of bronze medals, commemorative of Pasteur, which may be obtained for 5½ francs from the Secretary, 6 rue de Messine, Paris.

Dr. Calmette's report of the work of the Institute during the War is well worth reading. He rightly makes much of the fact that the work of the Pasteur Institute was incessant and far-reaching in the years just after Pasteur's death. "In less than a third of a century, Pasteur's teachings revolutionised medicine, surgery, veterinary science; created entirely the science of hygiene for individuals and communities; gave a great impetus to colonisation, and enriched nations by the immense progress of agriculture and agricultural industries."

The War suddenly strained all the energies of the Pasteur Institute. All those workers who were not above the age for active service were mobilised. The Institute, and its branches in Lille and Algiers, were requisitioned at once for the needs of the Army. The demand for protection against typhoid was soon followed by the demand for protection against tetanus. It took only a few days to use up the antitetanic serum—140,000 doses—which was in stock when the War began. Between August 1914 and the end of 1914 the Institute was able to provide more than six million doses of sera for France alone, partly for the Army, and partly for the Public Health service. During the German offensive of March-April 1918, the Institute was providing a vast daily supply of antitetanic serum. It is worth noting that the Institute also provided, in the course of the War, as many as 1,200,000 doses of mallein for the protection of army horses against glanders. Beside all the work which was done for the Army in France, we have to take into account a vast amount of work done for other countries—Italy, Serbia, Rumania, Belgium.

Moreover, there was all the endless business of research and invention to meet the incessantly changing conditions forced on the Institute by the exigencies of war. For example, an immense amount of work was done on poison gases.

Indeed, the whole strength of the Institute was put forth unsparingly, not only for the Army but also for the civilian population. Dr. Calmette does well to praise the branch Institute in Lille. "Though it was paralysed, we may even say martyrised, by the German occupation so early as the first part of October 1914, it took its share in the common work. Our colleagues who lived there four years, immured, without any sort of communication with France, without a letter, without any journals except the political newspapers of Cologne or Frankfort, deprived of almost every means of work, with much of their material destroyed or stolen, did all that was possible with their authority and zeal to protect the civil population against the moral and material miseries of all sorts from which they suffered."

Of course, other countries were not less busy than France. They were all working on Pasteur's lines. It was he, and he alone, who inspired them. To him the Franco-German War of 1870 had brought misery; he took it as his revenge to set France, by his work, high above Germany. There are not many of us now living who can boast that we met Pasteur here in England, and shook hands with him, and heard him talk of his work. One of us had this good fortune; and remembers well the grave and unhappy look of his face, and the measured and serious tone of his voice. It was given more to his family and his friends to know something of the wonderful beauty of his life. The pity is that we in England have no memorial of him; nothing to express to France our gratitude for what he did for us.

Hormones.

Glands in Health and Disease. By Dr. Benjamin Harrow. Pp. xvi+218. (London: George Routledge and Sons, Ltd., 1922.) 8*s*. 6*d*. net.

THERE is probably no chapter in physiology which calls forth to such an extent our sense of the marvellous as that dealing with the internal secretions and the functions of the ductless glands. All the effects which have been ascribed in the imagination of mankind to the action of beneficent or maleficent fairies or deities are brought here within the domain of sober physiology as possible results of deficiency or excess of one or other of the internal secretions. The production of dwarfs and giants, change of personality, mania, dementia, and idiocy, the manifestations of love, hate, rage, and fear, the characteristics which distinguish male from female, the powers of reproduction and all associated therewith, the normal performance of the processes of digestion and metabolism, have all been shown to be bound up with the power of certain cells in the body to manufacture chemical substances which they pass into the blood-stream. It seems quite natural that the respiratory centre should be stimulated to greater activity by the increased production of carbonic acid which accompanies muscular exercise, so providing the working muscles with a sufficiency of oxygen for their needs. A further development of this correlation by chemical messengers is found in the alimentary canal, where the presence of the products of digestion in the stomach excites, by means of a hormone, the further secretion of gastric juice. In the same way the entry of the acid pro-

ducts of gastric digestion into the small intestine evokes in the epithelial cells lining this tube the development of a substance—secretin—which is absorbed by the blood-vessels and carried round to the pancreas, liver, and intestinal glands, so as to bring about the simultaneous secretion of the three juices the co-operation of which is necessary for the complete digestion of all classes of foodstuffs.

These are examples of the restricted action of the chemical messengers, resembling closely the reactions brought about through the intermediation of the central nervous system, so that we are justified in speaking of them as chemical reflexes. Other hormones have a much wider action, which may extend to all or almost all the cells of the body. Our knowledge of these is scarcely half a century old, and began with the discovery in England of the relation of myxœdema and cretinism to atrophy or failure in development of the thyroid gland. Later research has shown that these conditions are due to the absence of a secretion manufactured by the thyroid. This secretion has been isolated and has been found to be a substituted iodine derivative of tryptophane. On its constant presence in the blood depends the normal growth and metabolism of all the tissues of the body. Since these include the central nervous system, development of the mind is affected as well as that of the body. Absence of this secretion in early life results in the production of a stunted cretin. Increased secretion by a hypertrophied gland causes increased rate of metabolism, quickened heart-beat, excitability which may culminate in mania, changed personality—all of which may disappear when the gland diminishes in size or the hypertrophied portion is removed.

Still more wonderful and widespread in its effects is the pituitary body. This consists of two parts—one of which is derived from the brain, the other from the back part of the buccal mucous membrane of the fœtus; each part is only about the size of a pea. Increased activity of the anterior part gives rise to gigantism in the growing animal, or, when it affects the adult, the overgrowth and deformation of face, hands, and feet, which is known as acromegaly. If it were possible to isolate and administer the chemical substance responsible for these growth changes, we should be able to rival the effects of the "Food of the Gods" imagined by Mr. H. G. Wells. Atrophy of this part causes diminished growth, excessive fat production, and a condition of infantilism, with lack of development of the sexual functions. The posterior part, which in appearance seems to consist of little else but neuroglia, the supporting tissue of the central nervous system, produces some substance which can be extracted from it by boiling water, and has, in infinitesimal doses, widespread effects on the most diverse tissues of the body. This extract is sold under the name of "pituitrin." According to the conditions existing at the time of administration it may increase or diminish the flow of urine; it causes rise of blood-pressure and contraction of the uterus, as well as of all other unstriped muscle, such as that of the intestines. For these purposes it has come into actual practice as a therapeutic agent. Its presence in minute quantities in the blood seems to be a necessary condition for the contractility of the blood capillaries, so that it becomes a regulator of the supply of the nutrient blood to all the tissues of the body.

It is not surprising that these later achievements of physiological research have impressed public opinion and have had a marked effect in the United States, where the public interest in things medical is aroused every week by popular articles on medical science in the Sunday papers. The arousing of uneducated curiosity has its dangers as well as its value. Sensationalism and imagination have not only rushed ahead of the ascertained facts but have also opened the way to a shameless exploitation of the uneducated curiosity which has been aroused. It is not so many years since bits of animal organs were regarded as essential ingredients of remedies for disease as well as for love-philtres and charms. The heart of the tiger or of the brave enemy was eaten to give courage to the victors, and at the present day we find a therapeutics advertised and exploited which is nothing less than a return to the superstitious practices of the middle ages. The principle is simple. If the kidney is affected, dried kidneys of animals are administered; if there is a failure of sexual powers, ovaries or testes are administered in the same way. It is only necessary to locate the disorder in order at once to apply the appropriate remedy. Charlatanism finds an easy and profitable prey in the curious and uneducated. The only protection against its attacks lies in more complete education, and it is for this purpose that such a book as that of Dr. Benjamin Harrow is useful. The author is apparently not a medical man, but is an associate in physiological chemistry of Columbia University. Though the restriction of his knowledge and experience is apparent, the book is nevertheless of value as a dispassionate and objective statement of the facts which are so far known as to the internal secretions. Throughout the author maintains a proper sceptical attitude in face of the uncritical or prejudiced statements which have been put forward by clinicians as to the influence of various preparations of the organs involved.

There are a few errors of fact, as well as certain questionable conclusions, which might well be omitted

in future editions. The statement that the action of these hormones is catalytic is unjustified and means nothing. We cannot speak of catalysis—*i.e.* a hastening of a chemical action—unless we have some definite chemical action in mind. In the case of these hormones, as in the case of drugs such as alkaloids, we have not the remotest idea how they work. It may be that their action is by catalysis of one or other of the reactions which occur in the series making up the life of the cell, but there is no evidence for or against such a statement, and there is a distinct danger that, by putting the action of drugs or hormones into such a category, we may forget our ignorance and refrain from further attempts at an analysis of the manner in which they work.

The author seems unaware of the fact so clearly brought out by Pézard, that the plumage of the cock is that of the neutral animal, desexualisation of the hen bringing about the production of the cock's plumage, which is left unaffected in the male by removal of the testes. It is not correct to speak of enterokinase as a hormone; it is a ferment which has a definite action on the trypsinogen secreted by the pancreas, converting this into trypsin. Two statements are a little surprising. In explanation of the term "thyroidectomy" it is mentioned that "dectomy" equals excision. Later on in the book the word "secretin" is stated to be derived from the Greek "to excite." These, however, are minor flaws and do not interfere with the value of the book as a whole, which can be recommended as an interesting and well-balanced account of the present condition of our knowledge on the subject of internal secretions. It is couched in such language that it will be intelligible to any educated reader with the veriest smattering of scientific knowledge. E. H. S.

Modern Processes of Ore-Dressing.

A Text-Book of Ore-Dressing. By Prof. S. J. Truscott. Pp. xi+680. (London: Macmillan and Co., Ltd., 1923.) 40*s.* net.

IN his preface Prof. Truscott states that his work is written primarily for the service of his own students at the Royal School of Mines, and correctly observes that such a book is needed owing to the important development of flotation processes in recent years.

From the dedication—"To Almighty God, the father of our Lord Jesus Christ"—one must infer that the author has put forth his best efforts into the work, and it certainly does bear evidence throughout of painstaking care. The matter is arranged methodically; the drawings and diagrams are abundant and excellent, and their selection leaves little to be desired. The many non-essential details which are often found in descriptions of ore-dressing plants do not occur, and all the space is well employed to give the student a correct and easy understanding of the subjects described.

The book deals first with washing and sorting methods and appliances, then with the various types of machines for breaking, crushing, and grinding of ores. Next are considered the problems and appliances for sizing by screens and by water, after which water concentration is described. The latter half of the book deals mainly with flotation concentration, magnetic, electrostatic, pneumatic, and centrifugal separations.

The space devoted to flotation (one-fifth of the total text) is indicative of the rapid growth and extreme practical importance of this method of concentration, which in less than twenty years has revolutionised the treatment of low-grade ores.

On the whole, the author is to be congratulated upon his presentation of a concise view of flotation technics to the general student, since the subject matter is extensive and in some aspects recondite. Under these conditions his treatment of the practical section must be considered satisfactory, but the chapter devoted to the more theoretical aspects of the subject is somewhat involved. This is scarcely to be wondered at, since a comprehensive theory of flotation (which at almost every point involves problems in regions of molecular physics only partially explored) has yet to gain general acceptance, and is still the battle-ground of two schools of thought—those on one hand who adopt the doctrines of the later school of colloid chemists, seeking explanations for causation based mainly on electrical theories, and the other or physical school, which finds sufficient explanation by the application of purely molecular laws. Electrical theories are both proximate, as the assumed electrical or electrostatic nature of flocculation and deflocculation phenomena, and ultimate, in seeking to explain the useful properties of oils and other reagents used in flotation in terms of the electronic constitution of atoms and molecules. The physical school is concerned only with the elucidation and quantification of the molecular attractive forces exerted between the reacting surfaces at liquid-solid contacts, such as give rise to surface- and interfacial-tensions, adsorption, and so on. On these grounds the phenomena of flocculation and deflocculation also seem to be more satisfactorily explained than by the electrical hypothesis.

Prof. Truscott, however, prefers to divide his favours between the two schools, accepting molecular attractions as explanatory of most of the flotation reactions, but adopting the electrical hypothesis for flocculation. The importance of the latter factor may be judged from the generalisation, now widely accepted, that where particles in an ore-pulp can be flocculated they can be floated; conversely, when they are put into the

condition of deflocculation (suspension or peptisation are other terms used) flotation of such particles will be rendered impossible. A main object of flotation is, therefore, to flocculate the valuable mineral in a pulp, and to deflocculate the gangue or unwanted mineral.

It may be pointed out that Brownian motion (p. 510, para. 6) is not due to the "inherent kinetic energy of extremely fine particles"; these indeed are passive agents, their motion being imparted by the kinetic energy of the water molecules which continuously bombard them—as shown in Perrin's classic experiments. Some other statements will provoke critical comment and seem to require qualifications—such, for example, as that on p. 506, where it is stated that the necessary filming of a mineral with oil cannot be achieved if the oil be completely emulsified. In the form stated it is not a fact, and theoretically it seems to overlook the phenomena of adsorption.

It should be mentioned that the book makes no serious attempt to deal with many of the problems which invariably confront the designers of mills, such as grades for launders and pipes, wet and dry pulp elevators and pumps, ore-bin construction, automatic feeders, etc. This, however, cannot be regarded as a shortcoming, and is perhaps to be commended, for the student should not be encouraged to imagine that he is fully competent to design a plant. It should be sufficient for him to obtain a thorough understanding of all ore-dressing appliances and methods in general use, and it is difficult to conceive how he could obtain so much sound knowledge so readily, and conveniently prepared for him, as he can in this book. Prof. Truscott apparently refrained from showing partiality towards any particular machines or methods, and has been cautious in his references to their merits or demerits. Practically everything said may be accepted as trustworthy, though a few statements noticed in respect of metallurgical matters are not strictly correct; for example, that much high-grade lead ore is smelted in reverberating furnaces, that zinc necessarily renders slags pasty, and that lead is highly objectionable in the retorting of zinc. These slight inaccuracies do not, however, affect the arguments they are used to illustrate.

S. J. S.

New Works on Relativity.

The Mathematical Theory of Relativity. By Prof. A. S. Eddington. Pp. ix+247. (Cambridge: At the University Press, 1923.) 20*s.* net.

The Principle of Relativity with Applications to Physical Science. By Prof. A. N. Whitehead. Pp. xii+190. (Cambridge: At the University Press, 1922.) 10*s.* 6*d.* net.

The Meaning of Relativity: Four Lectures delivered at Princeton University, May 1921. By Albert Einstein. Translated by Prof. Edwin Plimpton Adams. Pp. v+123. (London: Methuen and Co., Ltd., 1922.) 5*s.* net.

Modern Electrical Theory: Supplementary Chapters. By Dr. Norman R. Campbell. Chapter XVI.: Relativity. (Cambridge Physical Series.) Pp. viii+116. (Cambridge: At the University Press, 1923.) 7*s.* 6*d.* net.

La Théorie de la relativité d'Einstein et ses bases physiques: exposé élémentaire. Par Max Born. Traduit de l'allemand d'après la seconde édition par Dr. F.-A. Finkelstein et J.-G. Verdier. Pp. xi+339. (Paris: Gauthier-Villars et Cie, 1923.) 25 francs.

The General Principle of Relativity in its Philosophical and Historical Aspect. By Prof. H. Wildon Carr. Second edition, revised and enlarged. Pp. viii+200. (London: Macmillan and Co., Ltd., 1922.) 7*s.* 6*d.* net.

The Theory of General Relativity and Gravitation: Based on a Course of Lectures delivered at the Conference on Recent Advances in Physics held at the University of Toronto, in January 1921. By Dr. Ludwik Silberstein. Pp. vi+141. (Toronto: University of Toronto Press, 1922.) 2.50 dollars.

The Mathematical Theory of Relativity. By Prof. A. Kopff. Translated by Prof. H. Levy. Pp. viii+214. (London: Methuen and Co., Ltd., 1923.) 8*s.* 6*d.* net.

Vector Analysis and the Theory of Relativity. By Prof. Francis D. Murnaghan. Pp. x+125. (Baltimore: The Johns Hopkins Press, 1922.) n.p.

L'Évidence de la théorie d'Einstein. Par Prof. Paul Drumaux. Pp. 72. (Paris: J. Hermann, 1923.) 6 francs.

OF all the books on the Principle of Relativity which it has been our good and ill fortune to peruse during the last three years, there are none which have given such food for thought as those of Profs. Eddington and Whitehead. Other books, and their name is legion, fall into several well-defined classes. Among those before us are two serious and well-executed books addressed to students of experimental physics by Dr. Norman Campbell and Dr. Max Born. We are glad to note a cessation of the flood of popular accounts in which, mainly without success, more and less well-equipped writers have felt called upon to try their skill at hitting off the average man's understanding. Then there are the books in which metaphysicians have told us the effect which their reading around the subject, largely in semi-popular treatises, has had upon their thinking in regard to theology, sociology, and things in general. To this very important branch of the literature Prof. Wildon

Carr adds a new edition of his valuable book, which he has extended by a new chapter giving a more detailed description of Einstein's theory. Then there is a group of bare expositions of Einstein's theory, following closely his published work, with little digression or reflection. To this class belong the works of Drs. Silberstein and Kopff, which are mainly a record of lectures given by the authors in Toronto and Heidelberg respectively. Einstein's own volume, entitled "The Meaning of Relativity," is disappointing, as it falls straight into the same group, and gives us little more light on the *meaning* of relativity, save a re-emphasis that it is mainly a matter of mathematics. Prof. Murnaghan in his volume is more specially concerned with the pure mathematics, and seeks to lessen the difficulties of "The Absolute Differential Calculus" in any number of dimensions by tracing the whole subject through in an elementary manner. Prof. Drumaux writes a bright, readable, and well-balanced account of the theory; his general conclusions are admirable.

But the latest works of Profs. Eddington and Whitehead have characters of their own. We are exceedingly glad to have kept Prof. Whitehead's book by us until we have had an opportunity of seeing in book form the matured results of Prof. Eddington's mathematical investigations and his speculations as to the interpretation to be placed upon it all. We should recommend all those who are puzzled by the higher flights of his imagination to sit down to Prof. Whitehead's book, and after worrying through his first four chapters on physical principles to come back to Prof. Eddington and reconsider what he has to say. For while we yield to no one in our admiration for the work which the latter has done in emphasising the necessity for a thorough revision of the basic ideas of physical science, there remains an obstinate feeling that some of the more fascinating glimpses which he gives us may not stand a thorough logical examination. Prof. Whitehead, on the other hand, is a conservative. He acknowledges and presupposes the magnificent stroke of genius by which Einstein and Minkowski assimilated time and space, but, as he says, "The worst homage we can pay to genius is to accept uncritically formulations of truths which we owe to it."

Accordingly, the major part of his book is devoted to a logical consideration of the spatio-temporal character of events. Chapter II. consists of a lecture on "The Relatedness of Nature," given to the Royal Society of Edinburgh. It emphasises the fact that in our contemplation of Nature we are regarding events and processes. Descartes considered "stuff" (matter, ether) as being separable from the concept of process, realising itself at an instant, without duration; and to him "extension" was an abstract from the more concrete concept of "stuff." Space is thus essentially dissociated from time. But if, as Prof. Whitehead does, we find in events the ultimate repositories of the varied individualities in Nature, then we obtain the four-dimensional space-time as an abstract from those events. Space and time are thus correlative abstractions which can be made in different ways, each way representing a real property of Nature. The "event" or "point-event" which is made fundamental by many writers is therefore a pure abstraction, a fundamental element in the deductive and synthetic conceptual model which we have formed of Nature, holding the same place in it as the "point" in Euclid's elements of geometry.

So far we should find complete agreement between Einstein, Minkowski, Eddington, and Whitehead. It is when we come to the next chapter that we begin to feel that new ground is being broken, for Prof. Whitehead has perceived that the careful scrutiny of fundamental ideas necessitated by this unification of space and time has not yet been thoroughly carried out. The whole question of the nature of measurement and how it is at all possible has to be tackled, and we must begin by analysing the notion of "equality." In accordance with the ideas above, the fundamental step must be the matching, not of permanent bodies, but of passing events. "How time is to be got from the relations of permanent bodies completely puzzles me." "Why this pathetic trust in the yard measure and the clock?" he exclaims. So, starting from the simple idea of equality, we are led on into all those speculations concerning the character of the universe which have been raised by Einstein's theory.

We are left at the end of this chapter with a sense that "equality" and "measurement," far from being the sure foundation of physics, are either crude and primitive modes of experimentation or else the finishing touches to a wonderfully wrought conceptual picture of Nature. Here we think Prof. Whitehead and Prof. Eddington will be in sharp disagreement, and here we think remains still much room for clear exposition and hard thinking. While we welcome Prof. Eddington's authoritative exposition of the mathematical theory of relativity, our doubts as to the logic of his fascinating general account of the theory are confirmed. In the first section the fundamental hypothesis is stated that "everything we can know about a configuration of events is contained in a relation of extension between pairs of events. This relation is called the *interval*." The equality of intervals is to be tested observationally. We are told to take a configuration of events, namely, a measuring-scale, and lay it over a distance AB, and observe that A and B coincide with two particular events P, Q (scale-divisions). It seems to us that a scale-division is not an

event at all, but a world-line or chain of events. We are then to do the same to a distance CD, and so prove the equality of the distances AB and CD. We are told that in this experiment time is not involved, and to conclude that in space apart from time the test of equality of distance is equality of interval. Yet the essence of a measuring-scale is its permanence in time. We stumble badly over these opening paragraphs, and are glad to get on to the mathematical developments where all goes smoothly.

The same confusion of thought, as it seems to us, occurs again in the interpretation of Einstein's law of gravitation which is Prof. Eddington's own (§ 66). Einstein's law is equivalent to the statement that the radius of spherical curvature of the three-dimensional section of the world at right angles to any direction in the four-dimensional continuum has the same constant length $\sqrt{(3/\lambda)}$. A "more precise statement of this result" is said to be that "the radius of curvature of the world at any point and in any direction is in constant proportion to the length of a specified material unit placed at the same point and orientated in the same direction." In this more precise statement the word direction is used in the first instance for a direction in the four-dimensional world, but "the length of a specified material unit placed at the same point and orientated in the same direction" can only be interpreted as referring to three dimensions.

We do not raise these criticisms in any captious spirit. We believe there is a great deal to be said in favour of the general point of view stressed by Prof. Eddington that the uniformities revealed in Nature by physical experiment would not have been found if our physical measurements had not been made with apparatus which is itself part of Nature and is therefore pervaded by the universal relations. But the picturesque and concise language employed from time to time in this book may only too easily persuade the reader that he has understood when he has in reality only shirked the issue.

Thus, after thanking the author for his very complete account of the existing state of the theory and its speculative developments, we return almost gladly to Prof. Whitehead's conservatism, and read his chapter on some "Principles of Physical Science." We are almost grateful for his old-fashioned belief in the fundamental character of simultaneity, adapted to the novel outlook by the qualification that the meaning of simultaneity may be different in different individual experiences. We admire his cautious tread along these unexplored paths, and we should welcome him as our critic in the task that urgently needs undertaking, of examining the precise position to be allotted to the notion of "measurement" in the conceptual universe of the relativist.

Fossil Mammals from Bolivia.

Mammifères fossiles de Tarija. Par Prof. M. Boule, avec la collaboration d'A. Thevenin. (Mission scientifique G. de Créqui-Montfort et E. Sénéchal de la Grange.) Pp. vii + 255 + 27 planches. (Paris: H. Le Soudier, 1920.)

FOR more than three hundred years a great accumulation of bones has been known in the highlands of Bolivia near the small town of Tarija. The bones are scattered in confusion through a deposit of sandy mud, the parts of a skeleton rarely in natural association; and they are often well exposed in the little ravines which mountain torrents and streams have cut through the deposit in all directions. During the final years of the last century a large collection of the specimens was made by some local residents, Messrs. Echazù, and when the Marquis de Créqui-Montfort was exploring the country in 1903 he purchased this collection, and eventually gave it to the National Museum of Natural History in Paris. The Marquis has now generously provided the means for the publication of the handsome volume before us, in which Prof. Boule, assisted partly by the late M. Thevenin, makes the new discoveries available for science. The work is dated 1920, but was only distributed last year.

All the bones in the deposit at Tarija belong to mammals, most of them large, closely resembling those found in the sand and mud of the pampa of Argentina and in the caves of Brazil. They date back either to the latter part of the Pliocene or to the early part of the Pleistocene period, and are therefore of special interest, because they represent the time when the mastodons, tapirs, horses, llamas, deer, peccaries, and higher carnivores had just come south from the northern hemisphere over the newly-emerged land of central America, and had mingled with the strange edentates, rodents, toxodonts, and macrauchenias which were indigenous to South America, and soon became, for the most part, exterminated in their rivalry with the invaders. Altogether, thirty-five species of large size are represented, and their remains are described in detail by Prof. Boule, with the aid both of beautiful plates in photogravure and of numerous effective text-figures.

The individuals of several species are rather small compared with the corresponding forms found in the Argentine pampa and other favoured regions, for Tarija is at present nearly 2000 metres above the sea, and even at the beginning of the Pleistocene period, when the elevation was possibly less, the conditions cannot have been very genial. When the assemblage of animals in question was living in that country,

however, there must have been both greater warmth and more moisture to provide sufficient vegetation. The mastodons, tapirs, and perhaps macrauchenias, must have inhabited damp forests on the edge of swamps. The giant ground-sloths, Megatherium and Mylodon, could scarcely exist without forest vegetation. The numerous and varied small horses and llamas were as usual adapted for life on grassy plains. The Glyptodon was also probably a feeder on grass, and the Toxodon, which may have fed on dry scrub, seems to have been comparatively rare. When conditions began to approach those now met with at Tarija, all these animals would be either exterminated or driven to lower regions.

Like all his other descriptive works, Prof. Boule's account of the mammalian remains from Tarija is much more than a technical treatise. It summarises and briefly discusses our knowledge of the evolution of most of the groups represented. It teems with facts and suggestions which will interest both zoologists and geologists. It is a most valuable contribution to palæontological science. A. S. W.

Our Bookshelf.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 28. Pp. ix+1010. (London: The Institute of Metals, 1922.) 31*s.* 6*d.* net.

THE new volume of the Journal of this Institute is very bulky, owing to an increase in the number of pages occupied by papers and also in that of the abstracts. Two general lectures are included, one being by Sir Ernest Rutherford on the relation of the elements, and the other by Dr. Hutton on motion study and vocational training, the latter subject being a new one in this connexion. The sixth report to the Corrosion Committee is mainly concerned with the influence of colloidal corrosion products on the process, and contains much interesting matter, although the theory remains in a very imperfect state. The authors do not commit themselves to the support of any of the theories proposed in this field, and consider that several different processes are possible. A further contribution to the subject of the age-hardening of the light aluminium alloys is made by members of the staff of the National Physical Laboratory, and the hypothesis originally proposed to account for ageing is confirmed by the newer work. Several other papers deal with the properties of aluminium and its alloys. A curious binary system is that studied by Mr. M. Cook. The alloys of antimony and bismuth form a continuous series of solid solutions when allowed to solidify slowly, but if, by rapid cooling, a heterogeneous structure is obtained, prolonged annealing does not lead to diffusion. This paper contains some excellent photo-micrographs. Other papers include a general survey of eutectics by Mr. F. L. Brady, and a method of deriving a value for the absolute hardness of metals from the Brinell test by Mr. F. W. Harris, as well as several contributions on technical matters.

The abstracts section shows a great increase in bulk, and the literature of metallurgy has evidently been searched very thoroughly; but some space might be saved by the avoidance of duplication, and by omitting papers which are merely popular summaries of existing knowledge, containing nothing new. It is always difficult to decide where the line should be drawn in such cases, but the fact that the present volume extends to more than 1000 pages proves that discretion is desirable in the admission of abstracts to this important Journal.

The Gold-Headed Cane. By Dr. William Macmichael. A new edition, with an Introduction and Annotations by George C. Peachey. Pp. xxiii+195+5 plates. (London: Henry Kimpton, 1923.) 18*s.* net.

WE recently directed attention to an edition of the "Gold-Headed Cane" edited by Dr. F. R. Packard of Philadelphia (see NATURE, March 3, p. 281). The present volume, which represents the fifth edition of the work, is edited by Dr. George C. Peachey, who is well known in the medical world as the historian of St. George's Hospital and as a writer of various articles of medico-historical interest. In a scholarly introduction Dr. Peachey points out that the only two discoveries of real value which had issued from English thought before the Restoration were the work of physicians, namely, the discovery of terrestrial magnetism by Gilbert in 1603 and the demonstration of the circulation of the blood by Harvey in 1628. In the later period, however, and notably with the death of Sydenham in 1689, the year in which the autobiography of the "Gold-Headed Cane" begins, the leading physicians of the period whose lives are related by the Cane were remarkable for their success in practice rather than for any important additions they made to knowledge. No important contributions were made to medical literature by Radcliffe, Mead, Askew, or Pitcairn. An exception, however, must be made in favour of Matthew Baillie, whose position in the history of medicine as the first great English pathologist is not mentioned by Dr. Peachey.

The present edition, which is more sumptuous than any of its predecessors, contains in addition to the original illustrations six fine photogravure portraits of Radcliffe, Mead, Askew, the Pitcairns, and Baillie.

Everyday Life in the New Stone, Bronze, and Early Iron Ages. Written and Illustrated by Marjorie and C. H. B. Quennell. (The Everyday Life Series, II.) Pp. x+119. (London: B. T. Batsford, Ltd., n.d.) 5*s.* net.

MR. AND MRS. QUENNELL must have found their little review of the Neolithic and succeeding Ages vastly more difficult to write than their earlier book on the Old Stone Age. Not only is the material more heterogeneous in character and more widely scattered, but on many points with which they have had to deal summarily there is also a lack of agreement among archæologists. The limitations of space and the requirements of their public have precluded any discussion of controversial matters. To bear this in mind is to disarm criticism on points which, in a more ambitious undertaking, might call for extended discussion.

Notwithstanding the vast amount of ground which

has been covered and the mass of material which they have had to bring within the compass of their little book, the authors have produced an excellent and very readable popular account of the peoples of the later prehistoric ages in North-Western Europe and, in particular, of Britain. Without entering into detailed criticism, it may be suggested that more stress might have been laid upon early trade connexions between Britain and the Baltic and their bearing upon the archæological and ethnological problem. The synoptic chronological chart of ancient civilisations in parallel columns will be invaluable to those who have not made a special study of prehistoric archæology.

Der fossile Mensch. Von E. Werth. Zweiter Teil. Pp. 337–576. (Berlin: Gebrüder Borntraeger, n.d.) 12*s.* 8*d.*

THIS is the second part of a comprehensive treatise on the handiwork of early man. It begins with the middle of a sentence on p. 337 and ends in a similar way on p. 576, and the reviewer has not seen what went before or came after these broken sentences. The volume consists of a very detailed and exceptionally well illustrated account of palæolithic flint implements, and gives information relating to the extinct fossil animals and plants associated with the various types of implements and to the problems of the glacial periods.

Throughout the book very full bibliographical references are given to memoirs written in the German language, and occasionally to those written in French; but works written in English and information which can only be obtained at first hand in English memoirs, such, for example, as that relating to the discoveries at Piltdown and elsewhere in Britain, are wholly ignored. Moreover, the views expressed in the book are strictly orthodox, and the author is very cautious in referring to matters which do not fall into the old scheme of interpretation adopted by him.

Although the work is called "Der fossile Mensch," there is, at any rate in this part, no reference to the fossilised remains of man. The book is a valuable work of reference for flint implements and for German ideas regarding problems of chronology. The author refers Pithecanthropus to the oldest interglacial period and assigns the Cromer Forest-bed to the same horizon.

G. ELLIOT SMITH.

The Andover District: an Account of Sheet 283 of the One-inch Ordnance Map (Small Sheet Series). By O. G. S. Crawford. (Oxford Geographical Studies.) Pp. 99. (Oxford: Clarendon Press; London: Oxford University Press, 1922.) 7*s.* 6*d.* net.

MR. CRAWFORD'S memoir covers an area which, as he points out, is not particularly well adapted to treatment on the lines of natural regions. In the main he contents himself with indicating the larger divisions, and has taken his units chiefly on a geological basis. On these lines he divides the area into three main natural regions—Andover, the belt of high ground between Basingstoke and Savernake, which is crossed by the Winchester and Newbury Road, and the Vale of Kingsclere. In addition, a portion of the London Tertiary basin and of the Vale of Pewsey come into the north-east and north-west corners respectively. Each of these is studied in detail in respect of its physical and economic aspects. In the latter section Mr. Crawford deals with a subject which in part he has made peculiarly his own, and his analysis of the relations of prehistoric Roman and modern settlements and of early and recent lines of communication in this area will be highly appreciated by archæologists and students of topography.

A number of useful appendices deal with such subjects as measurements, grouping of parishes, prehistoric sites, Anglo-Saxon bounds, forest regions, place-names, and the like. The volume is well illustrated by photographs and numerous plans prepared from the Ordnance Map.

Air Ministry: Meteorological Office. The Marine Observer's Handbook. Third edition (with corrections to September, 1922). (M.O. 218.) Pp. iv+99. (London: H.M. Stationery Office, 1922.) 5*s.* net.

THIS book is prepared exclusively for the use of navigators and seamen who keep a record of the weather; it is especially intended for the mercantile marine. There are many essentials in the keeping of the Meteorological Log for the Meteorological Office, among which may be mentioned the uniformity of scales, much of which is new to the ordinary navigator. Instruments, if required, are loaned by the Meteorological Office, which in return for the instruments supplied claims possession of the Meteorological Log. Among the observations required are wind direction and force, barometer, temperature of air and sea, cloud, weather, state of sea, the set and rate of current, and other features of interest. The handbook shows how the observations should be made, and how the results are used for the advantage of seamen and others.

The present-day navigator has many advantages quite unknown to navigators in bygone days, especially with respect to wireless reports, which enable any captain afloat to make for himself by the aid of messages from other adjacent vessels a synchronous chart showing the weather conditions by which he is surrounded. Storms may thus be avoided, and advantage can be taken of favourable weather conditions.

C. H.

Cours de chimie inorganique. Par Prof. Fréd. Swarts. Troisième édition, revue et augmentée. Pp. iv+734. (Bruxelles: M. Lamertin, 1922.) 50 francs.

THE third edition of Prof. F. Swarts' "Cours de chimie inorganique" includes new matter dealing with the constitution of the atom, isotopes, and catalysis. It is perhaps the best book of its type that has appeared in French, but English students would probably prefer to learn chemistry from text-books of similar scope published in their own language.

Outlines of Theoretical Chemistry. By Prof. Frederick H. Getman. Third edition, thoroughly revised and enlarged. Pp. xi+625. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 18*s.* 6*d.* net.

PROF. GETMAN'S "Outlines of Theoretical Chemistry," which appeared just before the War, received a drastic revision in 1918. The third edition has been brought up-to-date by the inclusion of recent work on isotopes and on atomic structure, but retains most of the features of the preceding edition.

Letters to the Editor.

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

Gravitation and Light-Pressure in Spiral Nebulæ.

PROF. LINDEMANN'S idea that the spiral nebulæ may be clouds of particles small enough to be repelled by light is of considerable interest. But we must remember that light carries with it another potential influence which it exerts when it encounters matter, namely, the power of ejecting an electron with an energy of the same order as that of the electron responsible for the light. Star-light, therefore, should be able to eject electrons with enormous energy; and this kind of induced radio-activity may have several partly unforeseen results. A stellar variety of spectrum is one of them, if a continuous spectrum can be composed of a multitude of fine lines, with gaps only where the specific exciting radiation was absent.

Unpolarised self-luminosity is surely more likely than mere reflection of incident light. The reddened light from the centre, observed by Mr. Reynolds, might well be a sunset effect, due to vision through a number of small blue-reflecting particles; the phenomenon does not harmonise so well with the idea of borrowed light.

I suppose that Dr. Jeans's spiral polar arms might occur in a Lindemann cloud as in any other enormous quasi-gaseous mass.

The fact that some few of these nebulæ are approaching the galaxy, instead of rapidly receding, may be accounted for by the suggestion that in these few the particles have aggregated into larger groups (as they may under some kinds of electrification), so that gravitation once more predominates over light-pressure.

The excessive transparency of space seems limited to our own extensive neighbourhood, for in remote regions opacity will set in sooner or later, and all stray radiation—however enfeebled by distance—will sooner or later be re-absorbed, with perhaps exciting and generative material consequences. The birth as well as the death of matter seems not hopelessly beyond our scope. OLIVER J. LODGE.

Breeding Experiments on the Inheritance of Acquired Characters.

ALTHOUGH I agree with Dr. Kammerer in holding the opinion that somatic modifications do, sooner or later, affect the gametes or reproductive cells in such a way as to produce an inherited development of a corresponding change of structure, I regret that the evidence presented in his lecture printed in NATURE of May 12 is in some respects open to the objection that it is not in accordance with the present state of biological knowledge. Another objection, which may be partly due to the fact that the lecture is only a brief summary, is that the evidence does not include sufficient detail, or precise comparison with controls.

For example, Dr. Kammerer states that "Thanks to its enclosing membrane, the ovary of the Salamandra can be removed from the surrounding tissue as a whole," which, according to the context, is not the case with the ovary of birds. I have never heard hitherto of the existence of an enclosed ovary in any amphibian. Unless I am altogether mistaken, the germinal surface of the ovary is exposed to the coelom in Salamandra as in other Amphibia, and the ova escape through this surface as they do in birds, and not into an internal cavity of the ovary as, *e.g.*, in teleostean fishes. If the latter were the case it would be very difficult to understand how ovarian transplantation could be carried out as in Kammerer's experiments.

The fact that Mendelian segregation occurs when naturally spotted Salamandra is crossed with naturally striped Salamandra, but not when it is crossed with experimentally striped specimens, suggests that in the former case the striped character is gametic, while in the latter it is not. But if the experimentally striped character is not gametic, what becomes of the heredity? Kammerer says doubtless both are inherited, but the long-established character obeys the Mendelian law, the new character does not. But T. H. Morgan has shown that new gametic characters in Drosophila obey Mendelian laws from their first appearance. Newness or oldness has nothing to do with Mendelism. A slight degree of heredity is possible, then the experimental striping causes only a slight change in the gametes. Then I presume the natural striping has been caused by exposure to yellow surroundings (soil) for thousands of generations and has become completely gametic, or almost so.

The difference in Mendelian behaviour then would be due to the fact that the natural striping is almost entirely gametic, the experimental striping almost entirely somatic. Such a result would agree with the result of my own experiments on the production of pigment on the lower sides of flat-fishes, supposing it to be true that spotted salamanders occur in Nature on dark ground, striped (yellow) specimens on light or yellow ground.

On the other hand, in the experiments on the results of ovarian transplantation Kammerer puts forth the extraordinary conclusion that the soma of the naturally striped female has no influence on the ova derived from a spotted female, but the artificially striped soma makes the ova derived from a naturally spotted female behave as though they came from a striped female. Here we have a complete gametic change due to somatic influence, while according to the Mendelian experiments there was little or no evidence of gametic change. Such contradictory results *may* be true, but it would require a great deal of corroboration to prove them.

Kammerer states that the case of *Ciona intestinalis* affords an *experimentum crucis*. He certainly exhibited photographs of living Ciona in the parents of which the siphons had been several times amputated. In these young specimens the siphons were "monstrously long," and had been so "from birth." Putting aside the fact that Ciona is not, I believe, viviparous, where were the controls? I have a very strong suspicion that all young Ciona when extended under favourable conditions (*e.g.* supply of oxygen and food) have "monstrously long" siphons. The evidence required is a large number of exact measurements, under the same conditions, of the siphons in the young of parents which were subjected to amputation, and in those of uninjured parents. J. T. CUNNINGHAM.

East London College, Mile End, E.,
May 12.

Vertical Change of Wind and Tropical Cyclones.

THE first step towards forming an opinion about the physical processes which operate in the formation and maintenance of tropical cyclones is a clear

understanding of the structure of the atmosphere in which the formation takes place. A feature of the atmospheric structure which is gradually asserting itself is the resilience of stratification due to the increase of potential temperature with height. We have always recognised isothermal structure as stable, still more so an inversion of lapse rate; but, when one thinks of it, it is clear that the datum for stability is the lapse rate of the saturation adiabatic for upward movement, and that of the dry adiabatic for downward movement. Anything on the isothermal side of these lines implies stability and resilience upon displacement, gradually and continuously increasing up to the isothermal condition and beyond that to inversion.

Since the stratification is only disturbed by saturated air sufficiently warm, the successive layers of the atmosphere in ordinary conditions may be regarded as independent layers, easily capable of motion along surfaces of equipotential temperature, but unable to move up or down across those surfaces. In this respect the layers are like a pack of cards, deformable with a certain amount of resilience, very slippery, but not interpenetrable. The impenetrability of one layer by another is quite inexorable at the bottom, where there is a discontinuity of density between land or water and air, and at the top of the troposphere, where there is thermodynamic discontinuity no less effective in the end, though the effort involves much greater sacrifice in the way of displacement required to produce the necessary resilience. Between these two extremes of resilience the surfaces of equipotential temperature are nearly horizontal. Expression is usually given to the principle of resilience by regarding the motion in any layer as being limited to the horizontal. Of course, the limitation excludes the cases of penetrative convection which sometimes occur, and also the eddy effects due to the motion of a layer relative to the next above or below. But one is as rare as heavy rainfall, and the other, though never absent, is very small in magnitude. Thus for a first survey both may be left out of account.

Also, to begin with, it is best to think of the atmosphere as made up of a number of layers of finite thickness, and not attempt the gradation of an infinite number of layers of infinitesimal thickness. There is often a natural sorting of the structure into irregular strata; but, for the moment, let us think of twenty layers each half a kilometre thick between the ground and the stratosphere, the two boundaries the resilience of which must eventually balance the internal stresses of a quasi-permanent cyclonic vortex.

The motion in each of the twenty layers except the lowest will adjust itself to the distribution of pressure in that layer. The law of the lowest stratum is different. In consequence of surface friction there is a flow across the isobars, with all the disturbing consequences thereof.

As we regard the undisturbed medium as a pile of twenty horizontal layers, so we must regard a cyclonic system as made up of a number of independent layers. We must consider the vortical motion produced in the medium as twenty separate rotating discs, not as a unified rotating column. There is practically nothing in the structure to prevent the slipping of one disc of revolving fluid over another to any extent. The unit of cyclonic activity is not a column reaching from earth to heaven, but a layer, say half a kilometre thick, with a mass of fluid revolving according to its own laws between the upper and lower boundaries.

In these circumstances, if the centres of the revolving masses were accurately superposed to begin with, it would be a marvel of Nature if they remained so. Since pressure is transmitted, the displacement of one would alter the distribution of pressure for all beneath, the inflow at the bottom would affect the mass-distribution of those immediately above, and the relative motion at the surfaces of separation would add further complications.

If all this be correct, what might once have been a vertical revolving column, in a stream of which the velocity varied with height, would soon have become a number of separate and more or less degraded revolving discs. If there happened to be a thick enough layer in the original medium without any height-change of velocity, there might be enough organised rotational energy to preserve the original identity: otherwise the energy would soon be lost in eddies and ultimately in frictional heat.

I am not sure whether Mr. Banerji (NATURE, May 19, p. 668) realises that that was the kind of structure which I had vaguely in mind three years ago when I wrote the remarks in Geophysical Memoir, 19, to which he refers. The lapse of time has enabled me perhaps to think it out more clearly and to develop further the condition for no change of velocity with height. If one imagines a number of masses of saturated air overcoming the resilience locally, passing through a series of superposed layers of air and removing therefrom automatically, by eviction, a vast quantity of air amounting in the aggregate to millions of tons, each layer must set up its own scheme of pressure and rotation independently of the others. As a means of making a rotating column the experiment could scarcely succeed if, by the time that the removal was complete, the centres of the upper systems were displaced horizontally a long way from the lowest; the superposed pressures and the incidental relative motions would certainly spoil the symmetry and in time destroy the unity of the system.

The monsoon winds, of the peculiar behaviour of which Mr. Banerji speaks as being sufficient to account for the movements of the cyclonic storms in Indian seas, belong to the lowest kilometre and are therefore not properly amenable to the distribution of pressure. To my mind surface winds are primarily disturbers and destroyers of ordered vortical motion. A well-organised cyclone may succeed in feeding on their energy and thus increasing its own vigour in the way which Dr. Fujiwhara described recently to the Royal Meteorological Society. In Geophysical Memoir, 19, I was not dealing with that part of the subject, but only with the initial stages of the creation of the vortex.

NAPIER SHAW.

April 27.

The Relation of Actinium to Uranium.

AT present the most likely view of the origin of the actinium series is that uranium II undergoes a dual change in which about 96 per cent. of atoms form ionium and the radium series, and the remainder form uranium Y, the product of which, proto-actinium, is the parent of the actinium series. An alternative view is that uranium I undergoes the dual change. In 1917 Piccard from a consideration of the Geiger-Nuttall relation put forward the view that the actinium series might arise from an isotope of uranium, actino-uranium, of atomic weight 240, present in ordinary uranium to the extent of about 8 per cent. Partly from experimental work carried out by Mr. W. P. Widdowson and myself, and partly from a survey of certain general relations in radio-activity,

I have come to a different view, which I think represents the facts more adequately than these others. I agree with Piccard in thinking that the parent substance of the actinium series is an isotope of uranium, of atomic weight 240, not genetically connected with it; but differ principally in thinking the atomic weight of actinium is not 232, and that uranium Y is not the immediate parent of proto-actinium.

The scheme is as follows :

Element.	Period.	Atomic Number.	Radiation.	Atomic Weight.
Actino-uranium I .	$>5\times10^9$ years	92	α	240
Uranium Y_1 . .	25·5 hours	90	β	236
Uranium Y_2 . .	Probably very short	91	β	236
Actino-uranium II .	$>2\times10^6$ years	92	α	236
Parent of proto-actinium . .	>20 years	90	β	232
Proto-actinium .	$<1{\cdot}2\times10^4$ years	91	α	232
Actinium . . .	20 years	89	β	228
Radio-actinium, etc.	19·5 days	90	α	228

This scheme was arrived at from a consideration of the periods of corresponding members of the three disintegration series. Successive radio-active transformations may be classed in three ways :

(1) Four α-particles (five in the uranium series) follow each other without the expulsion of a β-particle.
(2) An α-particle is followed by two β-particles in succession and then an α-particle.
(3) An α-particle is followed successively by a β-, an α-, and a β-particle.

In the three known examples of the first type each product has on the average 800 times the period of its successor. (For the uranium series the ratio is 766, for the thorium 764, for the actinium 918.) Yet the periods of average corresponding members of the three series (in the order given) are in the proportion of 5×10^5, 50, and 1. Now the difference in atomic weight between the uranium and the thorium series is 2 only. I have assumed that if a time ratio of 5×10^5 to 50 corresponds to 2, a ratio of 50 to 1 corresponds to so small a fraction as to be negligible. If this be justifiable the atomic weights of the thorium and actinium series become identical. It follows that actinium has an atomic weight of 228 and so cannot be genetically connected with uranium if α- and β- be the only particles expelled in radio-active transformations.

I have found interesting relations connecting the periods of the bodies of the second and third types of successive transformations, but the only thing necessary for the scheme to be deduced is that in both these types the period of the first β-particle is greater than that of the second. There are in all, excluding the change, parent of Pa$\rightarrow$Pa$\rightarrow$Ac$\rightarrow$RdAc, ten examples of the second and third types known, in all of which this relation holds. It is consequently not unreasonable to suppose that the parent of proto-actinium has a longer period than actinium and consequently cannot be uranium Y. As the latter is very probably genetically connected with actinium, and is undoubtedly a product of a body of atomic number 92, it must be an isotope of the parent of proto-actinium probably with an atomic weight 4 units greater. To connect it with the parent of proto-actinium it is simplest to suppose that it is followed by a quick-changing product uranium Y_2, corresponding to uranium X_2, which is the parent of an isotope of the original actino-uranium, and this immediately precedes the parent of actinium as shown in the table above.

The scheme, so far as I am aware, does not seriously contravene the results of experimental work, and appears to be nearer what one would expect by analogies from the thorium and uranium series and the lower part of the actinium series than those previously proposed. None of the new proposed data given in the table contravene the Geiger-Nuttall relation. Moreover, they appear to make Fajan's rules connecting the order of the atomic weights of isotopic α-ray and β-ray bodies with the order of their periods more nearly exact than hitherto they have appeared to be. To Fajan's α-ray rule there have been hitherto three exceptions; on the new scheme there is only one. The two exceptions to his β-ray rule do not exist in the new scheme.

Our experimental work on the relative activity of uranium and its products in pitchblende leads to a ratio in the amounts of actinio-uranium and uranium I in uranium of about 5 to 95. But the experimental results to be expected on the assumption that uranium II breaks up dually in this proportion to form the actinium and radium series lead to so similar a result that at present our experimental work is insufficiently advanced to lead to a decision.

Mr. W. G. Guy in this laboratory has been for some time engaged with me in repeating Dr. O. Hahn's work on uranium Z as described in the latter's publication of 1921, and has independently come to very similar results to those described in Hahn's second and recent paper. He confirms Hahn's important result that uranium X_1 breaks up dually, in both cases with the emission of a β-particle to form uranium X_2 and uranium Z in a ratio of about 997 to 3. He has also measured the periods of uranium Y, uranium Z, and uranium X_2 accurately, and finds them to be 25·5 hours, 6·69 hours, and 70·5 seconds respectively. These agree with the published values. Dr. Hahn does not appear to have noticed that the branching ratio, which he gives as 996·5 to 3·5, is approximately equal to the reciprocal of the periods of the two bodies formed. This agreement may be a coincidence. If it is not, it would not be difficult to deduce from it information which might throw light on the mechanism of disintegration.

A. S. RUSSELL.

Dr. Lee's Laboratory, Christ Church,
Oxford, May 3.

Slag mistaken for a Meteorite at Quetta.

WIDE publicity has been given in the Press to a story of a fall of a large meteoric mass in Quetta, Baluchistan Agency.

The Geological Survey of India has always paid particular attention to falls of this kind, and, within an hour of the receipt of the news in Calcutta, was in telegraphic communication with the authorities in Quetta, and the receipt of specimens was anxiously awaited. Ultimately, approximately two hundredweights of material were carefully examined, and found to be entirely a glassy slag in which were embedded bits of iron wire and thin iron bands.

So far as can be judged, the sequence of events was as follows : A large stack of baled bhoosa (chopped straw) of about five hundred tons weight was fired by a flash of lightning during a heavy thunderstorm, and a mass of slag some five tons in weight was left behind. A bystander suggested that this mass was of meteoric origin.

G. H. TIPPER.

Geological Survey of India, Calcutta,
March 11.

Vision and Light Sensitiveness.

IN my former letter (NATURE, April 14, p. 498) I endeavoured to avoid dogmatism on this very obscure subject, and aimed rather at stimulating further research in what seems to be a phenomenon of great importance. Though I go all the way with Mr. Locket (NATURE, April 28, p. 570) in cautioning the utmost reserve in accepting my hypothesis, especially as, in my letter, it is supported, and designedly so, by no more definite evidence than the flicking of a fly; still, in the interests of research, I feel called upon to add some comments to his letter.

I have collected a large mass of evidence which, however, cannot be published *yet*, as it is far from complete. Moreover, as much of it appears to contradict the conclusions of great authorities, some of whom Mr. Locket mentions, it obviously cannot be urged until I have repeated each essential portion of it more than once, and explored in each experiment every possibility.

First of all, then, I submit that it is of the utmost importance to differentiate clearly between *sensitiveness to light* and *vision*, both in experiment and in deduction; for vision is by means of eyes, light sensitiveness not necessarily so. Plateau has proved (*Journal de l'Anat. et de la Physiol.*, 1886, p. 431) that certain myriapods distinguish between light and darkness by the general surface of the skin; though Forel and Lord Avebury have proved this not to be the case with ants. It would be interesting to know if it is so in Typhlopone, where there are no eyes. Wherever there are eyes I think we may, for the present, assume that there is sensitiveness to light, but this is far different from presuming that there is vision. I have been unable to discover any evidence for vision in the Epeiræ studied, or in *Tegenaria domestica* or *Agelena labyrintheca*, when proper precautions have been taken. In these instances a fly, with the wings cut off, will not disturb them; but, if the fly have wings or stumps of wings with which it can buzz in the forceps then the case is very different. The necessity for taking every precaution may be shown by the extreme sensitiveness of *T. domestica* to the presence of carbon dioxide, so that even slight breathing on the specimen causes movement. Though this spider will revive after a collapse of five minutes in a vacuum at 6 mm. of mercury, though it will live for some minutes apparently with comfort in coal gas, an atmosphere of carbon dioxide kills it instantly.

Another precaution, most essential to success, is to avoid casting shadows on the animal under observation; in the case of the black-bellied tarantula (*Lycosa narbonnensis*), and in very many others, there is a manifest seeking for light. This is most apparent when the young are on the parent's back. Here, possibly, lies the solution of this enigma. This spider carries her young on her back with, so far as I can see, no food for about six months. These fasting youngsters grow strong, expend energy, and certainly do not become emaciated. Do they get their energy from the air alone? Do they possibly get it from the sun, as vegetable life does? I cannot yet answer this. Here the investigation would extend from the pigment-spot in *Euglena viridis* to the facts of modern heliotherapy.

Turning to Mr. Locket's remarks on the ants, the species employed for the most part were *Formica fusca* and *F. sanguinea*. In these insects Forel (*Rec. Zoolog. Suisse*, 1887) has proved that there is normally sensitiveness to light which is destroyed by varnishing the eyes, and Lord Avebury mentions ("Ants, Bees, and Wasps," 13th edition, p. 405) their sensitiveness to "ultra-violet rays much beyond our limits of vision." This same authority says quite plainly (*op. cit.* pp. 273, 272, 266, 256, 251) of *Lasius niger* that, "though it seems clear that they are helped by sight," they do not trust much to their eyes, and are "little guided by . . . surrounding objects." In another experiment, "if she [the ant] were much aided by sight, then she would have had little difficulty in finding her way back." On the other hand, he concludes from further work (pp. 268, 270) that by altering the *position of the lights* "the ant went wrong," and that, "in determining their course the ants are greatly influenced by the direction of the light." Here the difference between mere *light sensitiveness* and *vision* is strongly supported.

Forel's experiment ("Senses of Insects," pp. 124-128), noted by Mr. Locket, had seemed to me conclusive until I repeated it, taking care to supply several control ants the eyes of which were varnished with a transparent fluid. From the results I concluded that the difficulty in finding home was as much due to the annoyance of being handled and varnished as to being hoodwinked.

When working on the flies, including both species mentioned by Mr. Locket, I did not varnish the eyes; I used a second sheet of glass between the fly's back and the moving object. Still this experiment with the second glass was not repeated often enough to allow me to state my results with assurance, and I agree with Mr. Locket that varnish should have been employed. With regard to the motion of air,—and this is the kernel of Commander Hilton Young's hypothesis,—vibration due to sound waves and simple air currents must be treated separately. Many insects and spiders are extremely sensitive to the former, and there can be no doubt that the fly is sensitive to the latter, though I doubt whether to the extent suggested by Commander Hilton Young.

I cannot agree with Mr. Locket in his use of the ocelli as an explanation. It was, I think, Johannes Müller's opinion that they were especially useful for close vision. But we have the authority of Plateau, Forel, Réaumur, Marcel de Serres, Dugès, Lord Avebury, and others, that varnishing of these organs made no difference. Though many, with Forel (*Rec. Zoolog. Suisse*, 1887), Lebert ("Die Spinnen der Schweiz"), and Pavesi (*Ann. Mus. Civ. di Genova*, 1873, p. 344), suggest that the ocelli serve for vision in semi-darkness, and the eyes for vision in full light, the experiments I have made in this field, necessarily obscure, have been fruitless, so far as I have been able to devise them.

The instance of the male Attid, given by Mr. Locket, I have not worked on yet; as well as the many examples of what appears to be lethal fascination as in *Mantis religiosa*. There is clearly an enormous amount of work to be done,—so far I have not touched the scorpions,—and I speak, as I did in my former letter, only of those species which I have studied, necessarily few relative to the vast kingdom under discussion. So I can end no better than again, with Mr. Locket, cautioning reserve.

J. P. O'HEA.

St. Beuno's College, St. Asaph,
April 29.

Phosphorescence caused by Active Nitrogen.

IN a letter under this title in NATURE of May 5, p. 599, Prof. E. P. Lewis announces his recent discovery that active nitrogen excites phosphorescence in a number of solid compounds. I should like to mention that during the summer of last year I observed the same phenomenon in the case of an

aluminium compound, which does not, however, occur in the list of substances given by Prof. Lewis.

In resuming, during July last, a series of spectroscopic investigations begun in 1913 on the lines of earlier work by the present Lord Rayleigh and Prof. Fowler, I attempted a preliminary observation of the spectrum resulting from the introduction of the vapour of aluminium chloride into the stream of active nitrogen. After a long exposure a solid deposit was produced on the inside of the afterglow tube, and when the stream of active nitrogen was passed through the same tube a few days later the deposit exhibited a bright green fluorescence. It was hoped that this observation might be recorded in a future paper, after opportunity for further spectroscopic work had occurred. In view of Prof. Lewis's announcement, however, perhaps this note by way of corroboration is not out of place.

W. JEVONS.

Physics Department,
Artillery College,
Woolwich, May 11.

The Dissolution of the Conjoint Board of Scientific Societies.

ACTING under the instructions of the Executive Committee, we have now wound up the affairs of the Conjoint Board of Scientific Societies.

Everything connected with the "List of Scientific Periodicals" has been placed in the hands of the Trustees who have been appointed to carry out this publication. The work on the List is now well advanced.

The Royal Society has agreed to accept the custody of filed records and documents related to the work of the Board and its Committees, with the exception of that just mentioned. These have now been lodged with the Society, except the records of three Committees, at present in the hands of their secretaries for final revision before lodgment with the Society.

Copies of the proceedings of the Board have also been deposited with the British Museum, the Royal Society of Edinburgh, the Patent Office, Sir Arthur Schuster, Sir Herbert Jackson, and Prof. W. W. Watts. Sets of printed matter have been also handed to the Department of Scientific and Industrial Research, the National Physical Laboratory, the Science Library, the University of London, the Imperial College of Science and Technology, the British Museum (Natural History), and the London Library.

HERBERT JACKSON.
W. W. WATTS.

May 14.

The Capture of Electrons by Swiftly Moving Alpha Particles.

THE swiftly moving α-particle produces a large number of ions in its passage through a gas, as is evidenced by the beautiful Wilson photographs of α-ray tracks. It is a matter of some surprise that at the act of ionising a molecule, or immediately after, the α-particle does not attach one or more of the free electrons to itself. The approach is very near and the force is that due to a double charge.

The experiments of Rutherford, Marsden and Taylor, and others indicate that the swiftly moving α-particles begin to take up electrons when the velocity has decreased to 0·4 of the initial value ($v_1 = 0{\cdot}4\ v_0$). The recent experiments of Henderson (Proc. Roy. Soc., January 1, 1923) indicate that at this velocity the α-particle takes up one electron. It then continues its smashing career through matter without change until the velocity is reduced to 0·15 of the initial value ($v_2 = 0{\cdot}15 v_0$). At this velocity, approximately, the α-particle takes up a second electron and becomes a more or less harmless atom of helium.

The limiting velocities at which the α-particle captures the first and then the second electron seem to be rather definitely fixed. The initial velocity from radium-C is $v_0 = 2{\cdot}06 \times 10^9$ cm./sec. The velocity at first capture is $v_1 = 0{\cdot}4 v_0 = 8{\cdot}2 \times 10^8$ cm./sec. The velocity at second capture is stated by Henderson to be at least as small as $v_2 = 0{\cdot}15 v_0 = 3{\cdot}1 \times 10^8$ cm./sec.

It is desired to point out here that this failure to capture an electron may be due to the high velocity of the α-particles. The free electron will at once start toward the α-particle. If the latter is moving with a velocity greater than the velocity of fall (parabolic velocity) of an electron into the K ring, the electron will fail to reach the K ring and effect a combination. Having this situation in view, I have calculated the limiting parabolic velocity for an electron falling into the K ring of (1) a doubly charged α-particle and (2) one having a single charge. The radius of the K ring is given by $a = h^2/4\pi^2 meE$, where E is the excess nuclear charge in each case. This velocity is given by $\frac{1}{2}mv^2 = Ee/a$. From these considerations the calculated velocity for the first case is $v_1 = 6{\cdot}2 \times 10^8$ cm./sec. In the second case the charge E is single, and the velocity $v_2 = 3{\cdot}2 \times 10^8$ cm./sec. The experiments are necessarily not very exact, but the agreement is sufficiently close to suggest that this may be the proper explanation of the action.

From this point of view, all α-rays, of whatever initial velocity, should capture the first and second electrons at the same velocity. This is a matter of sufficient importance to determine experimentally.

BERGEN DAVIS.

Columbia University,
New York.

Recent Auroræ.

MAGNETIC disturbances and associated phenomena have perhaps a special interest when they occur during the minimum period of sunspot activity, owing to the comparative rarity of these events at this time. When, therefore, I read in NATURE of April 21, p. 534, the account by Father Cortie of the recent disturbances, it reminded me of observations I had made of the aurora in activity on the dates referred to. On February 25, in a very clear sky, with a nine-days-old moon shining, the northern horizon was seen to be brightly illuminated by auroral light at 8.45 P.M. for about half an hour, but no streamers were seen. On March 24, again in first-quarter moonlight, but a very hazy sky, I saw an auroral display of unusual beauty at 9 P.M. over Bassenthwaite Lake. The arch was elevated ten degrees, with streamers and lances shooting upwards for, in some cases, another thirty degrees. The length of the arch I could not measure, owing to each end being hidden by lofty mountains, but it was visible for sixty degrees. It was clear-cut below, and merged gradually into the moonlit haze above.

The reflection of the streamers in the perfect mirror-like surface of the lake, and the shining arch flanked by snow-capped heights, dimly seen in the misty moonlight, combined to form a picture of indescribable beauty.

W. B. HOUSMAN.

Seaton, Cumberland,
April 25.

Recent Experiments in Aerial Surveying by Vertical Photographs.[1]

By Prof. B. MELVILL JONES and Major J. C. GRIFFITHS.

I.

IT is proposed to describe in these columns the results of experiments on aerial surveying that have been in progress at the University of Cambridge since 1920. The experiments were made possible by the co-operation of the Royal Air Force and the Department of Scientific and Industrial Research with the chair of aeronautics at Cambridge. They were suggested in the first place by Mr. Hamshaw Thomas of Cambridge as the result of his experiences of air-mapping in Palestine during the War. The authors wish to acknowledge their debt to Mr. Thomas, not only for the original suggestion, but also for valuable advice during the progress of the work.

To make an accurate survey by air, it is necessary to have information concerning the position and orientation of the camera at the moment of exposure. If the ground concerned is flat and the tilt of the camera is known, the photograph can easily be re-projected to give a true plan. When the ground is hilly, two photos of the same area, taken from known points, and with known tilts, will provide information from which a complete model, or map with contours, can be constructed.

If three points that are accurately known in position occur in a photo, it is possible to find the position and orientation of the camera from internal evidence in the plate itself. This process is called "re-section." It is thus theoretically possible to map an indefinite area of country from a single base of three known points, for these points could be made to occur in the first two photos, which could then be used to determine the positions of other points, from which further photos could be re-sected, and so on. In practice this process would lead to accumulations of error which, with the methods yet available, would soon become prohibitively large. It is for this reason necessary, if the re-section method is to be used at present, to provide a net of ground-surveyed control points such that three will occur in most, if not all, the photographs.

When the aerial map is merely required to record changes, or to fill in detail in a country that has already been closely surveyed, as, for example, in the war mapping of the Western Front, or in the re-mapping of towns in peace, many accurately surveyed points will already exist and the re-section method will be the obvious one to use. When, however, the problem is to map large areas of unsurveyed country, as, for example, the interiors of Australia or Africa, the cost of providing so many ground-surveyed points will generally be prohibitive. This will be especially the case when the country is flat and heavily wooded.

It is, however, precisely in connexion with large areas of this nature that the outlook for aerial surveying, on a large scale, is most hopeful. In such cases it will not, in general, be practicable to spend much money per square mile of survey, so that it becomes necessary to employ methods that neither require a close preliminary ground survey nor involve too much office labour per photo. Both these conditions rule out the re-section method for work of this class.

Now exact determination of the position and orientation of the camera in space, by methods that are independent of the photo itself, is a matter of great difficulty, but it happens that an exact plan of level country can be constructed from overlapping photos, without knowing the exact position of the camera, provided that all the photos are taken from the same height and with the camera axis vertical. The reason for this is that all such photos will show a true plan of the ground to the same scale, and therefore they can be shuffled together, until the detail joins up everywhere and a true plan is formed.

If, therefore, a camera can be kept at a constant height, with its axis vertical, and moved about over the ground, so that the whole country is covered by overlapping photos, it will be possible to construct a continuous plan of the ground from contact prints straight from the original negatives; and it will not be necessary to provide for known points to appear on each photo, or to determine the position of the camera at each exposure. Moreover, the heavy office work involved in re-secting and re-projecting each photo will be avoided entirely.

Such a process is strictly accurate only when applied to absolutely flat country, but when working from 10,000 feet, as we do, undulating country up to about 500 feet local differences of level can be classed as sufficiently flat from this point of view. It must also be remembered that flat country is often the most difficult to survey from the ground, and is therefore the country in which an alternative method is most required.

We are thus led to the conclusion that the economical mapping of moderately flat country, by means of vertical photographs, depends upon the accuracy with which the camera can be maintained at a constant height, with its axis vertical, and upon the ability of the pilot to fly so as to cover all the ground with photographs that will neither overlap too much nor leave gaps. The experiments at Cambridge have been concerned mainly with the accuracy obtainable in these operations, given suitable apparatus and sufficient training in air routine.

FINDING THE VERTICAL.

The problem of keeping a constant height is quite straightforward and easy to understand; the only difficulty is to do it. The problem of keeping the camera axis vertical is complicated by the fact that all forms of apparatus that are designed to indicate the vertical are disturbed by horizontal accelerations of the aeroplane, which often persist in one direction for so long as twenty seconds at a time. It is possible to devise gyroscopical instruments that will seek the vertical so slowly as to average out these disturbances, but much experience has been gained with instruments of this type during the War, and this experience was not encouraging, mainly owing to the liability to failure of the delicate apparatus required.

In aerial surveying it is, however, necessary to fly

[1] Substance of two lectures delivered at the Royal Institution on February 15 and 22.

very straight and steadily in order to cover the ground correctly, and, when one is flying straight and steadily, simple vertical indicators such as the spirit level indicate truly.

Now it had been found, in connexion with bombing experiments during the War, that it is comparatively easy to fly very straight and steadily when no other condition is imposed, but that it is much more difficult to do so when trying to pass over a pre-arranged point. The reason for this is that the pilot normally estimates the horizontal and vertical by reference to the horizon, and, when forced to look at the ground beneath him, is quite unable to distinguish the true vertical from the apparent vertical as distorted by acceleration.[2] It is obviously necessary to look at a point in order to get over it, so that the reason for the distinction between merely flying straight and flying straight over an object is at once apparent. To overcome this difficulty it is necessary to devise methods of carrying out the survey with the minimum attention to the ground beneath.

We decided to divide our experiments into two groups as follows :

1. To study the accuracy with which it is possible to keep the camera at a constant height with its axis vertical, when the difficulty of finding a predetermined track is reduced to a minimum.

2. To find out how to fly over a predetermined straight track without losing accuracy from that determined above.

In connexion with the first group of experiments, we were fortunate in having near Cambridge a stretch of very flat country covered with numerous well-mapped and easily identified points and traversed by two large straight canals, more than twenty miles long, called the Bedford Levels.

It is easy to fly down a long straight landmark of this nature with very little attention to the ground immediately beneath. We therefore flew along these canals at about 10,000 feet, keeping as straight and level as possible, and taking a series of photographs at regular intervals. We then developed these photos and, from them and a 6-inch Ordnance Map, calculated the position and orientation of the camera at the moment of exposure by the method of re-section.

The re-section was very laborious, but eventually, after about two years' work, we obtained results for 170 exposures, and these showed a probable error of tilt of about 1° from the vertical and a probable variation of height from the mean of a flight of 40 feet. The distribution of errors in both tilt and height was quite normal.

From this data it is clear that the tilt of the camera axis from the vertical seldom exceeded 2° and that the height of the camera seldom varied more than 100 feet from the mean of each flight. Simple calculations, supported by previous experience in Palestine, lead to the conclusion that such errors should not introduce serious errors into maps made on the assumption that the axis is vertical and the height constant. This excludes, of course, errors that are cumulative over large distances.

[2] It is easily shown that a pilot, looking down at a point beneath him and trying to fly so as to pass over it, will tend to fly along one of a series of curves of which the equation is $p\rho$=const., where p is the perpendicular from the origin on the tangent from the point where the radius of curvature is ρ. These curves in general never pass over the required point (*i.e.* the origin).

Covering the Ground without Gaps.

The second problem was to cover the required country to be surveyed without leaving gaps and without losing accuracy. It is on this problem that most attempts at commercial surveying have broken down, the primary cause of failure being the inability of the pilot to distinguish between the true and apparent vertical. So long as the pilot is allowed to look constantly down at the ground, in an endeavour to cover it accurately, tilts up to six or more degrees are liable to occur, and the tracks that are made under these conditions are often so curved as to cause large gaps between the strips of photos.

By experiment we have found that the best way to solve the difficulty lies in allowing the pilot to locate his position by reference to the ground beneath, at the start of each flight only, and insisting that he must fly henceforward without further reference to the ground.

To do this in such a way that successive flights on the out and return journeys will cover the ground in parallel strips, it is necessary, first, to find and allow for the wind at the height in question. This we do by a method that was developed by the Air Ministry for purposes of aerial navigation, and we have brought the routine to such a pitch that within ten minutes after reaching the survey height, 10,000 feet, we can find the wind and make all necessary calculations for compass courses, etc. It requires considerable training and experience before this can be done.

However good the methods employed, the strips on successive journeys will not be exactly parallel, and, since they are located only at one end, their length will obviously be limited if gaps are to be avoided. We find that this limit comes out at between 10 and 15 miles. The starting points for the strips are either marked on existing maps or on preliminary strips of photographs, taken along the edges of the mosaic at right angles to the mosaic strips ; these preliminary strips are called "indication strips."

The pilot, therefore, begins by getting over a point, as accurately as he can, and then taking up a pre-calculated compass bearing as quickly as possible. A difficulty may here be experienced owing to the well-known fact that compasses on aeroplanes are affected by a change of course and do not settle down on a true bearing until the aeroplane has been flying straight and steadily for some time. If the pilot has managed to get over the starting point while flying on the correct bearing, this difficulty will not arise, but when working from tractor aeroplanes, as we are forced to do, one cannot always manage this, because the lower plane obstructs the view of the point during the approach, unless the approach is made in a curve.

To overcome this difficulty we use an apparatus designed by the Royal Aircraft Establishment. This consists of a free gyro that can maintain its orientation in space for some ten minutes, without reference to the movements of the aeroplane. We release this gyro while flying on the required course, just before reaching the starting point, and use it to return to the correct course immediately after passing the point. We consider that an apparatus of this nature will always be a great help in aerial surveying, especially when working from tractors, but we think that a

survey could be successfully carried out without it when working from pushers. When flying without this apparatus, either more skill is required, or the beginnings of each strip will be rather less accurate than they might be.

The photographic strips themselves can be kept straight by flying on a distant point near the horizon, but this operation can be much assisted by another gyro instrument that controls the rudder through a relay and thus keeps the aeroplane on a straight course automatically. This apparatus relieves the pilot of the most fatiguing part of his work and, by allowing him to concentrate more on such things as maintaining constant height and speed, improves the general quality of his work. We have carried out surveys both with and without this instrument, and, while we have proved that accurate work can be done without it, we should always recommend its use in any large surveying scheme.

AREA COVERED IN A FLIGHT.

We have found from experience that 100 sq. miles is about the area that can conveniently be covered in one flight. This requires about 80 minutes flying on the actual mapping and about three hours from ground to ground. This amount of work is about what a crew can perform regularly, day by day; hence it follows that aerial surveying by these methods can be carried out at the rate of about 100 sq. miles per day. If the separate strips are made ten miles long, the average day's work will, therefore, cover a square of ten miles to the side.

We have found that an area of 100 sq. miles, involving about 130 photos, forms a convenient unit for compilation, for, although we have compiled a very successful map of 225 sq. miles in one unit, we consider this to be too large for economical work. The method, therefore, that we favour for mapping large areas, is to compile the prints of each day's work into separate mosaics and, after reproducing these to any required scale in a large camera, or photostat, to fit these larger units together in the same way as the individual prints were fitted.

(*To be continued.*)

Science and Radio-Communication.[1]

By Sir RICHARD GLAZEBROOK, K.C.B., F.R.S.

PROBLEMS in which there is a close connexion between theory and practice can be found in every branch of engineering, perhaps with more striking effect in electrical and metallurgical science, in the laws of stress and strain in structural materials, and in the fatigue of parts subject to vibration, rather than in the questions which pertain more closely to the domain of civil engineering. Let me deal first, briefly and incompletely it must be, I fear, with that branch of electrical engineering—radio, or wireless telegraphy—which at present exercises such a fascination over the popular mind, which is already and will be to a greater extent in the future a link to bind together all nations of the earth. Sir William Anderson, in the first James Forrest lecture delivered thirty years ago, refers to Preece's early experiments between Lavernock and Flatholme, a distance of eight miles, as a startling consequence of electro-magnetic theory. Now the earth is girdled with a wireless chain depending from two, or at most three, great stations. I have just received from the International Union for Scientific Radio Telegraphy details of a scheme for the determination of longitude in which the principal co-operating stations will be Bordeaux, Annapolis, and Pearl Harbour.

In the year 1865 Clerk Maxwell read before the Royal Society his paper on "The Equations of the Electro-Magnetic Field." It was an attempt, which has stood the test of time—the conditions which led Lorentz and, later, Einstein to introduce certain modifications were not dealt with by Maxwell—to apply mathematical reasoning to those principles, enunciated by Faraday, on which the construction of generators and motors, transformers, and practically all electrical machinery is based. This reasoning led him to the result that the effect of changes in an electric current in a conducting wire would be propagated through space with a speed depending on the two constants[2] which define the electric and magnetic conditions of the medium surrounding the wire. The values of these constants for air can be found from electrical considerations, and hence the velocity with which electro-magnetic disturbances are propagated can be calculated. To quote his words:

"We now proceed to investigate whether these properties of that which constitutes the electro-magnetic field, deduced from electro-magnetic phenomena alone, are sufficient to explain the propagation of light through the same substance," and his conclusion is: "The agreement of the results seems to show that light and magnetism are affections of the same substance and that light is an electro-magnetic disturbance propagated through the field according to electro-magnetic laws."

Maxwell found that when the calculations were made the resulting value for the velocity was approximately equal to the velocity of light. The work was extended in his "Treatise on Electricity and Magnetism," published in 1873. The values of the velocity of light and the velocity of propagation of electro-magnetic waves were not known then with present-day accuracy, and he concludes that they are quantities of the same order of magnitude. A glance at present-day[3] figures shows that they are identical, and the electro-magnetic theory of light is universally accepted. Nor was the result true only for propagation through air or interstellar space; such observations as were then available showed that, in all probability, it held for all transparent media, though there were discrepancies, known now to

[1] From the James Forrest lecture on "The Interdependence of Abstract Science and Engineering," delivered before the Institution of Civil Engineers on May 4.

[2] The velocity is given by $1/\sqrt{\mu k}$, where k is the inductive capacity and μ the magnetic permeability of the surrounding medium.

[3] Messrs. Rosa and Dorsey of the Bureau of Standards, discussing the various determinations of the electro-magnetic velocity, express the view that the figure $2{\cdot}9980 \times 10^{10}$ cm./sec. is accurate to 1 part in 10,000, while the best result for the velocity of light is, to the same accuracy of measurement, $2{\cdot}9986 \times 10^{10}$ cm./sec. See "Dictionary of Applied Physics," vol. ii.

be due to dispersion, which required explanation. But there was a wide gap between this theoretical deduction of Maxwell and the wireless telegraphy of to-day, which needed many more investigations in "pure" science before the bridge was complete. We at the Cavendish Laboratory—I was a student at the time—implicitly believed in its truth; but no one had received electro-magnetic vibrations—at any rate, to his certain knowledge. The method of generating them and the means for measuring them were still to come.

For the former we have to go back to a remarkable paper [4] by a very distinguished honorary member of this Institution, Lord Kelvin. Helmholtz [5] seems to have been the first to conceive that the discharge of a condenser through a wire might consist of a forward and backward motion of electricity between the coatings—a series of currents in opposite directions. Lord Kelvin took up the question mathematically and investigated the phenomena. He showed that under certain conditions there would be oscillations of periodic time $2\pi\sqrt{LC}$, where L is the inductance of the coil, and C the capacity of the condenser. These oscillations must, according to the theory, give rise to waves travelling out into space with the electro-magnetic velocity. Fitzgerald, at a meeting of the British Association, had predicted in 1883 that they might be produced by utilising the oscillatory discharge of a Leyden jar, and Sir Oliver Lodge in 1887 produced and detected them. For their detection the principle of resonance was employed. Any mechanical system free to vibrate has its own period of oscillation, and the application to it of a series of small impulses at intervals coincident with the free period of the system results in a disturbance of large amplitude. So, too, an electric system having capacity and inductance has its own period of electrical oscillation, and, if this coincides with the period of incoming electrical waves, electrical disturbances of a magnitude which can be detected by our apparatus are set up. It is necessary that the receiver and the transmitter should be in tune. Lodge made use of this principle, and, by receiving the waves on wires adjusted to resonance with his Leyden jar and coil, was able to detect them. David Hughes, working in the early 'eighties, had already detected such oscillations, but was discouraged from pursuing the subject.

In 1879, in consequence of the offer of a prize by the Berlin Academy, the attention of Heinrich Herz, then a student under Helmholtz, was attracted to the problem of electric oscillations and their detection. He came to the conclusion that with the means of observation then at his disposal "any decided effect could scarcely be hoped for, but only an action lying just within the limits of observation." The investigation was laid aside, only to be revived in 1886 by a chance observation of the effect of resonance in two circuits which happened to be in tune, and his realisation of the fact that herein lay the means of solution of his problem. His paper "On Very Rapid Electric Oscillations" appeared in Wiedemann's *Annalen*, vol. xxxi. for 1887, and from this experiment came verification of Maxwell's theory, the basis of all our knowledge of wireless.

[4] *Phil. Mag.*, 1855.
[5] "Über die Erhaltung der Kraft," 1847.

Fitzgerald directed the attention of English physicists to the work at the British Association meeting in 1888, and Lodge exhibited many of the effects of the waves at the Royal Institution in 1889. The investigations which led to such brilliant results were inspired by the desire for knowledge; the idea of their practical application was entirely absent. Signalling by wireless waves was not foreshadowed until Crookes suggested it in 1892, and in 1893, the year of Sir William Anderson's lecture, Lodge heard of Branly's coherer and applied it to the rectification and reception of wireless waves. From this started the investigations of many of those whose names as pioneers are familiar to all. But another discovery in pure science was necessary to complete the work.

Edison had shown in 1883 that if an insulated electrode was inserted in an ordinary glow lamp there was a current of negative electricity from the filament to the electrode—the emission of negative electricity from a hot body had been observed by various experimenters—and Fleming made some observations about this date on the Edison effect. In 1904 he applied them to produce a valve rectifier for high-frequency oscillations by connecting one pole of his receiving circuit to an insulated plate or cylinder within a carbon lamp, of which the negative electrode forms the other pole of the receiving circuit. When the filament is made incandescent, negative electricity can readily pass from it to the insulated plate and hence into the receiving circuit; the flow of positive electricity in the same direction is checked; the lamp has a rectifying action.

Dr. Lee de Forest improved this oscillation valve a little later, making it an amplifier as well as a rectifier by placing between the filament and the plate or cylinder a grid of metal wire connected to an external source of electromotive force, by means of which its potential can be varied. There is ordinarily a current of negative electricity passing from the filament to the plate—the plate current it is called—through the interstices of the grid. By varying the potential of the grid this current can be varied, and the conditions can be so adjusted that small changes in the potential of the grid will produce large changes in the plate current; the plate current is passed through the primary of a step-up transformer, in the secondary of which is the receiving telephone, and the effect is thereby made audible. The grid is connected to one pole of the circuit receiving the incoming waves, and the small variations of potential which they produce thus give rise to large variations of the plate current, and hence the sound is amplified. By placing a number of valves in series very large amplifications are possible.

The other uses of the valve are very numerous. It is now employed as a transmitter for wireless work; while it finds many applications as a source, or rather regulator, of vibrations of comparatively short period. The Post Office has used it as an amplifier of speech, while Mr. F. E. Smith has applied it as a source of sound in connexion with the measurement of audibility. The whole of this arose from Edison's observation of the discharge of negative electricity from the heated filament.

To quote again from the first James Forrest lecture: "The engineer must banish from his mind the idea

that anything can be too small or too trifling to deserve his attention." The modern development of the valve, through the researches of those who have brought it to its present excellence, has rested on a still smaller entity, the electron, a body with a mass of $0{\cdot}900 \times 10^{-27}$ grams, about 1/1800 of the atom of hydrogen, carrying a negative charge of $1{\cdot}591 \times 10^{-20}$ electro-magnetic units [6] of electricity, first glimpsed by Crookes, then proved to exist by J. J. Thomson.

The appearance of a Crookes tube or vacuum tube when carrying an electric discharge is well known. When the pressure is sufficiently reduced, the tube is non-luminous except for a beam of light which proceeds normally from the cathode—the negative electrode—and penetrates into the tube a distance depending on the pressure; this beam constitutes the cathode rays: if the rays strike the glass at the end of the tube, a vivid fluorescence is produced.

Crookes showed that the beam constituted a current of negative electricity; it could be deflected by a magnet. Experiments by Perrin and J. J. Thomson proved conclusively the existence of the negative charge. Thomson showed also that the stream consisted of an assemblage of minute particles—electrons. He measured the velocity of the particles and the ratio e/m of the charge on each to its mass. Further experiments, of which perhaps those of Millikan are the most important, have led to a determination of the charge on the electron, and from this and a knowledge of the ratio e/m the values of e and m are found. These values are the same whatever be the nature of the cathode from which the rays take their origin—the mass and charge of an electron are the same whatever be its source. Thus now it is scarcely too much to say that nearly all electrical phenomena are conditioned by the presence and motion of electrons. The current in a cable is a stream of electrons; a conductor is a body through which they move freely; an insulator checks their activity. The power that drives our motors comes from them; the light of the electric lamp, the heat that comes from an electric radiator, have their origin in these tiny particles; the plate current of the valve rectifier referred to above is a stream of electrons; when the grid is negatively electrified, it adds negative electrons to the stream; when it is positive, some of the electrons from the filament are stopped in their passage through its interstices to neutralise the positive electricity it possesses.

Electrical engineering in its many branches is closely bound up with the properties of an electron discovered by men whose sole object it was to advance natural knowledge. Nor is this all: for from the electron came X-rays, though this, perhaps, is scarcely the correct way of putting it, as J. J. Thomson's discovery really followed that of Röntgen. About 1894, physicists in many countries were experimenting with Crookes's cathode rays. A chance observation made by a skilled worker revealed the fact that the cathode rays produced an effect outside the tube in which they were generated. Röntgen in the autumn of 1895 was conducting an investigation with a vacuum tube wrapped in light-proof paper, and noted that a fluorescent screen of barium platino-cyanide lying near shone out when the tube was excited; if he placed opaque objects between the screen and the tube, shadows were cast on the screen, showing that rays, the X-rays, proceeded from the tube in straight lines; and it was quickly found that the rays penetrated substances opaque to light, the penetration depending on the density of the substance. There is no need to dwell on the results that have followed from this and their significance to engineers. X-rays can penetrate 4 to 5 mm. of lead, 12 mm. of tin, 75 mm. of carbon steel, 100 to 150 mm. of aluminium, and 300 to 400 mm. of wood. By their aid hidden cracks or faulty welds can be shown upon metal structures, while they have been employed for many industrial purposes, besides their use in surgery and medicine.

For some time the nature of X-rays was a mystery. Their rectilinear propagation and the absence of refraction when they fell obliquely on the surface of a medium other than air were difficult of explanation. Now it is known that they are produced by a very rapid change of motion of electrons. When the velocity of an electron is altered, an electro-magnetic wave is produced, and, starting from the electron, travels outward with the velocity of light. The frequency in this wave—in the number of vibrations per second produced—depends on the suddenness of the change of velocity of the electron. If this is very great, the frequency in the resulting wave is also very great. When a beam of cathode rays falls on the glass walls or on the anti-cathode of an X-ray bulb, the electrons are stopped almost instantaneously. Electro-magnetic rays of very high frequency—X-rays—are produced. Their wave-lengths are now known to lie between 12×10^{-8} cm. and $0{\cdot}17 \times 10^{-8}$ cm. The wave-length of visible light is between 7700×10^{-8} cm. and 3600×10^{-8} cm., that of ultra-violet light lies between 3600×10^{-8} cm. and 200×10^{-8} cm., and it is to this minuteness of wave-length that the absence of refraction is due. In the hands of Sir William and Prof. W. L. Bragg, it has been the means of revealing the inner structure of materials in a manner which is of the utmost importance to engineers.

[6] One electro-magnetic unit is the charge transferred by 1 ampere circulating for 10 seconds.

Terrestrial Magnetism and the Orientation Faculty of Birds.

THE possible existence of a "magnetic sense" in animals has for long been a subject of speculation, and Lord Kelvin is numbered among those to whom the idea has proved attractive. No direct evidence in its favour has ever been obtained; but, on the other hand, there is no actual proof that some form of physiological sensibility to the phenomena of terrestrial magnetism may not exist and be a factor in that mysterious power of geographical orientation which is displayed by many animals and by primitive man.

The idea has often been invoked in the case of the especially remarkable powers of orientation which are possessed by migratory birds and by homing pigeons, and it is to be feared that much loose talk has at times been indulged in on this particular point. A recent author (F. Cathelin, "Les Migrations des Oiseaux,"

Paris, 1920) has gone so far as to propound a theory of migration which dispenses with instinctive behaviour in favour of "galvanotropism," and reduces birds to the status of mere automata acting under the compulsion of "des grands courants aériens électro-magnétiques équinoxiaux." Unfortunately for his argument, it is based on a conception of migration which is not consistent with many of the established facts, and it presupposes the existence of physical phenomena as to which the physicists are silent. Nor is its credibility increased by the absence of any suggestion as to a possible physiological mechanism linking the supposed physical causes to the alleged biological effects. At the best it is one of those "explanations" which call for more explaining than the original phenomena.

In these circumstances one welcomes a serious attempt, by a biologist and a physicist in collaboration, to set forth the possibilities of the case. This has been done by Dr. Rochon-Duvigneaud and Prof. Ch. Maurain (*La Nature*, 1923, 232) in respect of homing pigeons. In this paper Dr. Rochon-Duvigneaud begins by stating the biological data, and Prof. Maurain, who is director of the Institute of Terrestrial Physics in Paris, follows with a discussion of the physical facts, particularly those of terrestrial magnetism, which might be relevant. Prof. Maurain confines himself to a statement of apparent possibilities; he holds none of them as proved, and he urges the need for experimental inquiry. Whether his tentative hypothesis is sufficiently plausible from a biological point of view to constitute a *prima facie* case for further research on these lines, however, is perhaps open to doubt.

Prof. Maurain's suggestion may be stated as follows: The magnetic declination (angle of magnetic needle's lateral deviation from the geographical meridian) and the magnetic dip or inclination (angle of needle's vertical deviation from the horizontal plane) both vary from place to place over the surface of the globe. The periodical variations at any given place, and the irregular disturbances which also occur, are small in proportion to the otherwise constant geographical differences. Roughly speaking, therefore, every locality has its characteristic declination and dip. If lines be drawn through the places having the same declination, and other lines through the places having the same dip, these lines are (in Europe) roughly at right angles to each other. The lines thus serve as co-ordinates, which fix the position of any given locality like lines of longitude and latitude. Moreover, the declination and dip increase or decrease progressively as distance from a given locality is increased, except along those lines where one or other factor remains constant. So much is a matter of common knowledge.

It has then to be supposed that the pigeons are sensitive to changes in declination and dip, and indeed simultaneously sensitive to each factor independently of the other, and that when removed to a new locality the birds have a natural tendency, so to speak, to seek their own magnetic level. If a pigeon be removed to another place having the same declination but a greater (or less) dip, it would fly along the line of equal declination in the direction of decreasing (or increasing) dip. Similarly, if removed to a place having the same dip, it would follow the direction in which the declination changes towards the amount found at the home locality. Again, in the more general case of a bird removed to a place where both declination and dip are different, it would be affected by both factors and its homeward path would be the resultant of the two tendencies. (It is noted that there is no question of remembering the magnetic changes experienced on the outward journey, as a bird removed by a circuitous route will find a direct path home.)

Ornithologists will be grateful to the physicist for the statement of a possible case, but they will regret that Prof. Maurain has confined his argument to the relatively short journeys performed by homing pigeons and to the magnetic phenomena as they exist in Europe (for it is not in every part of the world that the lines of equal declination and of equal dip run at right angles to each other, and that there is only one point at which a given pair of values for these factors is to be found). They would have liked to see a case similarly stated in respect of the migrations of, say, swallows from South Africa to England (cf. NATURE, March 16, 1922, p. 346), over an area in which more complicated changes in terrestrial magnetism have to be reckoned with. Dr. Cathelin notwithstanding ("Le retour au nid reste donc pour nous une des grandes hérésies ornithologiques"), an ever-increasing volume of records of marked birds shows that swallows and others commonly perform very accurate feats of "homing" from great distances.

Returning to homing pigeons, however, we may examine the argument more closely. The physical phenomena exist, and a remarkable power of orientation is undoubtedly involved in homing; can a connexion be traced between them? The most serious objection seems to be the entire absence of any evidence of sensibility to magnetism on the part of birds or other animals; and without this physiological link speculation must needs be barren. Kelvin got negative results from his experiment of subjecting the human head to the influence of a powerful magnetic field; Du Bois observed no effect on protozoa; and the writers of the paper under discussion have similarly failed with pigeons. Within a limited field, it must be remembered, the strong electro-magnets used in such experiments are very many times more powerful than terrestrial magnetism: yet for Prof. Maurain's hypothesis we must suppose that birds are sensitive not only to minute changes in terrestrial magnetism, but also to changes in two of its factors separately. It does not seem, therefore, that the theory can be regarded as a promising one.

Prof. Maurain apparently holds, nevertheless, that there is a good case for further investigation, and he discusses in some detail the conditions necessary for an experiment on pigeons during their actual homing flight. It is not, of course, possible to interfere with terrestrial magnetism by means of artificial magnets over an area of any size, although it is admitted that pigeons find their way back as easily to lofts in great cities, where electric cables and the like cause an appreciable disturbance, as to lofts in the open country. The pigeon might be made to carry a small magnet and thus be kept within its field, but negative results would not be considered altogether convincing, because the amount of interference with terrestrial magnetism would be constant throughout; whether a portable apparatus giving varying magnetic effects could be designed is not discussed. Our author considers that

the only possibility is to rear pigeons in a confined space within a powerful and varying magnetic field, and to remove them eventually to a distance under similar conditions. On being liberated for flight the birds would, for the first time in their lives, come under the undisturbed influence of terrestrial magnetism, and in these circumstances it should, by hypothesis, be useless to them as an aid to homing. We may hope that the experiment will be attempted, but until and unless some positive indications are obtained we are justified in remaining more than a little sceptical as to the existence of a "magnetic sense." A. L. T.

New General Anæsthetics.

THREE-QUARTERS of a century ago the era of surgical anæsthesia was suddenly and unexpectedly opened with ether, chloroform, and nitrous oxide. The relative importance of these three in surgery has varied at different times, but none of the many substitutes suggested has secured a permanent footing in surgery, although several have had a shorter or longer vogue.

The paramount consideration in the choice of an anæsthetic is safety, and it is recognised that this may be conduced to by avoiding the prolonged unconsciousness of ether and chloroform. This has led to the increased prominence of nitrous oxide in recent years; but while this induces rapid and safe anæsthesia, it can be used for ordinary surgical work only with difficulty, owing to the cumbrous apparatus necessary.

Within the last few weeks two new anæsthetics have made their appearance in acetylene and ethylene, each diluted with oxygen; the first hails from the pharmacological laboratory of Prof. Straub of Freiburg, the second from Drs. Luckhardt and Carter of the University of Chicago. Each is said to induce anæsthesia without preliminary discomfort and with rapid recovery afterwards. This short duration of the action is similar to that of nitrous oxide and ethyl chloride, and is associated with the rapid absorption and elimination of the anæsthetics owing to their volatility; for all four are gases at ordinary temperature and pressure.

The new anæsthetics appear to be more powerful than nitrous oxide, however, for they are efficient when mixed with oxygen, and the anæsthesia can therefore be maintained continuously without danger of asphyxia. On the other hand, they are devoid of the halogen component of ethyl chloride, which lends it an effect on the heart which is absent in the unsubstituted molecule. The introduction of these unsaturated hydrocarbons is of practical and also theoretical interest. A higher homologue of ethylene was early suggested by Snow (1853) as an anæsthetic in amylene, and more recently a purer preparation of analogous composition had some success under the name of pental. Ethylene and acetylene have to be kept under high pressure, and it may be that this inconvenience may militate against their more general use, even if the favourable reports given by their sponsors are confirmed by further experience.

Obituary.

MRS. LUDWIG MOND.

ALL friends of Mrs. Mond, widow of Dr. Ludwig Mond, will mourn her death, on May 16, at The Poplars, Avenue Road, Regent's Park, of which she had so long been the attractive figure and ornament.

Those who knew Dr. Mond intimately enough to visit his home could never think of him alone but necessarily associated him with his wife; they were an inseparable couple in thought and, in all their social interactions, as wonderfully adjusted as were the two salts he caused to interact in the great works his genius created. This came from the fact of their early intimate association.

They were first cousins; her mother was his loving counsellor when he was a youth; and they became secretly engaged before he was of age, when she was a girl of thirteen at school. Up to their marriage, after he was established in England, they maintained a constant correspondence, of a most intimate character, which it has been my privilege to see in large part; it affords the most striking picture possible of the charm and simplicity of German life in those early days. Mrs. Mond's letters from the beginning show an extraordinary maturity and sobriety of judgment. It is clear that Dr. Mond's later æsthetic development was greatly due to the foundation laid during this period, mainly through the influence his wife exerted on him. In their married life she cast a spell upon all his friends which greatly added to his influence. Her ability is well brought out by Mr. T. P. O'Connor, M.P., in the *Sunday Times*, in the following few lines: "Mrs. Mond, his wife, struck me as being almost as big a mind as her husband. In a few sentences, describing the difference between the Gothic and the Renaissance types of architecture—especially of the architecture of the cathedral—I got a clearer idea of the two ideals than I could have learned from a dozen books."

By Mrs. Mond's death, the nation comes into possession of Dr. Mond's great gift of Italian pictures and the Royal Society receives his bequest of 50,000*l*. It is a sad fact that the enterprise in which Dr. Mond was so particularly interested—the International Catalogue of Scientific Literature—the promotion of which, I know, was specially in his thoughts when he made the bequest, has been allowed to lapse almost at the moment his gift becomes fruitful. He may be said to have been the main promoter of the Catalogue and the greatest believer in its ultimate value to the scientific worker. He would have deplored nothing more than its abandonment at the time when development of the spirit of international co-operation is so imperative a need.

Unfortunately, we have lost the broad outlook which characterised Mond and his generation; Michael Foster seems to have been its last exponent in the Royal Society, the last who dared to cultivate enthusiasm. Apparently, we are no longer able to maintain continuity of thought and action; nor, when we have done well, to realise the importance of our work and take pride in carrying it to completion. We prate of science but the true spirit of scientific method is no longer in us. H. E. A.

Current Topics and Events.

BY the death of Mrs. Mond, widow of Dr. Ludwig Mond, which occurred on May 16, the Royal Society becomes the beneficiary, under Dr. Mond's will, of a considerable sum of money in furtherance of scientific objects. Dr. Mond, as is well known, was a distinguished chemical technologist. He worked under Kolbe at Marburg, later under Bunsen at Heidelberg, finally becoming domiciled in England, where he secured the friendship of the leaders of British science, as also of many persons in literary and artistic circles. He was elected a fellow of the Royal Society in 1891, and died in 1909. The provisions of his will relating to gifts to science provided for the payment to the Royal Society, free of duty, of 50,000*l.*, the income to be employed in the endowment of research in natural science, more particularly, but not exclusively, in chemistry and physics, by means of rewards for new discoveries and pecuniary assistance (including scholarships) to those pursuing scientific investigations, and in supplying apparatus and appliances for laboratories and observatories, and in such other manner as the Royal Society should decide to be best calculated to promote scientific research. There was also the proviso that the Royal Society's council might allocate amounts for the publication and circulation of reports and papers communicated, and assist the preparation and publication of catalogues and indexes of scientific literature which the Society might have engaged in or might undertake in the future. To the University of Heidelberg a like sum was left, and for kindred purposes. Certain financial contingencies entailed that four years might elapse after Mrs. Mond's decease before these two bodies entered upon absolute ownership; notwithstanding, the legacies were to carry 4 per cent. interest per annum until paid up. It may be recalled that at the Royal Society's anniversary meeting of 1910 the then president referred to Dr. Mond in the following terms:—"The Royal Society has good cause to cherish his memory as that of a genial Fellow, who took an active interest in its affairs, affording it at all times the benefit of his business experience, and ever ready to aid financially any of its enterprises which seemed to him to stand in need of assistance. By his will also he has left a munificent benefaction whereby the Society will ultimately be enriched."

AT the present time the phytopathological service seems to be exceptionally vigorous in the United States, owing largely to the forward policy adopted both by the Department of Agriculture at Washington and by the various agricultural colleges and experiment stations scattered throughout the different states. In *Phytopathology* for March last, the report of the fourth annual field meeting of the American Phytopathological Society makes very suggestive reading as to the range of activities of the American phytopathologist. The three earlier conferences had been devoted to potato, fruit, and cereals respectively; meeting this time in the important vegetable-growing region around Delaware and Philadelphia, the conference spent one day inspecting the sweet-potato storage house of the Johnson Potato Storage Company (with a storage capacity of 125,000 five-eighths bushel baskets), and the farms in the neighbourhood, where cantaloupes, asparagus, tomatoes, cow peas, soy beans, and especially sweet potatoes, were growing. The next day, in the New Jersey district, experiments upon the control of tomato disease, carried out by a commercial firm, trials of sweet-potato varieties for resistance to fusarium wilt, and cold-storage plants and orchards, together with official tests on fungicides, were examined. The last day was spent in the extensive "trucking sections," *i.e.* regions growing vegetables for the market, around Bustleton, where the Pennsylvania Agricultural Experiment Station has a research laboratory. Here experiments upon the control of celery leaf diseases, downy mildew of the Lima bean, lettuce drop and rhubarb crown rot were seen in progress. It is true that in Britain the plant pathologist and other agriculturists have discussed the problem of potato-growing and especially their diseases, under the auspices of the National Horticultural Society, but no opportunities for the exchange of ideas and the accumulation of experience are available in this country to British plant pathologists, such as are annually placed before some 60 to 70 phytopathologists by this field conference.

THE value of the research laboratories now attached to many large firms was emphasised by Sir Richard Glazebrook in his "James Forrest" lecture to the Institution of Civil Engineers on May 4. The work of such laboratories is of necessity aimed at improving the products of the firm, but it is being realised more and more that for this purpose investigations in pure science are also essential. Probably the best-known engineering research laboratory controlled by an industrial firm is that of the General Electric Company at Schenectady. This laboratory has deliberately sought entirely new discoveries, new applications of materials, and new developments of electricity. From it have come the metalised carbon and the drawn-wire tungsten filament lamp, the nitrogen-filled high-efficiency lamp, the magnetite arc lamp, and the Coolidge X-ray tube. The development of each of these has involved investigations of great importance to pure science; Dr. Langmuir, of the G.E.C. laboratory, occupies one of the leading places among workers on the problem of the constitution of the atom. Other American laboratories are the Westinghouse Electric and Manufacturing laboratory and that of the Eastman Kodak Company; the work of the latter on light filters is well known, and has its bearing on the microphotographic work so important to engineers. There are few such great laboratories in England. But there are pioneers who recognised long ago the value of the great work which science can do for industry. Manganese steel was produced in 1882 from the laboratory of Sir Robert Hadfield, as the result of a scientific inquiry into the properties of alloys. The Brown-Firth laboratories of John Brown and Sons, and the laboratories of the Westing-

house works in Manchester have conducted and are carrying out valuable researches, and great things are looked for from the new laboratories of the General Electric Company at Wembley. The ideals which Mr. C. C. Paterson enunciated at the opening of the G.E.C. laboratory are high, and should lead to the advancement of scientific knowledge in many directions.

AT a meeting of the Royal Society of Arts on May 16, a paper on "Industrial Lighting and the Prevention of Accidents" was read by Mr. L. Gaster. The early part of the lecture was devoted to a summary of progress in illuminants, after which statistics were quoted showing that inadequate lighting is a contributory cause of many industrial accidents, those arising from "persons falling" being a specially striking example of this relation. Apart from possible ill effects on the eye, great importance should be attached to the effect of unsatisfactory lighting conditions in causing industrial fatigue, and consequently ill-health, spoiled work, and diminished output. In the cotton, fine linen and silk industries it had been found that output was 5-12 per cent. less by artificial light than by daylight. A recent investigation of the National Institute of Industrial Psychology showed that by using a lamp giving four times the light of an ordinary miner's lamp the amount of coal produced was increased by more than 14 per cent. The paper, which was fully illustrated by lantern slides, including some striking views of the L.G.O. repair works taken by daylight and artificial light respectively, was largely devoted to an exposition of the various reports issued by the Departmental Committee on Lighting in Factories and Workshops. It was mentioned that a similar Committee has been appointed by the Ministry of Labour in France to deal with the subject, and that seven American States now possess codes of industrial lighting. Mr. Gaster expressed the hope that the new Factory Act will endorse the recommendations of the Departmental Committee, and that illumination will be ranked with heating and ventilation as an essential item in the interests of health, safety, and efficiency of work.

WE have on several occasions referred with regret to the fact that no provision is made for a composite display of scientific discovery and achievement at the British Empire Exhibition to be held next year. In this connexion the following extract from the fourth annual report of the governors of the Imperial Mineral Resources Bureau is of interest: "The British Empire Exhibition authorities requested the Bureau to undertake the organisation of an exhibit illustrative of the mineral resources of the Empire, and the Governors set up a Committee which drew up a scheme for such an exhibit. Numerous meetings were held and the details of the exhibit worked out. We were subsequently informed that funds were not forthcoming from exhibition sources, and the Bureau then had to abandon the comprehensive scheme which they had elaborated for the illustration of the whole mineral wealth of the Empire."

A NOVEL feature of the meeting of the British Association at Liverpool, on September 12-19, will be a scientific exhibition at which there will be exhibits of apparatus in connexion with each section of the Association, and others showing recent advances in applied science. The exhibition will be held in the buildings of the Central Technical Schools, Byrom Street, Liverpool, which have been allocated for this purpose by the Technical Education Committee of the Liverpool Corporation. The buildings are extensive and centrally situated, and the electrical and other facilities are admirably adapted for the purpose. It is anticipated that all the leading manufacturers of scientific apparatus in the country will be represented. The exhibition will be open to members of the Association during the period of the meeting; but in view of the fact that it is the first of its kind, and will without doubt appeal to public interest in scientific achievement, it is intended to open the exhibition on September 10 and to keep it open until September 22, the public being admitted at a small charge.

THE constitution and by-laws of the new Engineering Joint Council have just been published. This Council is defined as "an advisory body without executive powers." It was founded by the Institutions of Civil, Mechanical, and Electrical Engineers and Naval Architects, but it is anticipated also that other institutions will desire representation on the Joint Council. These are divided into Constituent Institutions and Affiliated Institutions. The latter may be transferred to the former group when the standard of their entrance examinations is sufficiently high and the number of their corporate members is sufficiently large. The Council will not initiate proposals, but will consider matters referred to it by the Council of any one of the constituent institutions. As the welfare and safety of the whole nation are largely dependent on the prosperity of the engineering industries, it was felt that they should have a larger share in the national councils. The Joint Council, therefore, has been founded to foster engineering interests and to be ready always to take immediate action in any national emergency, and it has started auspiciously. The various institutions have worked very harmoniously together, and further important developments may be expected.

THE arrangements for the visit of Their Majesties the King and Queen to University College Hospital and University College, London, on May 31, are now approaching completion. As already announced, the ceremony is in connection with the great gift made in 1921 by the Rockefeller Foundation of New York for Medical Education. It will have two features, the laying of the foundation-stones of the new Obstetric Hospital and new Nurses' Home now being erected on sites adjacent to University College Hospital, and the opening of the new Anatomy Building which has already been erected in Gower Street. Their Majesties will arrive at 3.15 P.M., and the ceremony of laying the foundation-stones will take place in a pavilion to be erected in University Street. After

the conclusion of the first part of the ceremony, Their Majesties will proceed across Gower Street, and the King will declare open the Anatomy Building. The gift of the Rockefeller Foundation for these important medical objects is a sum of 400,000*l.* for the erection of the buildings in connexion with University College Hospital and Medical School; 435,000*l.* for an Endowment Fund for the improvement of medical teaching and for the purpose of developing general medical education and research on modern lines; 370,000*l.* for the erection and endowment of the anatomy buildings at University College, including the extension of the physiology and pharmacology buildings. The total benefaction thus amounts to 1,205,000*l.*, and is probably the largest single benefaction ever provided in this country for educational purposes.

A PRELIMINARY announcement regarding the general discussion on the electronic theory of valency arranged by the Faraday Society, to be held at Cambridge on July 13-14, has been issued. Prof. G. N. Lewis will open the proceedings on the Friday afternoon with a general introductory address, and he will probably be followed by Mr. R. H. Fowler, who will contribute a paper intended to open discussion on the physical and inorganic side of the subject. Among those expected to speak are Sir J. J. Thomson, who will be in the chair, Sir Ernest Rutherford, Sir William Bragg, and Prof. W. L. Bragg. The Saturday morning session will be devoted chiefly to applications of the theory in organic chemistry. Sir Robert Robertson, president of the Society, will preside, and opening papers will be given by Prof. T. M. Lowry and Dr. N. V. Sidgwick. Among those expected to speak are Prof. W. A. Noyes, Sir William Pope, Prof. A. Lapworth, Prof. I. M. Heilbron, Dr. W. H. Mills, Prof. J. F. Thorpe, and Prof. R. Robinson. On the Friday evening a complimentary dinner will be given to Profs. Lewis and Noyes and other guests at Trinity Hall. Arrangements are being made to accommodate those attending the meeting in one or other of the Colleges, and it will be possible to include a limited number of non-members of the Society. Particulars may be had from the Secretary of the Faraday Society, 10 Essex Street, London, W.C.2, to whom applications should be made at once.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 2.

THE annual general meeting of the Institute of Physics will be held in the rooms of the Royal Society, Burlington House, on Wednesday, May 30, at 5.30 P.M. In the course of his presidential address, Sir Joseph Thomson, who has recently returned from the United States, will refer to the position of industrial research there in physics.

AT the meeting of the National Academy of Sciences held in Washington on April 25, the following officers were elected: *President*, Prof. A. A. Michelson; *Vice-President*, Dr. J. C. Merriam; *Secretary*, Dr. David White; *Foreign Secretary*, Prof. R. A. Millikan; *Treasurer*, Dr. F. L. Ransome.

THE U.S. National Academy of Sciences has made the following awards: the Comstock prize to Prof. William Duane, professor of bio-physics in Harvard University, in recognition of his researches on X-rays, and the Mary Clark Thompson gold medal to Dr. Emmanuel de Margerie, director of the Geological Survey of Alsace and Lorraine.

AT the Royal Institution on Friday evening, June 15, Sir Ernest Rutherford will give his postponed discourse on "The Life History of an Alpha Particle of Radium," and his concluding lecture on "Atomic Projectiles" will be delivered on Saturday afternoon, June 16.

AT the annual general meeting of the Linnean Society of New South Wales, held on March 28, the following officers were elected: *President*: Mr. A. F. Basset Hull. *Members of Council* (to fill six vacancies): Mr. E. C. Andrews, Mr. J. H. Campbell, Mr. H. J. Carter, Sir T. W. E. David, Prof. W. A. Haswell, and Prof. A. A. Lawson. *Auditor*: Mr. F. H. Rayment.

PROF. J. P. HILL, Jodrell professor of zoology and comparative anatomy in the University of London, and Prof. J. T. Wilson, professor of anatomy in the University of Cambridge and formerly Challis professor of anatomy in the University of Sydney, have been elected honorary members of the Linnean Society of New South Wales.

AT the annual general meeting of the Institution of Electrical Engineers to be held on Thursday, May 31, there will be presented to the Institution: (1) An oil painting of the late Dr. Silvanus Thompson (presented by Mrs. Thompson); Dr. Thompson's library (presented by a number of members of the Institution and others); and (2) a bronze bust of Dr. Thompson, by Mr. Gilbert Bayes (presented by the Finsbury Technical College Old Students' Association).

NEWS has reached this country of the family of the late General Rykatchef, who was director of the Russian Meteorological and Magnetic Service until shortly before the War. General Rykatchef died on April 1, 1919, his wife on November 22 of the same year. The last survivor of three sons died on February 24, 1920. A son-in-law perished on July 6, 1919, leaving five young children. They, with their mother and her sister, who is well known to meteorologists and magneticians as her father's constant companion on his international journeys, are the only survivors of a once large family.

THE following foreign members have been elected by the Geological Society: Prof. L. Cayeux, Paris; Prof. J. M. Clarke, director of the New York State Museum, Albany (New York); Prof. H. Douvillé, Paris; and Prof. W. Lindgren, Massachusetts Institute of Technology, Boston, Mass. Foreign correspondents have also been elected as follows: Prof. E. Argand, University of Neuchâtel; Prof. L. W. Collet, University of Geneva; Prof. R. A. Daly, Cambridge (Mass.); Prof. G. Delépine, Lille; Prof. P. Fourmarier, Liège; Prof. V. M. Goldschmidt, Universitets Mineralogisk

Institut, Christiania; Prof. T. G. Halle, Naturhistorisk Riksmuseum, Stockholm; Prof. J. F. Kemp, Columbia University, New York City; Prof. C. F. Kolderup, University of Bergen; Prof. C. I. Lisson, Escuela de Ingenieros, Lima; Prof. G. A. F. Molengraaff, Delft; Dr. A. Rénier, Directeur du Service Géologique de Belgique; Prof. P. Termier, Directeur des Services de la Carte Géologique de France; and Dr. F. E. Wright, Geophysical Laboratory, Washington, D.C.

THE floral ballet, composed by Dr. G. Rudorf, and conducted by him at the Alexandra Palace on May 19, in aid of the Royal Northern Hospital, as announced in last week's issue, p. 681, proved very delightful music. Specially written for a choreographic flower-story arranged by Mrs. A. E. Ormen Sperring for her pupils, the work, which lasted three-quarters of an hour, contains a great variety of melodic material. In his professional capacity as a chemist, and as collaborator with Sir William Ramsay in a treatise on the rare gases, Dr. Rudorf is well known; and he is to be congratulated upon the skill he has shown in the production of a musical work of real merit.

MR. F. EDWARDS, 83 High Street, Marylebone, W.1, has just circulated a catalogue (No. 443) of some 1100 books and serials relating to anthropology, folklore, archæology, etc., some of which formerly belonged to Prof. Huxley. We notice that Mr. Edwards has also for disposal a small collection of Australian native weapons and implements of the period 1840–50, from the collection of Mr. S. T. Gill, an Australian artist.

Our Astronomical Column.

THE THEORY OF JUPITER'S SATELLITES.—Prof. de Sitter, of Leyden, lecturing on this subject at the University of Manchester on May 9, emphasised the interest attaching to the theory of the motion of the four Galilean satellites (to which his remarks were confined), because they illustrate the more important features in the theory of the motion of the planets round the sun, but with a time-scale reduced in a ratio of about 3000 to 1. The theory can thus be checked by observations extending over a period of a few decades, but the difficulty of deriving from the observations the masses of the satellites, and the elements of their orbits, is greatly enhanced by the intercommensurability of the periods of the three inner satellites. Though the tables published by Prof. Sampson a few years ago represented a great advance at the time of their appearance, they still require to be confirmed and extended by other methods. The commensurability of the periods renders the ordinary expressions found in celestial mechanics too slowly convergent, and necessitates the search for a new solution, starting from a periodic solution as the first approximation. The commensurability also makes the observations of eclipses and transits of the satellites less satisfactory than usual for the determination of the elements of the system. In order to counter these difficulties, such observations have to be extended over a whole period of revolution of Jupiter (12 years) and supplemented by photographs taken at selected epochs before and after each opposition. Such observations have been made at Greenwich, the Cape, and Johannesburg, and are now in Prof. de Sitter's hands for discussion. The discussion is well in hand, and the results promise to be satisfactory.

UNKNOWN LINES IN STELLAR SPECTRA.—To all spectroscopists the paper by Mr. F. E. Baxandall on "Lines of Unknown Origin in various Celestial Spectra" (Mon. Not. R.A.S., vol. 83, p. 166) will be very welcome. Mr. Baxandall's skill in deciphering spectra is well known, so the results here collected are of special value. In the year 1910 Sir Norman Lockyer published a list of fairly prominent lines for which no satisfactory origins had been found, but since then many of them have been run to earth, notably the line at λ 4688, which is now known to be due to ionised helium, and the ζ Puppis lines due to the same element. Eliminating these lines from the list of unknowns, Mr. Baxandall gives rather a formidable table containing about 130 lines still unknown. The wave-lengths of these lines have all been observed in some source of celestial light, and the table indicates which particular source, whether sun, star, corona, nebula, and so on, in which they have been observed. The paper is accompanied by copious notes and references.

850 NEW NEBULÆ.—Dr. Harlow Shapley, in the Harvard College Observatory Bulletin, No. 784, points out that photographs made with the Bruce telescope at Arequipa, Peru, supplement the data for nebulæ not easily reached from northern observatories. On a photograph made on September 19, 1922, with an exposure of six hours, centred on R.A. $22^h\ 40^m$, Dec. $-45°$, Dr. Shapley has found 850 new nebulæ. On the following night another exposure was made, this time for two hours only, which showed all objects brighter than the eighteenth magnitude. He points out that these new nebulæ are not of the nature of the faint irregular nebulous wisps frequently found in the vicinity of bright spirals, but are distinct nebulæ, the fainter ones almost exclusively oval or circular in form, distributed over an area of about thirty square degrees. It is interesting to note that only three nebulæ of the N.G.C. fall within this region and three from the second Index Catalogue. The brighter nebulæ are, almost without exception, elongated or show spiral structure, while the fainter ones appear largely to be globular. The shape of these latter, as Dr. Shapley points out, may be due simply to under-exposure of the plate, since many of the bright nebulæ, on a short exposure, lose the faint extensions that reveal their truly elongated shape. The interesting remark is made that on many parts of this plate at the eighteenth magnitude, the nebulæ are more numerous than the stars.

THE ASTRONOMICAL SOCIETY OF SOUTH AFRICA.—A local astronomical society was formed at Capetown ten years ago; this has now been extended to include the Johannesburg society, and the first Journal of the combined body was published in February. The inaugural presidential address by Dr. Hough deals with the tides in a clear and interesting manner, explaining methods of tidal analysis and prediction, and giving an outline of Sir G. Darwin's theory of the development of the earth-moon system by tidal evolution. The society has been especially active in comet and variable star work; the former is fully dealt with in the Journal.

Research Items.

INDUSTRIAL PSYCHOLOGY AND COAL MINING.—In the Journal of the National Institute of Industrial Psychology (vol. 1, No. 6), a colliery director discusses the application of industrial psychology to coal mining. He points out that hitherto it has been taken for granted that in some wonderful way the art of coal mining is handed on from old collier to young collier and from father to son. Again, the very vital importance of the industry to the country has made it the battle-ground of conflicting interests, so that employers and trade union officials make many statements about the needs and desires of the workers, statements which are not infrequently mutually incompatible. Seeing that there is so much bias, the writer suggests that the proper person to obtain actual facts is the man of science. He therefore advocates a considerable development of the small-scale investigation done already by the Institute for one firm, so that methods of training and instruction, general conditions of work, and allied problems should be studied and the best methods discovered. Just as it has been found necessary to study methods and training for sport, so a similar study would, in the writer's opinion, be found helpful in coal mining. If industrial psychology can show how to increase output and with it wages, and yet leave the coal-getter less fatigued, it will do more for the general trade of the country than has been dreamt of.

CHEMISTRY IN MEDIEVAL ISLAM.—In the issue of *Chemistry and Industry* for April 20, Mr. E. J. Holmyard contributes an interesting article on this subject. He points out that no serious attempt has hitherto been made to study adequately the large number of Arabic chemical treatises which have come down to us—and he might have added that, in spite of this, the most dogmatic assertions about some aspects of the problem are still put forward with surprising confidence by recent writers on the history of chemistry. Chemistry was taken over by the savants of Islam from the Greek school at Alexandria about the 7th century A.D., and for five or six hundred years—namely, to the 12th century—it was almost a monopoly with them. The most famous of its votaries was Geber, or Jabir ibn Hayyan, probably born at Harran in Mesopotamia, who attained a position of eminence under the Caliph Harun al-Raschid (A.D. 786–808). The identity of Jabir with the Geber of the Latin works, which became known to Europe about A.D. 1300, although it is now denied by most writers, is, according to Mr. Holmyard, very probable, and he has important new material in this field. The leanings to mysticism which Geber and other chemists show is probably to be attributed to Neo-Platonic influences, which also tinged their chemical views. A belief in astrology, and in the connexion between planets and metals, was shared by all thinking men of the time, but played a relatively unimportant part in the chemistry of Islam. Scepticism as to the possibilities of transmutation also appeared at an early date. Mr. Holmyard gives many further details, and his paper is one which throws much light on this interesting period in the history of chemistry.

DIFFICULT AND DELINQUENT CHILDREN.—In *Psyche* (vol. ii. No. 4) Dr. R. G. Gordon discusses the problems concerned with the difficult and delinquent child. Every teacher and doctor has come across the child who does not fit in with the others, who, in spite of all efforts on the part of those responsible, persists in various forms of misbehaviour, frequently of a futile and useless character, and finally becomes ungovernable. The problem should be faced by trying to find out why such a child is difficult, and for this purpose it should be possible for every suspected child to be examined, in the first place, physically, as it is known how such factors as abnormalities in the secretions of the endocrine glands, eye strain, etc., affect mental development; then his intelligence should be tested, and thirdly, his reaction to life should be investigated. It must be borne in mind that lack of intelligence is by no means an invariable concomitant of delinquent behaviour. The writer hopes that eventually the State will provide the means for such work, but he realises that the time is not yet. In conclusion, he puts in a timely warning that the proper selection of workers for such investigation is of vital importance.

TREATMENT OF ELECTRIC SHOCK.—Sir Bernard Spilsbury and other writers discuss the condition of individuals who have been subjected to electric shock, in *Archives of Radiology and Electrotherapy*, No. 272, March 1923, p. 316. The pathological changes in the tissues in fatal cases are generally very slight—burning at the point of entrance and exit of the current and hæmorrhages beneath or in the skin and into the muscles. Although some cases may die from paralysis of the heart, many are cases of "suspended animation" due to sensory stimulation causing paralysis of respiration. In many of the last-named class the immediate application of artificial respiration will resuscitate the unconscious and apparently dead with complete recovery.

NERVES OF THE FINGERS.—In the *Journal of Anatomy* (vol. lvii., Part III., April 1923) Prof. J. S. B. Stopford, of the University of Manchester, has published a short note on the distribution and function of the nerves to the fingers. The paper is of exceptional interest and importance, because it gives a new orientation to the results of the last twenty years' researches on sensation and the interpretation of the effects of nerve injuries. With the object of settling this difficult problem once for all, Dr. Henry Head submitted himself to experiment in 1903, and had two nerves in his forearm cut across, so as to study the process of recovery of sensation. The nerves selected for this test were supposed to be distributed only to the skin, and Dr. Head assumed that when they were cut the nerves concerned with deep sensibility would remain intact. Prof. Stopford now finds that the nerves in question are not purely cutaneous, but also supply joints and some of the subcutaneous tissues. Hence the interpretation of Dr. Head's classical experiment and the far-reaching generalisations based upon it need to be re-examined in the light of these anatomical facts, which are doubly important because their reality has been established by an investigator of rare insight, who has a sympathetic understanding of Dr. Head's methods and results.

LINKED CHARACTERS IN THE MILLIONS FISH.—In a continuation of his investigations on the millions fish (*Lebistes reticulatus*), Dr. O. Winge (*Comptes rendus trav. Lab. Carlsberg*, vol. 14, No. 20) obtained a fish with a new factor for elongated caudal fin. This factor shows ordinary sex-linked inheritance, and is therefore located in the X-chromosome. In crossing experiments there is evidence that the factor may become transferred from the X- to the Y-chromosome by crossing over. It then shows male-to-male inheritance, as is the case with several spot characters in Lebistes. Later it may cross over again to the X,

and so the manner of its inheritance oscillates irregularly between ordinary sex-linked and exclusively male-to-male transmission. This furnishes further evidence of the presence of active factors in the Y-chromosome of fishes. Some of the other evidence indicates that a localised sex factor is concerned in sex determination.

PECULIAR POLISH WHEAT CROSS.—In crosses between Polish and Kubanka wheat, Mr. F. L. Engledow (*Journ. Genetics*, vol. 13, No. 1) has studied the inheritance of length of glume, the respective parental lengths being about 12 mm. and 31 mm. The F_1 generation was intermediate, while in F_2 the three types could be classified by eye and approximated in numbers to the 1 : 2 : 1 ratio expected for a monohybrid difference. The segregated types bred true in later generations, while the intermediate type continued to split. The peculiarity was observed, however, that the Polish type segregated in F_2 had a mean glume length which had shifted from 31 to 24·6 mm., and this shift was maintained in later generations. The nature of this permanent modification in a character through crossing is discussed, and it is pointed out that a multiple factor hypothesis of size inheritance is insufficient to account for the results. The same phenomenon has been observed in other wheat crosses, but a complete explanation is not at hand. Perhaps the measurement of all glume lengths on each individual might aid in the analysis.

"BIG BUD" OF BLACK CURRANT.—This disease, caused by the currant gall mite, is widespread throughout Great Britain, and attacks and destroys black currant bushes. Hitherto no remedy has been discovered. In the orchard of the Crichton Royal Institution, Dumfries (a mental hospital), with 427 bushes, the following treatment (eighty-third annual report for the year 1922, Crichton Royal Institution, Dumfries) has been tried: The ground round the bushes was completely covered with straw and dead branches, which were then ignited (March 28, 1922). The scorched branches of the bushes were then cut off to within six inches of the ground, fresh straw was put on, and the whole again burnt. So far the treatment has been a success, for (1) less than 10 per cent. of the bushes have been lost, and (2) fully 90 per cent. have made a good recovery, showing 2-3 feet growth of healthy wood, with flower buds, giving promise of a half-crop the following (this) year, and with no indication of the mite at the end of 1922.

DATE PALMS OF IRAQ.—The Agricultural Directorate, Ministry of Interior, Iraq, has issued the third memoir of a series upon dates and date cultivation of the Iraq. In the memoir, V. H. W. Dowson briefly describes some of the better known varieties of the female palms of the Iraq and the dates they produce; the earlier memoirs have dealt with the habit, cultivation, and yield of the palms. Some of these varieties differ markedly in habit of growth and in average yield of produce, and the dates are by no means all the same, differing probably as much to the expert observer as do the different apples displayed in the shop window to the average English buyer, to whom all dates are very much alike. It is interesting, for example, to learn that the Ista-amran palm, forming some 45 per cent. of the palm population of the Shatt Al' Arab, produces a date which the Arab would class among the "hot," *i.e.* relatively indigestible dates. This palm gives relatively low yields, and yet probably one-third of the dates exported from Basrah are of this variety! Obviously, with attention turned to varieties, their quality and yield, there are great possibilities before the date industry, Iraq containing, it is estimated, some thirty million date palms; at present, the author reports, the demand for Iraq dates is only increasing in the United States. Prepared originally for the purposes of the Revenue Department of the Iraq, this memoir is a tribute to the industry of a recently constituted Administration and to its author, who confesses that its preparation has been rather a recreation than a labour, "because the date palm is so interwoven into the history, literature, and life of the Arab race."

A CAUSAL ORGANISM OF NASAL POLYPUS.—In his memoir on *Rhinosporidium Seeberi* (Trans. Royal Soc., Edinburgh, vol. liii. part ii., No. 16), Prof. J. H. Ashworth has accomplished a notable piece of work, and one which forms a valuable contribution to medical biology. This remarkable organism, hitherto placed among the Sporozoa but regarded by Prof. Ashworth as a unicellular fungus, probably belonging to the Chytridineæ, is responsible for the development of a form of nasal polypus in human beings. Fortunately, it appears to be rare, at any rate among Europeans, and its geographical distribution is peculiar, including India, Ceylon, Argentina, and Tennessee, U.S.A. (one case). Prof. Ashworth was able to study the organism in the case of an Indian medical student at Edinburgh, and gives a detailed and beautifully illustrated account of the life-history. Attempts to cultivate the parasite in other animals or *in vitro* have been unsuccessful, and the method of infection is unknown.

THE DEVONIAN FORMATION IN AUSTRALIA.—Dr. W. N. Benson's "Materials for the study of the Devonian Palæontology of Australia" (Rec. Geol. Surv. New S. Wales, vol. x. pt. 2) is a memoir that will be much appreciated by geological students. It begins with an historical introduction in which the author sketches the progress in discovery of the Devonian rocks of Australia and their separation from the Silurian with which they had been formerly associated. The rocks and their contents of the several faunal provinces are next described as well as the distribution of the Australian Devonian fauna. There is also a chapter on Middle Devonian vulcanicity. An excellent bibliography and a useful register of the fossil localities follow, but what will prove of most use to the general student is the very full census and index of both fauna and flora, which forms half of the memoir and includes references to close on two hundred genera.

UPPER CRETACEOUS DINOSAURIA FROM ALBERTA.—From among a collection of fossil vertebrates in the University of Alberta, obtained from Upper Cretaceous beds (Belly River formation) of the Red Deer River, C. W. Gilmore has singled out and describes, with excellent figures, some exceedingly interesting Dinosaurs (*Canadian Field Naturalist*, vol. xxxvii., No. 3). *Corythosaurus excavatus*, n.sp., is the second species of a genus the skull of which in its general outline recalls that of a bird rather than a reptile. In the case of this Dinosaur, however, the beak portion of the skull is formed by the premaxillaries, the entire upper and posterior portion of the crest being occupied by the nasal bones. Quite other in aspect is the skull of all the Upper Cretaceous armoured Dinosaurs: in them it is greatly depressed and has a broadly rounded muzzle. A well-preserved skull and right ramus, which the author tentatively refers to *Euoplocephalus tutus*, Lambe, has afforded him the opportunity of

contributing to the knowledge of the cranium of this group, for with the exception of the type of *Panoplosaurus mirus*, Lambe, only unsatisfactory fragments have hitherto been available. The author further directs attention to some features in the cranial structure of a specimen of Eoceratops from the same district, as well as to the first occurrence in the Belly River formation of a lacertian reptile, as evinced by the discovery of a dorsal vertebra bearing a striking resemblance in size and form to those of the genus Saniwa.

METEOROLOGY OF THE GULF OF BOTHNIA.—Several papers dealing with the meteorology of the Gulf of Bothnia and the northern part of Sweden have lately appeared. In "Ström och Vindobservationer vid Fyrskeppen" (Havsforsknings Institutets, No. 13, 1922), Mr. G. Granqvist records the wind direction and force at certain Finnish lightships, four in the Gulf of Finland and seven in the Gulf of Bothnia, during 1921. The records are of varying lengths of time, in most cases from June to November or December, but in two cases for January also. Observations were taken three times daily. In Statens Meteorologisk-Hydrografiska Anstalt, i. No. 4 (Stockholm, 1922), Dr. C. J. Östman has a paper on "Recherches sur les grands vents près de la côte suédoise du Golfe de Botnie." The observations deal with the winds above force 7 on the Beaufort scale in eleven lighthouses and lightships. As a rule, the records are for the years 1907–1921, and cover the twelve months. The paper contains a discussion of the direction and nature of the depressions which influence the Gulf. The meteorological observations taken at the Swedish station at Abisko in Lapland during the year 1921 are published (Abisko Naturvetenskapliga Station, Stockholm, 1923). The hourly data are given *in extenso* with the legends of the tables in both Swedish and French. They include records of the water temperature in Lake Torneträsk.

RADIO IN RELATION TO WEATHER OBSERVATIONS.—Weather reports by wireless telegraphy and by the radiophone as received and disseminated in the United States from the beginning of this century to the present date are dealt with by Mr. E. B. Calvert of the U.S. Weather Bureau in the U.S. *Monthly Weather Review* for January. The history of the initiation and the development of the radio service is full of interest, and is dealt with from the year 1895, when Marconi commenced his investigations in wireless telegraphy, until the inauguration of radiophone weather broadcasting through the United States in February last. The Weather Bureau was the pioneer of all agencies of the U.S. Government in investigations and experiments in wireless telegraphy. It is stated by the author that in his opinion meteorology will advance hand in hand with radio, and that there must be close and undisturbed contact between the agencies engaged in meteorological and radio activities. Meteorology is essentially an international science, and weather has no national allegiance. Weather conditions prevailing in one country to-day may affect another to-morrow, or perhaps a week hence. The author is very strongly impressed with the importance of exchange of meteorological reports between different countries and especially among the nations in the Northern Hemisphere, in which radio must play a large and important part. Daily weather forecasts and storm warnings for all interested in agriculture ashore and for all vessels afloat in the open ocean and elsewhere have now become the common property of all. Mention is made of the forecasting demonstrated by the French training-ship *Jacques Cartier*, which carries weather experts and disseminates and broadcasts weather forecasts daily in both English and French, aided by reports from shore stations and from ships within call.

ATOMIC RADII IN CRYSTALS.—In a short paper in the Proceedings of the U.S. National Academy of Sciences for February, Dr. R. W. G. Wyckoff discusses, with the aid of numerical data, the hypothesis that the atoms of each element are of a definite size, and that crystals are built up by their packing together. The calculation of the "sphere of influence" of atoms can now be made from four independent starting-points: from metals, from the diamond and divalent metal carbonates of the calcite group, from pyrites (FeS_2), and with the aid of cæsium dichloro-iodide ($CsCl_2I$). The metals do not fit well into the scheme, calcite and related minerals present difficulties because of the two different assignments of position which have been made to the oxygen atoms, while the results from pyrites and cæsium dichloro-iodide are in substantial agreement and are chosen as offering the basis for the fairest test of the hypothesis. It is claimed that numerous results (given in the paper) not in accord with the hypothesis show conclusively that the latter is not in harmony with experiment—a result which might be anticipated on theoretical grounds, although approximate agreement is obtained in isomorphous crystals composed of only two kinds of atoms, where the interatomic distances have additive properties. In cases of compounds where the atomic environments are different, the interatomic distances may change by several tenths of an Ångstrom unit.

GASOLINE IN THE UNITED STATES.—The natural-gas gasoline industry in the United States continues to expand, and the total production of nearly 450,000,000 gallons of gasoline in 1921 exceeded that of 1920 by some 145,000,000 gallons, according to statistics recently published in an advance chapter of the Mineral Resources of the United States for 1921. The value of the gasoline produced, however, dropped to 10,000,000 dollars less than in the previous year, owing to the break in the petroleum market and the general lowering of prices. The processes involved in the production of natural-gas gasoline are constantly undergoing changes, and there is obviously still plenty of room for improvement of the plants employed. The compression process of extraction is fast giving way to the absorption process, not because the latter is technically more efficient, but because the product obtained by the absorption process is more uniform, stable, and commands a higher market price. The combination of both compression and absorption processes, however, is finding increasing favour with operators, and may quite conceivably become the standard plant of the future. Production of gasoline on a large scale is faced with certain problems which are not always easy to contend with; for example, summer temperatures frequently cause difficulty in cooling the water sufficiently for condensation, while cold weather, on the other hand, aids condensation to such an extent that pipe-line freezing occurs, interrupting the transport of the gasoline. Another problem seriously affecting the industry is that connected with waste of gas which must inevitably occur when a new well is brought in; obviously, in operating a new lease, it is not policy to install an expensive plant until the probable output of gas from several wells has been gauged; drilling these new wells takes time, and thus in developing a property much gas is initially lost which it would undoubtedly pay to treat for gasoline.

The Royal Society Conversazione.

THE first of the two annual conversaziones of the Royal Society was held at Burlington House on May 16, when Sir Charles Sherrington and the officers of the Society received the fellows and guests. In the space available it is impossible to deal adequately with all the exhibits, so we propose to group them according to subject and to give a brief account of some of the items in each group.

The National Institute of Industrial Psychology exhibited some results of the researches it has undertaken, among which were curves obtained by Dr. G. H. Miles and Mr. Eric Farmer showing the effects of encouraging rhythmical movements and of reducing needless decisions. Output increased by more than 35 per cent., despite which the workers spontaneously testified to their lessened fatigue. Mr. Eric Farmer also demonstrated the reduction of after-images produced by using a frosted glass on the miner's standard electric lamp.

The effect of temperature on the biological action of light was illustrated in a demonstration arranged by the National Society for Medical Research (Dr. Leonard Hill and Dr. A. Eidinow). Hay infusoria were exposed in shallow quartz cells to the mercury vapour lamp. The quartz cell in each case is attached to a glass cell through which water is circulated at a given temperature. The lethal power of ultra-violet rays is manifested by granulation and loss of mobility, and at 20° C. these signs appear in about one-third of the time required at 10° C. Mr. H. J. Buchanan-Wollaston had an interesting exhibit showing the value of markings on herring-scales as a means for estimating age and growth rate of the fish. Scales from the same fish may have widely differing numbers of rings; those on the outer part of the large scales should be read in groups, and the age checked by means of dorsal scales and "key-scales." The ages deduced are much less than those obtained by Danish workers.

Some developments in microscopy were illustrated by the exhibits of Mr. Conrad Beck and the National Institute for Medical Research (Mr. J. E. Barnard, Mr. John Smiles, and Mr. F. Welch). Mr. Beck showed a new illuminator for opaque objects, consisting of an aplanatic ring of glass silvered on the back surface, which enables a short focus reflector of great light intensity to be used with powers as high as 4 mm. (1/6).

The Director, Royal Botanic Gardens, Kew, showed specimens of efwatakala grass (*Melinis minutiflora* P. Beauv.), a valuable pasture grass in the tropics, reported to be repugnant to the tsetse fly. This property appears to be due either to the aroma of the oil exuded by the hairs on the leaves or to its stickiness. In another exhibit, species of Psychotria, Pavetta, and Kraussia (Rubiaceæ) with nodular swellings in their leaves, due to the presence of colonies of bacteria, were shown. The bacterium can assimilate free nitrogen from the air. The Physical Department, Rothamsted Experimental Station, Harpenden (Dr. B. A. Keen, with Mr. E. M. Crowther and Mr. W. B. Haines), had exhibits dealing with flocculation and deflocculation in soils. An automatic electrical balance, devised by Prof. Oden and Dr. Keen, gives a continuous time record of the accumulating weight of deposit from a soil suspension. Analysis of the time-weight curve thus obtained gives an indication of the type of soil.

Messrs. J. J. Griffin and Sons, Ltd., showed a "Boys" integrating and recording gas calorimeter which has already been described in NATURE (August 19, 1922, vol. 110, p. 251). Dr. Hele-Shaw exhibited his stream-line filter, which causes the fluid which has to be filtered to flow with stream-line motion. This is done by forcing the fluid down holes drilled through parallel sheets of paper impervious to the fluid itself; the fluid escapes by passing between the sheets of paper. Dirty water and oil, and water containing a dye, were all freed of foreign material. Among the exhibits of the International Western Electric Company was a low voltage kathode ray oscillograph. The instrument consists of a glass tube in which a kathode ray is generated between a hot filament kathode and a small tubular anode. The ray is rendered visible by striking a fluorescent screen at the end of the tube. It is deflected on passing between two pairs of plates to which two alternating potentials are applied. The fluorescent spot then traces out a curve which is a graph of the relation between the two potentials. Among the exhibits of the Research Department, Woolwich, was an apparatus for the detection of feeble X-ray beams by smoke clouds. A smoke cloud, having a flat top, is produced in a small chamber, below an electrode maintained at a potential of about 400 volts. Even a feeble X-ray beam striking the cloud produces ions, some of which attach themselves to the smoke particles, and the latter can be seen rising from the top of the cloud. A chronograph for use with a photographic recorder was also shown. Time intervals of 1/1000th second are recorded on a moving cinematograph record by interrupting the spot-light from an Einthoven galvanometer by means of a wheel with 20 radial vanes, which is made to revolve at 50 revolutions per second. The accuracy of the recorder for long or short time intervals is at least 1/10,000th second.

Mr. S. G. Brown exhibited a frenophone, a form of loud-speaking telephone, in which the sound is amplified by friction. The telephonic current controls the pressure of a small cork pad upon a revolving glass disc, and the variations in the resulting frictional drag are applied to the telephone diaphragm of the instrument. Very clear articulation is produced. In an exhibit by the Cambridge and Paul Instrument Co., Ltd., a phonic motor driven by a tuning-fork controls a contact on a circular rheostat, which is rotated by a direct-current motor. If the latter gains or loses speed relatively to the phonic motor, the rheostat automatically synchronises the motor with the tuning-fork. The mechanism was designed by Dr. W. Rosenhain.

Curious as well as interesting were the exhibits of Mr. Harrison Glew, who showed a bar magnet of cobalt-steel floating above the opposed poles of a fixed magnet (NATURE, May 12, p. 669), and of Mr. E. Hatschek, who had a number of permanent "hanging drop" and vortex forms produced by running gelatin sol into suitable coagulating solutions, while the device of Mr. D. Northall-Laurie, showing photomicrographs of crystals in colour mounted to show changing tints, was very striking. Colour photographs (Paget process) are taken of the subject, and the slides are constructed to allow the viewing screen to be moved across the transparency. The tint of the slide then changes from green through various intermediate colours to red, just as the tint of crystals examined under a microscope by polarised light can be made to change. There were other specimens and pieces of interesting apparatus, such as that shown by Messrs. Adam Hilger, Ltd., for optical research, but a fuller account cannot be attempted.

During the evening, Sir Richard Paget lectured on the reproduction of vowel sounds, and Mr. Walter Heape on the Heape and Gryll rapid cinema machine.

Conference of Universities.

IN the programme of the annual conference of the universities of the United Kingdom, which was held on May 12 at King's College, London, the first place was given to the subject of the financial outlook of the universities. The income and expenditure for 1921–22 of the universities and university colleges of Great Britain in receipt of annual Treasury grants are displayed in Tables 7 and 8 of the returns recently published by the University Grants Committee. The aggregate income of these institutions (Oxford and Cambridge are excluded from the returns, their grants having been "special emergency" grants) is shown as 3,578,768*l.*, derived from: Parliamentary grants (35·3 per cent.), Fees for tuition and examination (35·7 per cent.), Local Authorities' grants (11·7 per cent.), Endowments (10·3 per cent.), Donations and Subscriptions (2·7 per cent.), and other sources (4·3 per cent.). Of expenditure 49·3 per cent. was on Salaries of Teaching Staff, 13·4 per cent. on other Departmental Maintenance, 13·1 per cent. on Maintenance of Premises, and 10·2 per cent. on Administration.

The outstanding feature of the situation is the cramping of university activities owing to want of funds. "The grave condition of commerce and industry," says the Committee, "has temporarily called a halt to the forward movement which derived its impulse from the experience of the War: such a halt was natural—perhaps inevitable—but it cannot be prolonged without arresting developments which can only be neglected at grave risk to national efficiency." The Committee finds in the universities' expenditure on their libraries an illustration of the parsimony which they are compelled to practise. In a report dated February 3, 1921, the Committee directed special attention to the vital necessity of proper provision for library maintenance and declared that the character and efficiency of a university may be gauged by its treatment of this, its central organ, and it now characterises the expenditure on libraries and museums in 1921–22 as "dangerously small." The whole expenditure under this head was about as much as is spent on the upkeep of their libraries by the two universities of Chicago and California. The Committee is satisfied that at practically all the universities the greatest care has been taken to limit expenditure to essentials, and to get full value out of every pound spent. It follows that if the developments so urgently necessary for national efficiency are to take place, the universities' incomes must be augmented.

The discussion at the conference followed generally the lines of Dr. Adami's paper read at the Universities' Congress of 1921, and was directed especially to the question how far it is possible and desirable to obtain increases of annual grants from Local Authorities. Sir Theodore Morison suggested that provincial universities may be regarded as beneficial alike to (1) their students, (2) the cities they are located in and the surrounding districts, and (3) the nation; and that where more than two-thirds of the university's income is obtained from the students and the nation, it is not unreasonable to look to local sources for an increase of their contribution. He adduced statistics showing that if cities which at present grant to their universities less than the produce of a penny rate, and counties and neighbouring boroughs which make grants equal to less than a halfpenny rate, were to increase their grants to these standards respectively, the English provincial universities would benefit to the extent of 55,000*l.*, or 4 per cent. of their total incomes; there are, moreover, a number of counties and boroughs within the spheres of influence of universities which do not at present make grants to them. Nor should it be difficult to convince local bodies of the great value to their constituents of a flourishing university in their midst. The services the universities can render to local communities may not be measurable in terms of money, but are not the less substantial, among them being assistance in the scientific development of local industries and the fostering of a spirit of regional independence. General appreciation on the part of local authorities of the value of such services should go far to minimise the dangers, to which attention was directed by several speakers at the conference, of dependence on grants out of rates.

With the exception of a remark by the president of the Board of Education to the effect that he believed the race of "pious donors" is not yet extinct, no suggestion was made as to the possibility of increasing endowments. The income from endowments not appropriated to specific purposes is shown in the Grants Committee's tables to amount at present to 155,230*l.*, or 4 per cent. of the total income; the income from appropriated endowments is 215,350*l.* Several speakers acknowledged the inestimable value of the services to the universities of Sir William McCormick's Committee in helping them to meet the crisis in their finances produced by the War. The president of the Board of Education, while assuring the universities that there is at present no disposition in Parliament to challenge their autonomy, observed that they would always need to be on their guard against claims that with the extension of State aid should go extension of State control.

In opening the discussion on "Music as a University Subject," Sir Henry Hadow made a vigorous plea for full recognition by the universities of the study of musical works as being on a par with, if not a part of, literature. This recognition would involve its acceptance as an optional subject for the B.A. degree. The discussion brought to light the fact that alike in London, in Wales, and in Scotland, the recognition of music as an optional subject for matriculation is being considered, and that the northern English universities' joint matriculation board has adopted, and the Oxford and Cambridge schools examination board is considering, an adequate music syllabus for their school certificate examination.

The discussion on "The Universities and Training for Administrative and Municipal Life," opened by Sir William Beveridge, who was ably followed by Sir Josiah Stamp, showed that the liveliest interest is being taken in this subject both within and without the universities, and that this has been greatly stimulated by the establishment last year of the Institute of Public Administration. Most of the speakers were in favour of the universities providing in this connexion, not preliminary professional training, but courses suitable for persons who have already entered on their official careers. The courses would be framed in consultation with representatives of central and local government authorities with the view of junior officials being released from their ordinary duties for attendance on them.

Mr. Arthur Greenwood, M.P., spoke on "Labour and the Universities," and a paper by the Master of Balliol on extra-mural education was read.

The discussions were marked throughout by an animation which proved that the subjects were well chosen. A report of the proceedings will, we are informed, be published by the Universities' Bureau.

The Department of Geology, University of Liverpool.

NEW GIFT FROM SIR WILLIAM HERDMAN.

ON Tuesday, May 15, the Council of the University of Liverpool accepted a gift of 20,000*l.* from Sir William A. Herdman for the provision of a new building for the Department of Geology. Sir William Herdman desired his gift to be associated with the memory of the late Lady Herdman, and that the new laboratories should bear her name. It will be recollected that, after urging for many years the desirability of the foundation of a chair of geology in the University, Sir William Herdman, in company with Lady Herdman, eventually offered the University the sum of 10,000*l.* for the purpose of endowing the George Herdman chair in memory of their only son, who was killed in action in 1916.

Largely through the foresight of Sir William Herdman and Sir Alfred Dale, the late Vice-Chancellor of the University, accommodation had been reserved in an extension of the Zoology Department. The Geological Department thus consisted of two floors and a library, but the new professor had the great advantage of dividing up the shell of the building into suitable laboratories and of equipping them for special needs. Sir William Herdman had been securing for many years valuable collections and books in preparation for the future department. The equipment of the laboratories was assisted very materially by a gift of 2000*l.* from Mrs. and Miss Holt, relatives of Lady Herdman, long well known for their great and numerous benefactions to the University. Many other donations towards equipment and the cost of purchasing collections, etc., were made by Sir William and Lady Herdman in the succeeding years, and several students in the Department had reason to be grateful for their kind and practical help.

The School of Geology, founded in 1917, has grown rapidly—not unexpected, when it is remembered that Liverpool has long been known for such distinguished amateur geologists as G. H. Morton, C. Mellard Reade, H. C. Beasley, and J. Lomas, and its active Geological Society with a sixty years' record of published work. The accommodation of the Department has for the past three years been insufficient for its needs, and Sir William and Lady Herdman frequently expressed their desire to see the school housed more fitly. Lady Herdman's sudden and lamented death last autumn prevented the new gift being a joint one, but it was a happy thought of Sir William Herdman to associate the names of wife and son with the laboratories and chair respectively.

Apart from this valuable assistance towards the furtherance of geological work, it may be recalled that in 1919 Sir William and Lady Herdman also endowed the chair of oceanography in the University.

University and Educational Intelligence.

ABERDEEN.—Dr. H. R. Kruyt, professor of physical chemistry in the University of Utrecht, delivered a University lecture on May 14, his subject being "The Electric Charge of the Colloids."

The Students' Gala Week in aid of the Aberdeen Hospitals has realised a nett sum of 4753*l.*

Prof. J. Arthur Thomson has been appointed a member of the committee of inquiry on trawling.

ST. ANDREWS.—Among the names of those on whom the Senatus Academicus has resolved to confer the honorary degree of LL.D. at the graduation ceremonial on July 6 are the following:—Sir William Henry Hadow, vice-chancellor of the University of Sheffield; Mr. Herbert William Richmond, University lecturer in mathematics in the University of Cambridge, and retiring president of the London Mathematical Society; and Sir Robert Robertson, chief Government chemist, London.

BIRMINGHAM.—The Huxley Lecture is to be delivered on Thursday, June 7, 5.30 P.M., at Mason College, by Sir Arthur Keith, who has chosen as his subject "The Origin of the British People."

Dr. H. H. Sampson has been appointed honorary assistant curator of the surgical section of the Pathological Museum, and Mr. J. S. M. Connell, honorary assistant curator of the gynæcological section.

Prof. John Robertson is to represent the University at the meeting of the National Association for the Prevention of Tuberculosis, to be held in Birmingham in July next.

The Ingleby Lectures will be delivered at 4 o'clock on May 30 and June 6 by Dr. H. Black, who will take as his subject "The Investigation of the Alimentary Tract by X-rays." The lectures are open to all medical men.

CAMBRIDGE.—Dr. W. L. H. Duckworth, Jesus College, has been elected as representative of the University on the General Medical Council.

Dr. E. Lloyd Jones, Downing College, has been re-elected demonstrator of medicine. An honorary degree of Master of Arts is to be conferred on Dr. J. T. MacCurdy, Corpus Christi College, University lecturer in psychopathology.

DURHAM.—An anonymous donor has presented the capital sum of 12,000*l.* to Armstrong College, Newcastle-upon-Tyne, the interest of which is to be devoted to the establishment of research fellowships and possibly prizes of similar character to the Adams prize at Cambridge, or in such other manner as the Council of the College may decide is best calculated to promote original work in pure and applied science and the humanities.

The Council of the College has decided to proceed immediately with the erection of a permanent library at an estimated cost of some 40,000*l.* It has long been felt that there is great need of a scholars' library on the north-east coast, and it is hoped that when the new library is built it will form a worthy centre for all students of the district, whether members of the University or not. It is understood that the Unemployment Grants Committee are favourably disposed to consider such a scheme as a work of public utility deserving assistance from public funds.

EDINBURGH.—On Wednesday, May 16, Prof. H. R. Kruyt, of the University of Utrecht, delivered a lecture on "The Electric Charge of Colloids"; and on Friday, May 18, Prof. W. de Sitter, of the University of Leyden, lectured on "Problems of Fundamental Astronomy."

LONDON.—Prof. Leonard Bairstow has been appointed as from September 1 next to the Zaharoff chair of aviation tenable at the Imperial College of Science and Technology. He has been head of the Aeronautical Department of the National Physical Laboratory, and since 1920 has been professor of aerodynamics at the Imperial College.

Dr. C. L. Boulenger has been appointed as from September 1 next to the University chair of zoology tenable at Bedford College. Since 1922 he has been lecturer in, and temporary head of, the department of zoology at the college. He is the author of a number of papers on Cœlenterata, helminthology, and other subjects.

Miss B. E. M. Hosgood has been appointed as

from September 1 next to the University readership in geography tenable at Bedford College. In 1918 she was appointed assistant lecturer in geography at the College, and has been since 1920 head of that department.

Dr. John Marshall has been appointed as from September 1 next to the University readership in mathematics tenable at Bedford College. He has been junior lecturer in mathematics at University College, Dundee, and senior lecturer in mathematics at University College, Nottingham. Since 1920 he has been senior lecturer in mathematics at University College, Swansea.

OXFORD.—On May 15 a decree was passed by Convocation authorising the presentation of an address to the Universities of Paris and Strasbourg on the occasion of the celebration of the centenary of the birth of Louis Pasteur.

It has been decided to offer an annual scholarship in chemistry under the will of the late Charles Day Dowling Gibbs.

A prize in natural science has been established by Mrs. Emily Poulton, in memory of her daughter, Hilda Ainley Walker, open to women members of the Society of Oxford Home-Students.

THE Ellen Richards Research Prize of 1000 dollars, for 1924, is being offered for theses by women, based on independent laboratory research. If the prize should not be awarded, a grant may be made under certain conditions. Information respecting the prize, and application forms, are obtainable from Dr. Lilian Welsh, Goucher College, Baltimore, Maryland, U.S.A., or from Mrs. Samuel F. Clarke, Williamstown, Mass., U.S.A.

THE Dr. Edith Pechey Phipson post-graduate scholarship, value 100*l.* a year for not more than three years, will be awarded in June by the council of the London (Royal Free Hospital) School of Medicine for Women. The scholarship is open to all medical women, preferably coming from India, or going to work in India, and is for assistance in post-graduate study. The latest date for the receipt of applications (which should be sent to the Warden and Secretary of the School, 8 Hunter Street, W.C.1) is May 31.

THE Board of Education is organising short summer courses of instruction for teachers in technical and evening schools (Form 105e. U.). Engineering science and electrical engineering are dealt with at Oxford and Birmingham. Both courses commence at Birmingham on July 23 and are concluded (July 28 to August 8) at Oriel College, Oxford. The courses include practical work on heat engines, hydraulics, mechanics, materials, electrical testing, wireless, thermo-electricity and magnetic testing. Building science is divided into two courses, (*a*) building mechanics and structures and (*b*) general science and laboratory work, both at Westminster Training College, Horseferry Road, London, S.W.1. Applications to attend these courses, to be obtained and returned through the local Education Authority if the teacher is working under such an authority, must be received by the Board of Education not later than June 1.

THE Manchester Municipal College of Technology is this year celebrating its "coming of age." It originated in a Mechanics' Institution founded in 1824 with the object, common to many similar foundations of the second quarter of the nineteenth century, of "enabling mechanics and artisans to become acquainted with such branches of science as are of practical application in the exercise of their trades." Conceived without much regard to the principles of industrial psychology, the methods employed commonly failed to attract people of the class for whom they were intended, and thirty years after its foundation a vice-president of the Manchester institution remarked, "Nature was as bountiful to the working-class in talent and energy as to the higher classes," but "those for whom this institution was destined did not avail themselves of it," and "until we enforced education upon all classes, Mechanics' Institutions, successful as they might be to some classes, would not produce the great advantage they might otherwise do." The Paris exhibition of 1867 having attracted attention to a growing inferiority of English arts and crafts, a cry was again raised for technical education among workmen, and this was echoed by the directors of the Manchester institution, who in their report for 1868 approved of "recurring to a system of education the basis of which was prescribed in the original preamble, viz. to instruct the working-classes in the principles of the arts they practise." In 1882 it was converted into a technical school, which was in 1892 taken over by the City Corporation. The College into which it has grown had in 1921–22 an income of 143,000*l.*, of which nearly 64 per cent. (more than the produce of a 4d. rate) was provided by the Corporation. Of the 6223 students 553 were taking courses of university standard. An interesting series of articles upon the work and development of the College has been contributed to the *Manchester City News* by the former principal, Mr. J. H. Reynolds.

AMONG the various links connecting abstract science and engineering is the scientific education of engineers. Thirty years ago Sir William Anderson deplored the fact that except in the noble endowments of the City and Guilds schools and the Government institutions at South Kensington in London, the movement to secure the necessary training languished for want of adequate support. Sir Richard Glazebrook, in his "James Forrest" lecture to the Institution of Civil Engineers on May 4, made reference to this, and gave a brief outline of the conditions at present. The City and Guilds College—the Engineering Department of the Imperial College—opened in 1886 with 35 students; in July 1922 there were 492 engineering students in the College, and 138 students of the Royal College of Science and the Royal School of Mines were also receiving instruction. The numbers for the Schools of the University of London and its other institutions were not quoted, but it may be said that these show corresponding increases. In the period from 1903 to 1922 London University conferred 1294 internal and 756 external engineering degrees. The growth in the provincial universities and colleges has also been very large. Among other hopeful signs is the increasing interest in the education of apprentices shown by trades unions; a report on this subject was presented at the Trades Union Congress last year. The scheme of industrial bursaries started in 1911 by the Royal Commission for the Exhibition of 1851 is for the award of bursaries to students who have done well in some branch of science and who propose to go into works. Up to December last about 19,000*l.* has been expended on 185 bursars. The scheme is an extremely useful one and could be extended with advantage. Many young men find it extremely difficult, after a successful college career, to obtain adequate works experience without causing an intolerable drain on the slender resources of their parents. It is also of interest to record that there is an increasing demand by employers for college-trained men; the associations of works and colleges were greatly strengthened during the War, and many firms now prefer men for their staffs who possess university degrees.

Societies and Academies.

LONDON.

Royal Society, May 17.—A. E. H. **Tutton**: (1) A universal interferometer. The essential feature is a travelling microscope driven by a specially constructed fine screw along a true V-and-plane guiding bed; one of the two glass reflecting surfaces is carried rigidly with it, and the amount of its motion is measured directly in monochromatic interference bands. There is an autocollimating telescope with micrometer eyepiece, a vacuum tube on the elbow tube, a constant deviation prism for the selection of the monochromatic radiation to be used, and large truly worked glass interference discs. The telescope is mounted to the right, and the driving wheel to the left, and the 30-inch long V-and-plane bed, in its rigid carrying plinth-bed, is supported on pillars at the Airy positions for no flexure, the whole being mounted on a heavy rectangular base. The large middle space on the latter is available for a large circular work-table with every possible requirement of adjustment for supporting the object or its manipulating apparatus. (2) A wave-length torsometer, and its use with the universal interferometer. This is a refinement of the Voigt instrument for determining the torsion constants of small bodies. It is essentially a miniature lathe-bed, carrying two similar but mutually reversed wheel-and-chuck fittings, the chucks for gripping the object bar ends, and the wheels, which move solidly with the chucks, for delivering the force-couple at one end and holding the object firmly at the other, the two ends being interchangeable. The power band passes round the lower half of one pulley-wheel and thence over a larger pulley-wheel on a standard. The end depending from in front of the latter terminates in a loop of the cord-band, into which the hook carried by the weight can be allowed slowly to fall, until the whole weight is acting in twisting the object bar. The torsometer is supported on the work-table of the universal interferometer. It is rigidly clamped with the two aluminium radials carried by the object bar near its two ends, in contact near their upper terminations with the blunt knife-edge ends of the two sliders. The Grayson-ruling signal is centred under the microscope when the radial under observation is just in complete contact with the slider. On delivering the weight and effecting the twist, the slide and signal move, and the movement is followed by driving the microscope by the big wheel of the interferometer until the signal mark is again centred, the number of interference bands effecting their transit being counted.—L. N. G. **Filon** and F. C. **Harris**: On the diphasic nature of glass as shown by photo-elastic observations. A block of flint glass was heated to about 400° C., when it showed some signs of softening; it was then allowed to cool under longitudinal pressure. On removing the pressure it was found to have become permanently doubly-refracting. The residual stress which should produce the observed amount of double-refraction does not balance according to the laws of statics. It is deduced that a "crypto-stress" exists, which does not manifest itself optically. This leads to the conclusion that the glass is not homogeneous, but behaves as a mixture of two components or phases.—C. E. **Inglis**: Stress distribution in a rectangular plate having two opposing edges sheared in opposite directions. Imagine a thin rectangular plate bounded by two horizontal lines AB CD and two vertical lines AD BC. The two horizontal edges, while remaining straight and unchanged in length and in distance from one another, are displaced longitudinally in opposite directions, the vertical edges being kept free from applied stress. The plate being thin, the distribution of stress consequent on this deformation is regarded as two-dimensional and the stress components are obtained through solutions of $\nabla^4 V = 0$. Along the horizontal centre line the stress starts from zero at the free edge, increases rapidly, and, for a plate in which the length is considerable compared with the depth, the stress soon assumes a constant value; but before doing so, it overshoots this value, and the curve of stress distribution in consequence develops humps near the free vertical edges. If the length–breadth ratio of the plate is 2 to 1 these humps combine to give a flat-topped curve. If the plate is square the coincidence of the humps makes the curve approximate to a parabola.—T. H. **Havelock**: Studies in wave resistance: influence of the form of the water-plane section of the ship. In these calculations the ship is represented by a vertical post of infinite depth the horizontal section of which is similar to the water-plane section of a ship. The level lines of the model are varied, while the displacement is kept constant. In this manner a comparative study is made of such problems in ship resistance as the effect of finer lines and greater beam and of the difference between straight and hollow lines.—W. M. H. **Greaves**: On a certain family of periodic solutions of differential equations, with an application to the triode oscillator. There is, under certain conditions, a discontinuous family of periodic solutions of the equations $dx/dt = \mu\xi$, $dy/dt = \lambda(x) + \mu\eta$, where $\lambda(x)$ is a function of x only, ξ and η are functions of x and y, periodic in y with period 2π, and expressible as Fourier Series in sines and cosines of multiples of y, the coefficients being functions of x, not involving t explicitly, and μ is a constant parameter. An application is made to the equation of Appleton and Van der Pol for the triode oscillator the equation of which can be reduced to a particular case of the above equations.

Geological Society, April 18.—Prof. A. C. Seward, president, and, afterwards, Dr. H. H. Thomas, vice-president, in the chair.—J. F. N. **Green**: The structure of the Bowmore-Portaskaig district of Islay. Quartzite is defined as containing a limit of 10 per cent. of felspar, more highly felspathic rocks being termed "arkose." On this definition the Islay upper quartzite is throughout true quartzite; but the so-called lower quartzite is not quartzitic, being composed of arkoses and greywacke-slates identical with the matrix of the Portaskaig conglomerate; they have been grouped together as the Portaskaig beds. Thus the dolomitic group intervenes between the Portaskaig beds and the Islay quartzite. The supposedly Torridonian Bowmore sandstone consists of arkoses and flags. The flags, which, owing to isoclinal folding, have apparently an enormous thickness, are identical in minute detail with certain siliceo-argillaceous flags that always occur in the dolomitic group next to the Islay quartzite. They are termed the Bowmore flags. Thus there is no change of facies at the supposed thrust, and its presumed line of outcrop shows that the rocks are folded up without disruption, except for some shearing on the reversed limbs of overfolds. The Loch Skerrols thrust is non-existent. The Bowmore flags are perfectly conformable to the white edge (a well-marked horizon) of the Islay quartzite; the dolomitic flags associated with them are partly or wholly cut out in places by the Portaskaig beds. The latter are probably younger than the dolomitic group. On Beannan Dubh the rocks lie in isoclinal folds with low dip, by which the Portaskaig conglomerate

is brought up in anticlines. The structure of Islay is probably synclinal. Only one system of folding is required to explain the facts.

May 2.—Prof. A. C. Seward, president, in the chair.—J. **Joly**: The bearing of some recent advances in physical science on geology. In his lecture, Prof. Joly dealt with the subjects discussed in the article "Surface Movements of the Earth's Crust" in NATURE of May 5, p. 603.

Royal Anthropological Institute, May 1.—Mr. H. J. E. Peake in the chair.—V. Gordon **Childe**: The Neolithic painted pottery of south-eastern Europe. The sites in question extended from the banks of the Dnieper in the Kiev Government to the slopes of the Carpathians, and are restricted to the fertile "black earth" belt. Three groups were found: an eastern group along the Dnieper (the Tripolje culture proper) with much incised ware; a central group in Bessarabia, Moldavia, Bukowina, and Eastern Galicia, where pottery with black paint predominated, and a western group represented by Koszylowce west of the Sereth with polychrome painting. At Cucuteni in Moldavia an older phase of this culture was discovered with polychrome pottery and good spiral designs. The painted pottery comes either from large rectangular structures of wattle and daub called *ploshchadky* or from huts partly hollowed out in the earth (*zemlyanky*). No hearths have been found in the former, but the latter regularly contain an oven situated in a deeper trench filled with kitchen refuse. No authenticated metal finds were reported from Schipinitz, and at other parallel stations (except Cucuteni II.) metal was either completely absent or represented only by small implements of pure copper. Polished stone axes were also very rare, but fine flints and numerous artefacts of bone date the culture to the last phase of the stone age. The culture of the "black earth" was apparently terminated by the incursion of nomadic tribes.

May 14.—Dr. A. C. Haddon, past-president, in the chair.—Mr. J. E. P. **Murray**: Native administration in Papua. The principle that government of the backward races should be in the interests of these races themselves has been followed by the Australian Government in the administration of Papua. It is necessary, however, to understand the Papuan character if an intelligent native policy is to be pursued, and on this account an anthropological department was instituted. The indenture of women is not allowed in Papua except for domestic purposes under certain conditions. The indenture of women would probably result in the breaking up of village life, which would put an end to any possibility of developing the territory through native enterprise. Changes introduced into native life by the arrival of the white man can be classified as (1) moral; (2) material; for the latter the Government must find a remedy or it fails in its duty altogether. One most obvious remedy is work, not merely in the interests of the white employer, but work for the native's own interest and on his own land. The introduction of the native tax in Papua has made it possible to deal comprehensively with the question of native plantations, and plantations worked by natives in partnership with the Government. The proceeds of the tax are used only for native education and for other purposes directly for the benefit of the natives. In the future the danger to the native under Australian rule lay in "benevolent capitalism."

Linnean Society, May 3.—Dr. A. Smith Woodward, president, in the chair.—W. T. **Gordon**: Fossil coniferous genus Pitys. The specimens were obtained from beds of siliceous volcanic ash, at Gullane, 17 miles east of Edinburgh, and comprised a new species, showing cortex and leaves; hitherto nothing was known of the genus, except pith and wood.—R. **Gurney**: The Crustacean plankton of the English Lake district.—S. L. **Ghose**: A systematic and ecological account of a collection of Blue-green Algæ from Lahore.—J. **Groves**: Notes on Indian Charophyta. In 1882 representatives of the genera Chara and Nitella only were known from India. Now a Nitellopsis, a Lychnothamnus, and three species of Tolypella have been recorded. Within the past three years, in a comparatively small area, Mr. G. O. Allen added three well-marked species to the Indian flora besides rediscovering *C. Wallichii*, of which only the male plant collected in 1809 by Dr. Wallich was previously known, and establishing the occurrence of *Nitellopsis obtusa* (in Kashmir), the only previous Asiatic record of which was dependent on a poor specimen from Burmah.—J. G. H. **Frew**: On the morphology of the head-capsule and mouth-parts of *Chlorops tæniopus* Meig. (Diptera).—A. M. **Alston**: On the genital system of the wood-boring beetle, *Lyctus brunneus* Steph. Both of the ovipositor and the rectum are of great length.

Aristotelian Society, May 7.—Prof. A. N. Whitehead, president, in the chair.—L. J. **Russell**: Some problems in the philosophy of Leibniz. The metaphysical concept of the monad was reached in the later part of Leibniz's philosophical development and the sources of the doctrine are only to be discovered by studying his writings, many of which are undated manuscripts, chronologically. In the "Discourse on Metaphysics" (1686) we find he has arrived at the conception of created substance. It was this conception which provided for him a rational justification of his view of the relation of God to the universe and of his conception of the universe as a harmony. It was into this framework that the monadology was fitted. Leibniz seems never to have doubted the validity of the conceptions of God as the architect of the world machine, and as the ruler of the republic of spirits. The first saved him from the pantheism of Spinoza, which would have made the second irrational. The reconciliation of the two conceptions presented the chief problem of his philosophy.

Zoological Society, May 8.—Dr. A. Smith Woodward, vice-president, in the chair.—H. **Burrell**: Note on a hibernating female specimen of the marsupial *Acrobates pygmæus*.—F. M. **Duncan**: The microscopic structure of mammalian hairs, with especial reference to the hairs of the primates.

Optical Society, May 10.—Mr. T. Smith, vice-president, in the chair.—J. W. **French**: Stereoscopy re-stated. Stereoscopic vision is possible only within certain limits. For certain pairs of objects, whether on the same or different horizons, there are generally two extreme critical points beyond which stereoscopic vision breaks down. For certain pairs of objects on the same horizon there are two inner critical points. Objects of dissimilar form but approximately the same average angular dimensions can frequently be combined stereoscopically; thus a circle can be combined with a triangle if their average angular dimensions are about equal. When the angular dimensions are very different, combination is generally impossible; thus, for example, a thin line cannot be combined with a thick line or triangle. When the pairs of objects are dissimilar in size, there is only one pair of outer and inner

critical points if the objects are on the same horizon and one outer critical point if they are on different horizons. For pairs of objects any of which can be combined together, there are two pairs of such critical points.

Royal Meteorological Society, May 16.—Dr. C. Chree, president, in the chair.—M. de Carle S. **Salter** and J. **Glasspoole**: The fluctuations of annual rainfall in the British Isles considered cartographically. Maps expressing annual rainfall 1868–1921 as a percentage of the average, fall roughly into three types, indicating respectively (i.) excess of orographical rain, (ii.) deficiency of orographical rain, (iii.) excess of cyclonic rain. The mean range of variation per annum is 35 per cent., with local extremes varying from +80 per cent. to −59 per cent. In the earlier years the maxima were generally in the east: in the middle of the period in the west: and in the later years in the south. The general rainfall varied from 136 per cent. in 1872 to 77 per cent. in 1887, the deviation exceeding 20 per cent. in only 5 years, and averaging 8 per cent. From 1868 to 1882 maxima occurred at intervals of 5 years; from 1889 to 1909 of 3 years; and from 1910 to 1921 of 2 years. There is also evidence of a long-period fluctuation with two maxima about 40 years apart. Annual pressure maps for the same series of years appear to show three main types of variation due to (i.) shifting of the S.W. wind drift to N. or S.; (ii.) changes in the gradient; (iii.) local deflections of the isobars. Type (i.) appears to determine the amount of general rainfall; type (ii.) determines the distribution of rainfall; type (iii.) affects both variables, and includes all extremely dry or wet years.—A. W. **Clayden**: An improved actinograph; note on the influence of a glass shade. Two similar bimetallic coils, like those used for thermographs but with $7\frac{1}{2}$ turns each, are mounted about a common axis and attached to a recording pen, in such a manner that the movements of the pen register only the difference of temperature between the two coils. The axis is fixed in a position parallel to the polar axis with the coils at its ends. The instrument stands in a case so that the coil at the lower end is shaded from the sun, while the coil at the upper end is exposed under a hemispherical glass shade to full sunlight and is blackened. The records for five consecutive years from February 1914 show a rapid rise of radiation during January to April, a slight drop about the middle of May followed by a rise to June and a fall during the latter half of the year which is notably more gradual than the vernal rise.—E. E. **Benest**: Notes on the "Sumatras" of the Malacca Straits. These squalls usually blow from the south-west, and are more frequent between April and October. A greater number is experienced between Malacca and Pulo Penang than between Malacca and Singapore. "Sumatras" always occur at night, and are generally accompanied by thunder, lightning, and torrential rain; they seldom last more than two hours. The strength of the wind is estimated as between 40 and 55 miles per hour. A characteristic cloud formation is a heavy arch or bank of cumulo-nimbus, which rises to an estimated height of about 7000 ft. and rapidly spreads over the whole heavens.

PARIS.

Academy of Sciences, April 30.—M. Albin Haller in the chair.—A. **Haller** and L. **Palfray**: The mixed and symmetrical 1-ethanoic-1-camphomethanoic esters and their saponification products. These compounds, containing both the (CH_2.CO_2H) and (CO_2H) groups, attached to the same atom of the camphor molecule, form esters which are singularly difficult to hydrolyse.—A. **Calmette**, A. **Boquet**, and L. **Nègre**: Rôle of the *terrain* in the evolution of experimental tuberculosis in the rabbit and guinea-pig. The interval of time between the injection of tubercle culture into a rabbit and the death of the animal through tuberculosis has been proved to be inversely proportional to the number of bacilli inoculated, the bacilli arising from the same culture. With guinea-pigs and rabbits the number of bacilli injected appears to be the main factor in determining the time of evolution of the disease, and there are no indications of a factor involving variable sensibility of the individual animals.—Georges **Bouligand**: The singularities of harmonic functions.—A. **Sainte-Laguë**: Networks.—J. **Haag**: The gravitational field of n bodies. A correction of an earlier note on the same subject.—Louis **Roy**: Gauss's theorem of least constraint. This theorem of Gauss is stated to be incorrect.—M. **Cisotti**: Remarks on the note "Superficial circulation" by M. P. Noaillon.—F. **Henroteau**: Variations of the spectrum of the star θ_2 Orionis. In addition to the absorption lines due to hydrogen and other elements, a photograph of the spectrum taken at Ottawa in 1919 and January 1920 showed fine, intense emission lines. These lines were not found by O. Struve (Yerkes Observatory) in 1922, but were present on a spectrogram taken March 2, 1923. Hence this star, class B and not variable, shows bright lines only at intervals, a new phenomenon in astronomy.—Max **Morand**: Certain electromagnetic consequences of the principle of relativity.—L. **Dunoyer**: Induction spectra and spark spectra. Reply to a criticism by Léon and Eugène Block.—S. K. **Mitra**: The demagnetisation of iron by electromagnetic oscillations. A study of the effects of variation of the frequency of the alternating current on the residual magnetisation. The demagnetisation increases as the frequency of the oscillations is lowered.—Félix **Michaud**: Deformations of jellies by the action of an electric current. When a jelly is placed between two metallic electrodes, and an electric current is passed, it contracts towards the anode, and swells out near the cathode. The nature of the metal used for the electrodes is without influence. The action depends on the colloid; gelose gives a more intense effect than gelatin.—Pierre **Brémond**: The persistence of the colour of the ions in ceramic colours or colouring materials obtained at a high temperature. Attention is directed to the fact that some of the colours shown by ceramic products due to metallic constituents, and produced at high temperatures, correspond with those found in the salts of the same metals, or in hydrates which are stable only at low temperatures.—Mme. and M. A. **Lassieur**: The estimation of antimony by means of phenylthiohydantoic acid.—Marcel **Pichard**: Method of analysis of cocoa butter and its mixtures with vegetable fats. The method is based on the form of the cooling curve of the melted fat, when allowed to solidify slowly.—L. J. **Simon** and Léon **Piaux**: The conversion of alanine into pyruvic acid by the direct action of oxygen. Alanine can be oxidised directly to pyruvic acid by shaking with oxygen in the presence of alkali and metallic copper, but the proportion of copper present must be carefully regulated (1 molecule alanine to $\frac{1}{4}$ atom copper) and the reaction stopped immediately the absorption of oxygen ceases.—M. **Aloy** and M. **Valdiguié**: The oxidations and reductions produced by uranium salts under the influence of light. The antioxygen effect of phenols. Uranium acetate can act like an oxidising-reducing ferment. A solution of this salt, just acid with acetic acid, when mixed

with glucose and methylene blue, placed in an evacuated bulb, and exposed to sunlight, oxidises the glucose and reduces the methylene blue simultaneously.—J. **Orcel**: The prochlorites of corundum rocks. These minerals, ten analyses of which are given, are divided into two sub-groups, ripidolites defined by the ratio MgO/FeO ≥ 3 and grochauite, with a ratio MgO/FeO = 10.—Pierre **Viennot**: The Labourd stratum, French Basque region.—Léon **Moret**: The facies of the Senonian sponges of the Beausset basin and their conditions of deposit.—C. **Kilian**: The Immidir, branch of the "Enceinte Tassilienne," Central Sahara.—René **Jeannel**: Sketch of the stocking of Europe by the species of the genus Choleva.—R. **Anthony** and F. **Villemin**: The lobation of the fœtal kidney in the primates.—Radu **Vladesco**: Diffraction of light by the eyelashes. The diffraction bands seen under certain conditions are due to the scales forming the outer envelope of the hair.—J. **Lopez-Lomba** and Mme. **Randoin**: Contribution to the study of B avitaminosis in the pigeon.—L. M. **Bétances**: Cytohemato-genesis in the Metazoa.—A. **Weber**: The inhibiting action of the internal medium of batrachians on the fecundation and the parthenogenetic activation of their eggs. In *Rana fusca* the internal medium, lymph or blood, behaves towards the activated egg as a toxic substance, to which the egg becomes permeable after puncture, while previously it was immunised against this toxic property.—Maurice **Aubertot**: The dissemination and transport of nematodes of the genus Rhabditis by Diptera.—R. **Courrier**: Remarks on the fecundation membrane of the egg of the sea-urchin (*Paracentrotus lividus*).—Edouard **Chatton** and Mme. M. **Chatton**: The influence of bacterial factors upon nutrition: the multiplication and sexuality of the infusoria.—Robert Ph. **Dollfus**: The cestode of the fine pearls of the Meleagrina of Nossi-Bé.

Official Publications Received.

Journal and Proceedings of the Royal Society of Western Australia. Vol. 8, 1921-1922. Pp. x+52. (Perth.) 5*s*.

Health for School Children: Report of Advisory Committee on Health Education of the National Child Health Council, Washington, D.C. (School Health Studies, No. 1: Department of the Interior, Bureau of Education.) Pp. 75. (Washington: Government Printing Office.) 10 cents.

Department of the Interior: Bureau of Education. Bulletin, 1922, No. 36: Report of a Survey of the University of Arizona. Pp. viii+89. Bulletin, 1922, No. 50: Educational Directory, 1922-1923. Pp. iii+179. 15 cents. (Washington: Government Printing Office.)

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts. Eighth Annual Report, 1922. Pp. 66. (Cheshunt.)

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review. Supplement No. 19: Thermal Belts and Fruit Growing in North Carolina. By Henry J. Cox. Appendix: Thermal Belts from the Horticultural Viewpoint. By W. N. Hutt. Pp. v+106. (Washington: Government Printing Office.) 50 cents.

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1922, presented to the Annual Meeting, February 12th, 1923. Pp. 63. (York.)

Diary of Societies.

SATURDAY, MAY 26.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—J. B. McEwen: Musical Education.

MONDAY, MAY 28.

FARADAY SOCIETY (at Institution of Electrical Engineers), at 3.—General Discussion on the Physical Chemistry of the Photographic Process.—Prof. W. D. Bancroft: Introductory Address—The Theory of Photography.—Section I. The Physical Chemistry of the Vehicle and of the Emulsion.—Dr. T. Slater Price: Introductory Address.—Prof. R. Luther: Effect of Treatment of Gelatin on the Sensitivity of the Emulsion.—E. P. Sheppard, F. A. Elliott, and S. S. Sweet: Notes on the Photographic Chemistry of Gelatin.—E. P. Wightman, A. P. H. Trivelli, and S. E. Sheppard: Structure of the Photographic Emulsion.—Dr. C. Winther: The Solubility of Silver Bromide in Ammonium Bromide and Gelatin.—At 5.—Section II. Reactions of the Plate during Exposure (including Latent Image).—Dr. F. C. Toy: Introductory Address—The Mechanism of the Latent Image Formation.—S. E. Sheppard, A. P. H. Trivelli, and E. P. Wightman: Exposure Theories.—Prof. R. Luther: The Relation between the Size of Silver Bromide Grains and Sensitivity.—W. C. Clark: Sensitivity of Silver Halide Grains in a Photographic Emulsion.—Dr. J. Errera: The Influence of the Dispersion of Asphalte Solutions on their Light Sensitiveness.—Section III. Development and Characteristics of the Developed Plate (including Optical Properties, Sensitometry).—O. Bloch: Introductory Address—Plate Sensitometry.—Prof. R. Luther: The Characteristic Curve.—Prof. R. Luther: Proportional Reducting Methods.—Prof. E. Goldberg: The Use of the Neutral Grey Wedge in Sensitometry.—T. Thorne-Baker: The Effect of Radiations of very small Wave-lengths on Optical Opacity and Gamma.—S. E. Sheppard and F. A. Elliott: The Theory of Development.—L. A. Jones: Recent Progress in the Sensitometry of Photographic Materials.—L. A. Jones: Some New Instruments for use in Photographic Sensitometry.—F. E. Ross: Optical Properties of the Photographic Emulsion.—At 8.—Section IV. Adsorption Reaction in Photographic Films.—Dr. Luppo-Cramer: Introductory Address.—Dr. Luppo-Cramer: Nucleus Isolation and Desensitisation.—A. L. Lumiere and A. Seyewetz: The Chemistry of the Red Toning of Sulphide-toned Prints.—Prof. R. Luther: Adsorption of Cupric Ion by Silver Bromide: Estimation of Traces of Copper by a New Catalytic Method.—Prof. R. Luther: Copper as Catalyst in Photographic Processes: Catalytic Effects in the Carbon Process.—E. R. Bullock: Theory of Photographic Due Mordanting.—Dr. J. Plotnikov: Future Problems in Photography.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Walford Davies: Speech Rhythm in Vocal Music (2).

ROYAL GEOGRAPHICAL SOCIETY (Anniversary Meeting) (at Æolian Hall), at 5.30.—Presidential Address.—Presentation of Medals and other awards, etc.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. Scott: Tradition and Originality in Italian Renaissance Architecture.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—C. D. Burns: The Contact of Minds.

ROYAL SOCIETY OF MEDICINE (Odontology Section) (Annual General Meeting), at 8.—Dr. S. Wallace: Observations on the Progress of Preventive Dentistry.

TUESDAY, MAY 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. M. Flinders Petrie: Discoveries in Egypt (2).

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.30.—Annual General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—C. Tate Regan: The Skeleton of *Lepidosteus*, with Remarks on the Origin and Evolution of the Lower Neopterygian Fishes.—Dr. C. F. Sonntag: The Comparative Anatomy of the Tongues of the Mammalia. IX, Edentata, Dermoptera, and Insectivora.—S. Maulik: New Cryptosome Beetles.

WEDNESDAY, MAY 30.

ROYAL SOCIETY OF ARTS, at 4.30.—A. J. Sewell: The History and Development of the Perambulator and Invalid Carriage.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications of the Microscope Section), at 7.—M. T. Denne: An Improved Apparatus for the Production of Photomicrographs.—C. A. Newton: A New Form of Microscope Lamp for Easy Exchange of Paralleliser and Polariser.—M. P. Swift: A Hutchinson Universal Goniometer.—At 8.—J. M. Coon: The Microscopical Examination of China Clay.—H. B. Milner: The Microscopical Investigation of Sands for various Industrial Purposes.

THURSDAY, MAY 31.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William M. Bayliss: The Nature of Enzyme Action (1).

ROYAL SOCIETY, at 4.30.—Dr. E. Griffiths and Dr. G. W. C. Kaye: The Measurement of Thermal Conductivity, No. 1.—Dr. G. W. C. Kaye and J. K. Roberts: The Thermal Conductivities of Metal Crystals. I. Bismuth.—C. V. Drysdale and S. Butterworth: The Distribution of the Magnetic Field and Return Current round a Submarine Cable carrying Alternating Current.—Prof. S. Russ: The Effect of X-rays of different Wave-lengths upon some Animal Tissues.—Dr. E. F. Armstrong and Dr. T. P. Hilditch: A Study of Catalytic Actions at Solid Surfaces. Part XI. The Action of Alumina and certain other Oxides in promoting the Activity of Nickel Catalyst.—N. K. Adam: The Structure of Thin Films. Part IV. Benzene Derivatives. A Condition of Stability in Monomolecular Films.—N. K. Adam: The Structure of Thin Films. Part V.—W. B. Rimmer: The Spectrum of Ammonia.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 (Annual General Meeting).—Presentation to the Institution of (*a*) An oil painting of the late Dr. Silvanus Thompson; (*b*) Dr. Thompson's Library; (*c*) A bronze bust of Dr. Thompson, by Mr. Gilbert Bayes.

FRIDAY, JUNE 1.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. Kendall: The Participation of India and Burma in the British Empire Exhibition, 1924.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—The Variation of Latitude in relation to the Physical Properties of the Earth's Interior. Chairman, Lord Rayleigh. Speakers, R. Stoneley, Dr. H. Jeffreys, and others.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Dr. H. Bradley: Dictionary Evening.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. H. A. Lorentz: The Radiation of Light.

SATURDAY, JUNE 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. A. W. Hill: The Vegetation of the Andes.

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 3.—Sir Charles Walston: Some Aspects of the Philosophy of Harmonism and Future Experiments.

PUBLIC LECTURES.

THURSDAY, MAY 31.

ST. MARY'S HOSPITAL (Institute of Pathology and Research), at 4.30.—Prof. L. Hill: New Ideas concerning the Biological Action of Light.

UNIVERSITY COLLEGE, at 5.30.—Prof. A. Cippico: Ludovico Ariosto (in Italian).

FRIDAY, JUNE 1.

UNIVERSITY COLLEGE, at 5.30.—Dr. P. Lang: Contemporary Swiss Literature. (Succeeding Lectures on June 8 and 15.)