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Scientific Officers in Tropical Agriculture.

MR. ORMSBY-GORE, Parliamentary Under-Secretary of State for the Colonies, speaking at the annual dinner of the National Union of Scientific Workers on March 19, emphasised the need for many more highly trained scientific officers in British colonial possessions. His recent visit to East Africa with Major Church, secretary of the Union, as members of the East African Parliamentary Commission, revealed to him some of the problems which could be solved only by the use of scientific knowledge, and developments which can come from scientific guidance alone. He regarded the present position as to officers and institutions concerned with tropical agriculture as "a disgrace to the Empire."

The earliest appointments of this class of scientific officers in tropical agriculture were the heads of the various tropical botanic gardens, usually systematic botanists, whose concern with agriculture was only a limited one, their principal duties being the introduction of possible useful plants, and the investigation of the local flora. The first officer of a more specialist type to be appointed in the British tropical colonies was the late Prof. Marshall Ward, who was sent to Ceylon in 1882 to investigate the coffee leaf disease (*Hemileia vastatrix*) and to endeavour to find some remedy for the already desperate position of affairs. But his advent upon the scene was much too late for any remedy to be applicable that was within the means of the planters, and the visit was unsuccessful, so that public opinion was set against such appointments. A little later, however, the well-known Dr. Treub obtained quite a considerable staff of specialist scientific officers at the great Dutch colonial institute in Java, to which Mr. Ormsby-Gore paid high tribute.

For a long time no further appointments were made in the British tropical colonies, and the next, so far as we are aware, was that of Mr. E. E. Green (now president of the Entomological Society), who in 1897 was made honorary government entomologist in Ceylon, with a small grant for expenses. In the following year, Mr. J. Parkin was appointed assistant in Ceylon to investigate the chemistry and physiology of the coagulation of rubber latex. Mr. Green did such valuable work in his honorary capacity that in 1899 he was appointed full-time entomologist, while in the same year the newly formed Imperial Department of Agriculture in the West Indies appointed Mr. Maxwell Lefroy (now professor at the Imperial College of Science, South Kensington) as entomologist, and Messrs. Harrison and d'Albuquerque as honorary chemists.

From that time onwards the number of scientific men employed in the tropical colonies has steadily increased,

though at first public opinion was opposed to such appointments, on the supposition that scientific work was unlikely to have much bearing upon practice in agricultural matters. This expansion is to some slight extent due to an element of good fortune which attended these pioneers, who were markedly successful in their early work, of which that of the first two may be quoted as an example. Mr. Green, with years of practical experience as a tea planter, made recommendations for the treatment of disease which were at once practical, economical, and successful, while Mr. Parkin devised the method of coagulation of rubber latex which is still followed. At first, the appointments were chiefly of officers to deal with diseases, or of chemists to deal with soil questions, and in this and other ways the old botanic gardens in some of the most important tropical colonies developed into Departments of Agriculture.

There are several essentials in the equipment of a scientific officer for the tropics, though naturally the training of each must vary with the duties which he is to undertake. These essentials are well set forth by Prof. Farmer in a pamphlet recently issued.[1] In the first place, the officer must, of course, have a thorough knowledge of the science with which he is to be concerned, a knowledge best obtained at one of the universities, where he should have taken a good degree in honours. Next in importance is a good general knowledge of tropical agriculture, and (especially in the case of officers like entomologists, who have to make recommendations which involve the outlay of money) of the economics of the various cultivations. Such knowledge is best obtained in a tropical country, and if the individual cannot afford to spend some time at such a place as the Imperial College of Tropical Agriculture in Trinidad, he should learn his work by being attached as assistant to some officer with long experience of the tropics. In the third place, the man should have a capacity for research, sufficient at any rate to enable him to find out the life-history of a disease, to test new plants or new conditions, to advise as to the best manures for unfamiliar soils, and such matters. While this capacity is largely inborn, it may be much improved by work under a capable and experienced chief, under whom he may carry out definite pieces of research. Finally, a most desirable part of the equipment is a capacity for giving—in speaking or in writing—clear and easily understood accounts of any work that has been carried out, whether his own or that of other workers. It is through the work of men of this type, adequately trained and reasonably paid, that, as Mr. Ormsby-Gore remarked, "we shall be justified in history as a great Imperial Power."

[1] "On the Training of Scientific Officers for Tropical Plantation Industry," by Prof. J. B. Farmer. Reprinted from the Official Report of the Brussels Conference, 1924; published by the Rubber Growers' Association, Inc.

Philosophy and Science.

The Scientific Approach to Philosophy: Selected Essays and Reviews. By Prof. H. Wildon Carr. Pp. viii+278. (London: Macmillan and Co., Ltd., 1924.) 12s. net.

FOR centuries past, science and philosophy, in spite of their common origin in the evolution of human thought, in spite, also, of the continuous (and inevitable) influence of each upon the other, have slowly but steadily drifted apart, both as regards their method and supposed subject-matter and as regards the avowed aims and general attitude of mind of their respective exponents. During the past twenty years, however, there has been a marked reversal of this tendency; and it is fitting that Prof. Wildon Carr should be one of the first to publish a systematic explanation of the causes and significance of the new movement, for he has done as much as any man to foster and encourage it.

Prof. Wildon Carr begins by pointing out that science and philosophy differ, not in their subject-matter, but in the mind's attitude towards it. Philosophy seeks to see reality as a whole, but science is more concerned with particulars. Philosophy proceeds from the whole to the parts, regarding the latter as significant only in their relation to the whole. Science, on the other hand, considers the parts as having reality in their own right, and proceeds, not to a systematic whole, but to invariable laws. It should perhaps be remarked that this view of the relation between science and philosophy is in fundamental contrast to that held, for example, by Mr. Bertrand Russell. For Mr. Russell, science and philosophy start from the same point and with the same material, namely, the particular facts of experience, and it is these particulars and the relations which subsist between them which are the essential concern of both. The difference between them lies in the fact that they proceed from their starting-point in opposite directions.

Prof. Wildon Carr considers that science and philosophy have reapproached through biology and electromagnetism; or, more particularly, through evolution and relativity. The dichotomy of Nature as objective reality and mind as ideal representation, assumed by science, has turned out unworkable. Progress in science has raised, in connexion with science itself, metaphysical problems which are compelling us to reconstruct the whole basis of scientific thought. The reproach, so often levelled at philosophy, that it is concerned with mere speculation regarding a transcendent reality, whereas science provides comparative certainty, is held by Prof. Wildon Carr to be due to the nature of the older idealisms. The "New Idealism," on the contrary, is the consciousness that the problems of science and philosophy arise from the

same subject-matter. It is in fundamental opposition to the "New Realism," for it regards activity and becoming as original, objects of ordinary experience as derived, and physical concepts as constructed; whereas the new realism assumes mind to be passive to the revelation of an external reality and active only in so far as it attends to what is thus presented.

Bergson and Croce are taken as the chief exponents of the new idealism. The importance of Bergson lies in his substitution of the concept of pure duration for that of pure extension. This implies that reality is fundamentally psychical, for only what is psychical "endures." Prof. Wildon Carr goes on to a discussion of Bergson's theories of mind-energy and of memory, in the course of which he indicates what, in the present writer's view, is a complete refutation of the theory (still held by some men of science) that brain produces mind. Briefly, his argument is that the theory in question leads to a contradiction and a vicious circle, for it can only infer the existence of the external world from the existence of brain process, while at the same time it is compelled to infer brain process from the existence of the external world of which the body is a part.

There follows an interesting exposition of Croce's main theses, namely, that philosophy is not a science with a special (abstract) subject-matter, but a way of studying reality in its most comprehensive sense; while history is not the record of what was, but the interpretation of what is. Hegel discovered the logic of philosophy—a special method of treating reality as a whole and not particular parts thereof; but he is criticised by Croce for failing to recognise that there are analogous logics of mathematics, science, history, etc., and for confusing the synthesis of contradictions with degrees of truth and reality.

That portion of the book which deals with relativity will perhaps be of most interest to the scientific reader. General relativity theory, if accepted, means the convergence of the two lines of intellectual development which we name science and philosophy. It reforms the notions of substance (ether) and cause (force), and implies that reality is "monadic" (*i.e.* constituted by "monads" or "minds" considered as metaphysical reals), the "universe" of physics and common-sense being dependent on subjects of experience in the sense that it is the co-ordination which they effect. In the result, materialism and natural realism cannot be indifferent to relativity, for their whole philosophy is at stake.

For philosophy in general, Einstein's scheme is superior because its constitution is inherent in experience and does not transcend the conditions thereof. It rejects an absolute *which is independent of experience*, and recognises as fundamental one of the chief tenets of monadism, namely, that there is no way of presenting the object of knowledge in complete detachment from the conditions of knowing.

After an illuminating review of the work of Descartes and Pascal, Prof. Wildon Carr concludes with a discussion of intercourse by means of speech. The problem here considered arises from the fact that individual experience is private and yet there is intercourse. The author argues, in this connexion, that language is not an invention due to our reasoning powers, but a product of evolution. We speak because we are organised to produce and respond to articulated sounds. Language is dependent on an internal psychical structure—we reason because we speak, and not vice versa.

It is in respect of this problem of intercourse and interaction between minds that a weakness appears in Prof. Wildon Carr's theories, and particularly with regard to the relation of body and mind, where it is argued that theory of intercourse is impossible if mind and body are distinct. But the difficulties of regarding mind and body together as one individual monad are very great. For example, such a view cannot account satisfactorily for the fact that the mind's relation to the body has a twofold character. On one hand, a mind's relation to its own body is quite different in certain obvious respects from its relation to any other body; but, on the other hand, in no less obvious respects it is related to its own body (*e.g.* when it sees it) in the same way as it is related to all other material bodies. In fact, here and elsewhere, when dealing with this problem of intercourse and all that it implies, Prof. Wildon Carr seems too prone to conceive interaction solely on the model of mechanical interaction. Indeed, on p. 277 of his present work he says quite definitely that "intercourse between monads cannot be conceived as a form of mechanical interaction." But, quite apart from the fact that, if what he says about relativity is true, there is, strictly speaking, no such thing as *mechanical* interaction, he has not, in the writer's opinion, succeeded in proving that intercourse between monads may not be a type of relation which can fairly be termed "interaction," where action or activity is used in the sense in which he himself uses it, of monads or psychical reals, and not in the mechanical sense.

The book is written in Prof. Wildon Carr's usual clear and eminently readable style. Though it consists of a number of papers given originally in comparative independence of one another, the thread of the author's thought is continuous throughout. The theme of his study is of the greatest importance at the present time, and cannot fail to be of interest to all who wish to appreciate the real significance of the new convergence of those two streams of thought which have produced at intervals what are perhaps the noblest and mos profound creations of the human mind. C. A R.

Chemistry and the Quantum Theory.

A System of Physical Chemistry. By Prof. William C. McC. Lewis. (Text-Books of Physical Chemistry.) Third edition. In 3 vols. Vol. 3: *Quantum Theory.* With certain Appendices by James Rice, A. M'Keown, and R. O. Griffith. Pp. x+407. (London: Longmans, Green and Co., 1924.) 15*s.* net.

AN important test of the value of a scientific theory is its comprehensiveness. It is a curious and, in some ways, a significant fact that the most detailed account of the quantum theory published in Great Britain (apart from translations) is written by a professor of physical chemistry and appears in a series of text-books devoted to that subject. There are signs that the boundary lines between "classical" physics and chemistry, almost unknown to Faraday, will again be obliterated and the two subjects become united in a theory of wider generalisation. An Armstrong and an Arrhenius may worship together in a more magnificent temple dominated by the genius of Niels Bohr. Chemists and physicists will no longer use different names for the same thing, but hark back to the point of view of Faraday, thus expressed by Poynting: "The hypothesis with which we start is that electrical and chemical forces are identical; that electrification is a manifestation of unsatisfied chemical affinities and that chemical union is a binding together of oppositely charged atoms or groups of atoms."

We are all agreed that matter may be described as composed of light negative electrons and more massive positive electrons or protons. We are all agreed that radiation may be regarded as an electromagnetic disturbance. To complete the picture we are forced by experimental facts to accept the two main postulates of Bohr: (1) Atomic systems can exist in certain "stationary states" which may be discussed by help of the ordinary electrodynamics in association with the appropriate quantum restrictions; (2) the passage of the systems between different stationary states cannot be treated by the classical theory, but involves, in some unexplained way, the emission or absorption of an amount of homogeneous radiation defined by the energy quantum $h\nu$, the product of Planck's constant h and the frequency ν. The foundations of the theory are discussed in an able manner in the appendices to the volume under review, and a special word of praise must be given to the lucid account of the "correspondence principle" by Prof. James Rice. Bohr's first postulate leads directly to the conception of energy levels, each such level being appropriate to a particular arrangement of the constituent charges of atom or molecule. It may be well to emphasise the importance of this conception in connexion with the problem of reaction velocity discussed by Marcelin and by Rice. The applications of the second postulate described in the volume are many, and it is possible to refer only to two which have recently attracted much attention.

The important photo-chemical law formulated by Einstein (1912) may be stated as follows: When light of frequency ν is incident on a system sensitive to such light, for each quantum of energy ($h\nu$) absorbed, one molecule of the absorbing substance is decomposed. It follows, according to this law, that the amount of substance acted upon by the light is proportional to the product of the absorbed radiant energy and its wave-length, and is independent of all other factors such as temperature. Most photo-chemical processes are complicated by secondary reactions which render it extremely difficult to test the direct applicability of the law. It is, however, now generally admitted that *the absorbing molecule* absorbs energy in quanta. The experimental evidence is discussed in Appendix VII. by R. O. Griffith, who concludes that the ratio of the number of molecules decomposed to the number of quanta absorbed may vary over wide limits, though in a large number of cases its value is not far removed from unity. In a few reactions and within certain narrow spectral limits the ratio has been found to be unity. In the photo-chemical decomposition of hydrobromic and hydriodic acids, one quantum brings about the decomposition of two molecules, one molecule being decomposed directly, the other by a secondary process. But, in general, the ratio above mentioned is determined by processes which occur between the act of absorption and the production of the final products. Thus the final conclusion reached may be stated by saying that there is strong evidence in favour of the view that the ratio of the energy absorbed to $h\nu$ is equal to the number of absorbing molecules, but this number may differ considerably from the number of molecules decomposed. It is, accordingly, extremely probable that the primary process consists in the absorption of an energy quantum, but the subsequent changes are frequently so complicated that it is not at present possible to express them in terms of the quantum theory.

The second question of great interest is the radiation hypothesis of chemical change first suggested by Trautz and discussed later by Perrin and the author of the present volume. Whilst the hypothesis accounts satisfactorily for the influence of temperature upon the velocity constant, it has not yet been shown that the hypothesis is capable of accounting for a velocity constant itself, the observed velocities being greatly in excess of those required by the hypothesis. Prof. Lewis sums up the position (in 1923) in a very fair way, without coming to any definite conclusion. He points out that the true analogue of thermal chemical change

on the radiation hypothesis is the thermionic effect, consisting in the emission of electrons due to the temperature of the material itself, and consequently due to the radiation density of all wave-lengths characteristic of the temperature of the material. The analogue of photo-chemical change is the photo-electric effect, in which electrons are emitted from a material owing to exposure of the surface to radiation from an external source at a relatively high temperature and usually of relatively short wave-length.

The reviewer has carefully compared the new edition with that of 1919 and finds that not only has the size of the volume been doubled but many desirable alterations and corrections have also been made. There are some points which require correction, but as the author remarks with truth, in such a rapidly changing subject it is exceedingly difficult to carry out the process of selection and condensation in a satisfactory way. Whilst the book cannot be described as a work of the very first rank, no serious student of advanced chemistry or physics can afford to overlook it. H. S. ALLEN.

Among the Natives of East Africa.

Beneath African Glaciers: the Humours, Tragedies, and Demands of an East African Government Station as experienced by an Official's Wife; with some Personal Views on Native Life and Customs. By Anne Dundas. Pp. 238 + 28 plates. (London: H. F. and G. Witherby, 1924.) 12*s.* 6*d.* net.

MRS. DUNDAS, as the wife of one of the Chief Commissioners (in the Kilimanjaro district), has had special opportunities for studying native problems on the spot, and these opportunities she has used to the utmost. It is admirable the ease with which she adapts herself to novel surroundings, making the best of everything, seeing something of interest in every place and object, whether at home or on the march. This is no small achievement when one considers the multitude of discomforts which have to be contended with in the climate of equatorial Africa; yet with a mind so active and so fully occupied with all that is going on around her, she is fortunate in having little time to dwell on these matters. Her sympathy with the inhabitants, and her power of expressing, in clear and pleasant language, the results of her observations and the conclusions she has come to, add a charm which is not often found in a book of this description. Existing and prospective officials, whose fate it may be to govern primitive races, could not do better than study closely what she has to say.

It is quite refreshing to read of the unsophisticated life the natives of this country lead—apparently happy—unspoilt, as yet, by the professional agitator, who earns his living by disturbing the "natural true contentment of spirit" in which man lives. The chapter on missionaries and their ways, and the conclusions the author comes to, are of much interest because of the important influence they are sometimes able to exert on the destinies of uncivilised people. One cannot help thinking that the author's views are sound common sense. What missionaries should do, when they begin to work among primitive races, is to devote all their energies to educating them, without trying to convert them, and without interfering with their native customs, for the latter often has the effect of undermining the authority of their chiefs through whom it is our policy to govern; any interference necessary in this direction should be left to government.

Mrs. Dundas puts all this very well, and we must leave it to her readers to see how she does it. We may say, however, that her views appear to be those of a thoughtful inquirer, even on such a delicate subject as polygamy, deserving the closest attention of all who really have the welfare of native races at heart, and we hope her writings will bear some fruit. It is not the first time missionary methods have been criticised, but we are not sure criticism has produced much effect.

Mrs. Dundas has a good deal to say about Kilimanjaro, Africa's highest mountain, in sight of which she spent so much time. Two chapters are devoted to native manners and customs, and one to "big and little game." The book is well illustrated by scenes from life in Tanganyika, but a map is badly wanted, and if the volume is ever reprinted one should certainly be added. H. L. C.

Our Bookshelf.

L'Isotopie et les éléments isotopes. Par Mme. Pierre Curie. (Recueil des Conférences-Rapports de Documentation sur la Physique. Vol. 9, 2e série, Conférences 1, 2, 3. Édité par la Société *Journal de Physique.*) Pp. 210. (Paris: Les Presses universitaires de France, 1924.) 22·50 francs.

THE announcement that the first series of reports published under the auspices of the *Journal de Physique* was to be followed by a second series must have been welcomed by many physicists, to whom the task of keeping abreast of the manifold developments of the subject has become of daily increasing difficulty. The editors have been fortunate in their choice both of author and subject for this opening volume of the second series. There can be no doubt of the authority with which Mme. Curie speaks in all matters radioactive, or of her ability to marshal and expound her facts in a manner which makes them easy to grasp and assimilate. The fact that she has not been personally concerned in the more startling of the discoveries which she has to narrate is an additional advantage, as it has enabled her to exercise a critical discrimination not so

easily attained by one more intimately connected with the development of the subject.

The present volume is admirable, and covers a considerably wider field than might be expected from its title. It opens with an excellent synopsis of the chemistry, electrochemistry, and classification of the radio-elements leading up to a study of the radioactive isotopes. The following section deals with the isotopes of the non-radioactive elements, and the experiments of Aston, Dempster, and others. A third brief section is devoted to some interesting speculations on the structure of the atomic nucleus, and the volume concludes with a critical account of the methods adopted or proposed for separating the pure isotopes from the mixed element.

A full bibliography is appended. Unfortunately, there is no index. The book is clearly printed and well illustrated with diagrams and plates, and its value is enhanced by numerous well-displayed tables. Mme. Curie has collected in these 210 pages a mine of information, much of which can only be consulted elsewhere in original publications. Both physicists and chemists should find this volume a valuable addition to their bookshelves. J. A. C.

Electrical Machinery and Control Diagrams. By T. Croft. Pp. xii+305. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 15*s.* net.

IN practice, an electrician sometimes merely requires a circuit diagram of the apparatus or equipment with which he is working. He must therefore use symbols to denote electric bells, dynamos, etc., and show how they are connected with the accessory apparatus, such as switches, fuses, and regulating resistance coils. It is of importance that standard symbols should be internationally adopted. Considerable progress has been made in this direction by the International Electrotechnical Commission, and the leading countries of the world have sent in suggested symbols. Complete agreement, however, has not yet been obtained.

The symbols adopted by the author are those used by the Electric Power Club of America. They are very similar to those used in other countries. The 500 circuit diagrams given cover practically all of the apparatus used in a modern power or super-power electric station. The diagrams are of all degrees of complexity, beginning with the simple manually controlled starting rheostat and going on to the automatic substation. To the practical engineer they will be helpful. We hope that in the second edition of this book the author will be able to adopt international diagrams, and that he will also include diagrams for radio communication circuits.

Psychological Tests of Mental Abilities. By Prof. A. S. Woodburne. Pp. v+232. (Madras: Government Press, 1924.) 2.8 rupees.

ALTHOUGH the method of mental testing is a comparative innovation in the field of education, its use is already almost ubiquitous. Most people know that it is widely employed in Europe and America, but perhaps fewer realise that its use has spread to Japan, China, Turkey, and, as the book under notice shows, to India.

Prof. Woodburne was invited last year to give a course of lectures on intelligence tests at the University of Madras, and he has extended his remarks to form a book. The larger part of it is a lucid description of the general principles of testing, and it shows evidence of wide reading and careful discrimination. Ample illustrations are given of the various types of linguistic, performance and vocational tests.

Some good work has already been done in India along these lines, and it is interesting to read of the necessary adaptations of standard tests in order to make them suitable for that country. Particularly illuminating also are the investigations of Prof. Haylands and of the author for the purpose of comparing the mental processes of the Indian and English adolescent. Indian educationists are keeping well to the fore in mental testing, for they have already planned a central clearing-house for results, and have suggested adequate instruction in testing methods for all their training college students.

In an Unknown Land. By Thomas Gann. Pp. 263+32 plates. (London: Duckworth and Co., 1924.) 21*s.* net.

THE unknown land of which Mr. Gann writes is Yucatan, which he visited with Dr. S. G. Morley for the purposes of archæological investigation. From Belize the party went northward and then westward on a two months' trip round the coast, making several inland expeditions to visit ruined Maya cities. Incidentally the book contains a great deal of information on a part of Central America that is little known and not easy of access, but its main value is the account the author gives of the Maya ruins and the Santa Cruz Indians. These form an independent tribe, since the Mexican government virtually evacuated their province, and represent the purest descendants of the Mayas. A great deal of work was accomplished, including visits to Chacmool, a previously unknown ruined city, Tuluum, which has always been difficult to reach owing to Indian hostility, and two minor new discoveries at Cancuen and Playa Carmen. All these are fully described. Of great interest are the accounts of the remarkable mural paintings of human figures and gods executed in bright colours on a hard stucco, found at Tuluum in a fresh condition despite their age of four centuries. The elucidation of the Maya method of dating in Yucatan was another striking discovery.

Graphic Statistics in Management. By W. H. Smith. Pp. vii+360. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 20*s.* net.

THE recording of business activity by graphical means is extending rapidly among the controllers of large businesses, and a book like the present volume, written primarily in the atmosphere of American big business, should be of especial interest in Great Britain. The whole subject is treated in picturesque graphical fashion; no mathematical symbol appears anywhere, and yet a considerable degree of analysis of financial and business activity, production, sales, markets, and costing is successfully effected. The chapter dealing with graphical statistics in advertising is capital, a large number of illustrations of varying character being shown, including one demonstrating the effect of advertisement on church attendance and Sunday morning offerings!

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.*]

Biographical Byways: Dr. S. P. Langley.

I REGRETTED to see Sir Arthur Schuster's article in NATURE of February 7 presented so unpleasing a picture of my old chief, Dr. S. P. Langley. Like some other great men I have met, his character had blemishes, and, as one of Sir Arthur's anecdotes indicates, it was surprising to see in so great a man such care to preserve the appearance of dignity which he thought properly attached to his office and his attainments. If he had been as careless of it as Lord Kelvin, dignity would have wrapped itself about him like a cloak, crowned with the mantle of lovableness, which, to his intimates, Langley surely possessed. One is reminded of the Scripture saying: "He that loveth his life shall lose it."

In regard to the eclipse of July 29, 1878, Sir Arthur Schuster's recollection is contradicted by Langley's own account. Prof. Cleveland Abbe, indeed, was carried down on account of sickness, but Langley, though at first ill, remained at the summit of Pike's Peak, observed the eclipse, sketched the corona to 12 diameters, and his report and sketch is to be found in the publications of the U.S. Naval Observatory (Washington Observations, 1876, Pt. 2, vol. 23, pp. 203-10).

As a pioneer, Langley has to his credit the great forward step that he took in the spectral study of the energy of radiation of the sun, the moon, and terrestrially heated bodies. He was the founder of modern methods in this branch of science. Also, he lent his prestige to rescue from the domain of ridicule the subject of mechanical flight, and investigated at great length, with novel devices, the reactions of moving surfaces in the air. On the basis of these experiments he accomplished prolonged steady flight of quarter-sized engine-driven mechanical models, about eight years before the first human flying with power-driven aeroplanes took place. Except for bad judgment in shooting his larger machine from a house-boat, instead of allowing it to take off gradually as was proposed, engine-propelled human flight would have been made several years before it actually occurred. The blemishes of such a man ought not to blind us to his greatness.

I am happy, however, to be able to soften the implication of the final anecdote of Sir Arthur Schuster. He got the quotation, I suppose, through several mouths, and it is not accurate. When I was about to start on my first expedition to Mount Wilson, in the year 1905, Dr. Langley came to my office to talk over the plans. Months earlier we had discussed his value of 3 calories for the solar constant, and he was nearly convinced, I believe, that it had been based on an error of logic in the reduction of the Mount Whitney observations. Yet he did not desire to publish a retraction, for, as he said, "Mr. Abbot, I did that work when I was at the height of my powers. Now that I have been long out of the field, I am not more competent than I was then to reason upon it." He paused a moment, and added with a twinkle in his eye: "As the witty Frenchman has said, 'What has posterity done for us that we should care so much for the opinion of posterity?'"

So, when we finished our interview in April 1905, it was rather in the nature of good-natured chaffing than in the nature of an order when Langley said to me: "You will, of course, bear in mind that it is rather the *variation* of the sun that you are going to measure than the absolute value of the solar constant." The twinkle came again into his eye, as he continued: "In fact, Mr. Abbot, I might add that for me the best value of the solar constant is that which nearest approaches 3 calories!" and, as he always did when he had said a good thing, he turned quickly and almost ran away. It was the last time that I saw Dr. Langley alive.

C. G. ABBOT.

Smithsonian Institution,
Washington, U.S.A.,
March 3.

Passivity of Iron and other Metals.

IT is well known that the principal metals which show the phenomena of passivity are chromium, manganese, iron, cobalt and nickel. These elements have this in common that they form divalent ions, and that while possessing electrons, on Bohr's theory, in the 4th-quantum orbit, their 3rd-quantum orbits are incomplete. My view is that these elements when in the active state have each two electrons in the 4th-quantum orbit, and that they become passive when one of these electrons is removed to a 3rd-quantum orbit. This implies that the usual chemical and physical agencies which make an active metal passive or a passive one active, merely, in some way, induce these electronic changes. It is for the physicists to say if this be possible. There is, however, no *a priori* objection to this view since transitions between 3rd- and 4th-quantum orbits of these elements are known to occur readily. I do not suppose a suggestion of this kind will explain the whole of the phenomena of passivity, which is admittedly complex, but I offer it as a contribution towards the explanation of the more obvious phenomena.

Very few determinations of the electrode potentials of metals in the passive state have been published, and some workers have doubted if such determinations have any significance. I have found a simple way of preparing and keeping metals permanently in the passive state, and of comparing their electrode potentials with those of metals which do not show passivity. This consists in obtaining metals two at a time in mercury and comparing their powers of reducing solutions in sulphuric acid of uranyl sulphate, ferric sulphate, potassium permanganate and other oxidising agents. I find the order of the potentials of the metals in mercury is (proceeding from electro-positive to noble metals and including only those relevant to this discussion): zinc, cadmium, thallium, tin, lead, copper, manganese and iron, bismuth, cobalt, mercury, nickel and platinum. The order of these metals seems quite definite. It is the same whatever oxidising agent be reduced, whether the solutions be hot or cold, whether sulphuric or hydrochloric acid be employed, and whatever other metals are present in the amalgam. The order of potentials of metals in the free state is known to be: manganese, zinc, iron, cadmium, thallium, cobalt, nickel, tin, lead, copper, bismuth, mercury and platinum. A comparison of these two lists shows that only the metals known to show passivity fall out of order. The simplest inference is that the passive state is a quite definite condition, and that it is produced and maintained when the metal is amalgamated. This is consistent with Lambert's discovery that pure iron is a noble metal when its surface is electrically neutral.

The ions of these passive metals, however, do not behave as if they were the ions of noble metals. For example, ions of tin, lead and copper, but not of

cobalt, iron or nickel, are easily reduced to the metallic state by zinc amalgam in sulphuric acid solution. The order of the ions is probably similar to that of the metals when their electrode potentials are determined in the free state. If this be so, it follows that elements which show passivity must have alternative configurations of planetary electrons, one of which corresponds to the configuration possessed by its ion. On present knowledge the number of electrons in the atom of iron is 2, 8, 14, 2 in the 1st-, 2nd-, 3rd-, and 4th-quantum orbits respectively, and in the ferrous ion 2, 8, 14, 0. If the latter configuration represents the ferrous ion, the former should represent the active iron because active iron passes readily into the ferrous condition. Passive iron may therefore have one of the configurations 2, 8, 15, 1; 2, 8, 13, 3. Similar considerations apply to the metals chromium, manganese, cobalt and nickel. When each of these elements has two electrons in the 4th-quantum orbit, it is likely to be in the active state and, when another number of electrons, it is likely to be passive.

I think that this number is probably one because (*a*) it cannot be less, and (*b*) the agencies that are known to bring about passivity might possibly force one of the 4th-quantum electrons into a 3rd-quantum orbit. This view receives some support from the following: nickel is normally passive, that is, it differs from the other elements which show passivity in being rendered passive more easily than active. Now, according to Kramers and Holst, the configuration of the electrons in nickel is likely to be 2, 8, 17, 1. This on the views expressed here would represent the passive metal, and the alternative configuration 2, 8, 16, 2, from which the nickel ion is derived, would represent the active.

I might add that metals when dissolved in mercury are far more efficient reducers in the presence of sulphuric acid than when in the free state. For example, tin, lead and iron are nearly one hundred per cent. efficient when reducing ferric sulphate in sulphuric acid of different strengths; that is to say, these metals go into solution only in so far as it is necessary to bring about the quantitative reduction.

A. S. RUSSELL.

Dr. Lee's Laboratory,
Christ Church, Oxford,
February 21.

The Compton and Duane Effects.

THE experimental arrangement used by Compton has been such as to emphasise the fact that the change of wave-length represented by the most intense part of the modified line agrees with the formula

$$\lambda_\phi - \lambda_0 = h \text{ vers } \phi/mc, \quad . \quad . \quad . \quad (1)$$

where λ_ϕ is the wave-length of the X-rays scattered at an angle ϕ and λ_0 is the wave-length of the primary rays. On the other hand, the experimental arrangement used by Duane has until recently been such as to emphasise the fact that very often the modified rays consist of a band of wave-lengths beginning at a wave-length change given by

$$\lambda_\phi - \lambda_0 = \lambda_0^2/(\lambda_s - \lambda_0), \quad . \quad . \quad . \quad (2)$$

where λ_s is a critical absorption wave-length of the scatterer. More recently Allison and Duane (*Phys. Rev.*, 25, 235, 1925) by using smaller scattering blocks have found an agreement with (1), although they remark that there is a band of wave-lengths about this value. This band nature of the wave-length change is also evident in Compton's curves (*Phys. Rev.*, 22, 409, 1923). Some of the width of the band is due to the variation of ϕ in (1), but when the width due to this cause is subtracted from the width shown in Compton's curves, there is still some excess width. The writer has been able to explain this excess width by taking into account the momentum of the scattering electrons in their Bohr orbits (*Phil. Mag.*, in print). The electrons are moving in all sorts of directions, and hence we get a wave-length change varying from a minimum to a maximum, the width depending on the magnitude of the momentum of the electrons.

More recently, the writer (*Phys. Rev.*, in print) has been able to show that, if the binding energy is above a certain amount, and therefore the momentum of the scattering electrons above a certain other amount, the width given by taking into account the momentum of the scattering electrons alone is such that the minimum change of wave-length is less than that given by (2). However, the least possible change of wave-length is given by (2), because the recoil electron must be given sufficient energy to overcome its binding energy to the atom in order to be ejected. If the energy given to the electron by the scattering process is less than this, then the electron cannot be ejected from its Bohr orbit, and we may suppose that the mass of the rest of the atom is added to that of the electron. This causes m in (1) to be large, with the result that the change of wave-length is negligible.

Hence we have a quantum theory explanation of the existence of the unmodified line. Whenever there is an unmodified line produced by the scattering of X-rays by electrons of a certain type (*K*, *L*, etc.), then the wave-length change of the beginning of the modified band is given by (2). For example, when Mo*Kα* X-rays are scattered at 90° by the *K* electrons of carbon, the modified band begins at a wave-length change of 0·012 Å.U. and extends to 0·057 Å.U. The short wave-length limit of the modified band is in this case independent of the angle of scattering, which is in agreement with Duane's earlier experiments. The long wave-length limit, however, depends upon the angle of scattering. Duane in these earlier experiments used a large scattering block, so that there was considerable variation of the scattering angle ϕ. This variation of ϕ causes a variation in the long wave-length limit of the modified band, but not in the short wave-length limit. The theory indicates that with a given value of ϕ the intensity is approximately the same all over the modified band. Hence with a large variation of ϕ the intensity would be greatest at the short wave-length limit of the band. This is the result observed by Duane.

The above is an explanation of Duane's results with a large scattering block. Compton, however, finds for $\phi = 90°$ that the wave-length change of the most intense part of the modified band is 0·0242 Å.U. Compton used a smaller scattering block and a spectrometer of less resolving power than Duane. With a small scatterer, the modified band would still extend from $\lambda_\phi - \lambda_0 = 0{\cdot}012$ to $\lambda_\phi - \lambda_0 = 0{\cdot}057$ Å.U. for the scattering of Mo*Kα* X-rays by the *K* electrons of carbon. However, there are also *L* electrons in carbon. Of these the *L III* electrons move in circular orbits, and these *L III* electrons produce a modified band extending from $\lambda_\phi - \lambda_0 = 0{\cdot}0185$ Å.U. to $\lambda_\phi - \lambda_0 = 0{\cdot}030$ Å.U. The band does not in this case extend from the value of $\lambda_\phi - \lambda_0$ given by (2), and hence there are no unmodified rays scattered by the *L III* electrons at 90°. The centre of the modified band is seen to be at 0·0242 Å.U., the value given by (1). The *L III* band will be superposed on the *K* band; but the former will stand out more strongly since the theory indicates that the intensity (*i.e.* the energy per unit wave-length width) of the *L III* band is greater than that of the *K* band.

Hence, when a small scatterer is used the modified band shows great intensity at 0·0242 Å.U. The centre of this intense portion and its width depend, however, on ϕ. Hence for a large scatterer the intense portion becomes indistinct. Further, for a large variation of ϕ, the theory shows that the most intense part of the band due to the *L III* electrons is displaced to the short wave-length side of the value obtained by putting the average value of ϕ in (1). Large scatterers, therefore, tend to obscure the existence of the Compton wave-length change.

Still further, a spectrometer of low resolving power will show the Compton wave-length change better than one of high resolving power. With low resolving power the most intense part of the band comes at 0·0242 Å.U. for $\phi = 90°$, whereas with high resolving power the band character of the modified rays is emphasised. For example, with high resolving power the Ka_1 and Ka_2 lines of molybdenum can be separated in the unmodified line, while the modified band will show no such separation, as each modified band overlaps the other due to its width. The absence of separation in the modified band might cause an experimenter using high resolving power to doubt the existence of the Compton effect.

G. E. M. JAUNCEY.

Washington University,
St. Louis, U.S.A.,
February 14.

Transmission of Stimuli in Plants.

NATURE of January 17 has just reached me and I hasten to send a reply to Mr. Snow's letter on this subject. I repeat once more that in the numerous experiments which I carried out with the stem of *Mimosa pudica*, the stimulus was never transmitted across the water gap. Mr. Snow repudiates the idea that he has disagreed with my conclusions in regard to the conduction in the petiole of Mimosa. "Actually, however," he says in his letter, "in agreement with him [Sir J. C. Bose] I have produced evidence to show that in the leaf, excitation is conducted in the phloem and has nothing to do with the transpiration current. I agree also that this conduction in the leaf is, in all probability, a true physiological process, and consider that Sir J. C. Bose's experiments on the petiole, which so strongly support this view, are of very great value. In the stem, however, as I found, this conduction in the phloem either fails completely, or at least is regularly too weak to cause the leaves to fall."

Since it is admitted that conduction does not take place across a water gap in the petiole, Mr. Snow will note that there is a serious breach of continuity in the assumption that the mechanism of conduction in the stem is widely different from that in the petiole. We stimulate the leaf; excitation is transmitted along the phloem in the petiole and overflows into the stem, causing the successive fall of the leaves. Where does the hiatus in the conducting mechanism come in? The supposed conduction across a water gap in the stem has led to the theory that the transpiration current in the wood is the means of conduction of excitation. But the observation of Mr. Snow himself does not support this theory, for he finds, in opposition to Prof. Dixon, that Dr. Ricca's theory of the transpiration current is inadequate "to cover *all* the phenomena of conduction in Mimosa, including conduction in the leaf and the subordinate phenomenon of 'high-speed' conduction in the stem."

In my "Physiology of the Ascent of Sap" (1923), p. 269, I have clearly explained the modes of intercommunication and interaction between more or less distant organs of a plant. "This is accomplished in two different ways, by *transfer of matter* and by *transmission of motion*. The first is exemplified by hydraulic convection of liquids carrying chemical substances in solution, such as occurs in the circulation of sap; the second, in the conduction of excitatory change along nerves." These two can be easily distinguished from each other from the fact that the conduction of excitation is from a hundred to a thousand times quicker than the sap-movement of the transpiration current. A very simple experiment which requires no apparatus is to put a drop of hydrochloric acid on the tip of a leaf of *Mimosa pudica*: the acid remains practically localised, but the protoplasmic excitation induced by it is transmitted with considerable velocity, causing the fall of numerous leaves both above and below. This experiment, which can be repeated without any difficulty, completely demolishes the theory of the transpiration current.

I have, as stated in my previous letter, carried out numerous crucial experiments which fully establish the nervous character of the transmitted impulse in Mimosa. It has been a matter of surprise to me that reference to my work has been omitted in all letters and articles on transmission of stimulus in Mimosa that have appeared in NATURE during the last year. This could not have been due to the obscurity of the journal in which my results appeared, for they were published in the Proceedings and Transactions of the Royal Society. The omission appears to me to be very curious; it cannot but obscure truth and thus divert the energy of workers in wrong directions which lead nowhere.

In this short communication I can make but bare mention of only a few of the results which I have recently obtained. The anatomical structure of the nervous tissue, made clear by selective staining of microscopic sections, has been found to be in every way the same in the petiole and in the stem. The distribution of the nervous tissue in the whole plant has been clearly traced, affording the fullest explanation of the transmission of excitatory impulse up and down and across the stem. The innervation of the contractile pulvinus, which functions as a muscle, has also been fully investigated, making possible a rational explanation of the purposeful movements by which the leaf places itself so as to absorb the largest amount of radiant energy. Still more striking is the success of my efforts to obtain, by means of selective staining, a definite outline of the rapidly contracting tissue in the pulvinus of *Mimosa pudica*. No such staining occurs in the slowly reacting pulvini of other plants. This characteristic denotes the possession of a specific catabolic substance, and is highly significant. These and other results prove that a very high and quite unexpected degree of differentiation has been reached in the nervous system of Mimosa. I am in hopes of early publication of these results. In case of unforeseen delay, I shall take the opportunity of sending a short account of them for publication in NATURE.

J. C. BOSE.

Bose Institute, Calcutta,
February 12.

The Behaviour of Crystals and Lenses of Fats on the Surface of Water.

DURING the last two years we have been interested in examining the behaviour of crystals and liquid lenses of fatty acids and esters when placed upon the surface of water.

Sir W. B. Hardy was the first to observe that the magnitudes of the surface tensions of the various

bounding interfaces for liquids, such as oleic acid, which spreads upon water, were in accordance with the theorem of Dupré,

$$\underset{H_2O.}{\sigma} > \underset{\text{Oil.}}{\sigma} + \underset{\text{Oil water.}}{\sigma}$$

A lens of oleic acid, when placed upon a water surface of limited area, does not extend as a thin lamina of oil in bulk, but as a unimolecular film, by a process of two-dimensional solution or evaporation from the edges of the lens. Equilibrium between lens and unimolecular oil film is finally attained when the rate of this process of surface solution or evaporation is balanced by the reverse process of condensation of oil molecules from the film. The surface pressure of the film when equilibrium is established is defined by the equation—

$$\underset{\text{Contaminated surface.}}{\sigma} = \underset{\text{Oil.}}{\sigma} + \underset{\text{Oil water.}}{\sigma}$$

We have noted that solid fatty acids and esters will spread on water surfaces until the surface tension of the water falls to a definite equilibrium value, but the rate of spread is much slower than for liquids.

The beautiful experiments of Mr. Adam have revealed the interesting fact that surface films may exist in two forms, the condensed and the expanded, the former being the two-dimensional prototype of solids and liquids, the latter of vapour. Both crystals and liquid lenses can exist in equilibrium with both these condensed and expanded films, the equilibrium pressures being naturally different for each phase, and varying in a marked manner with the temperature, similar to the three-dimensional phase properties of solubility and vapour pressure.

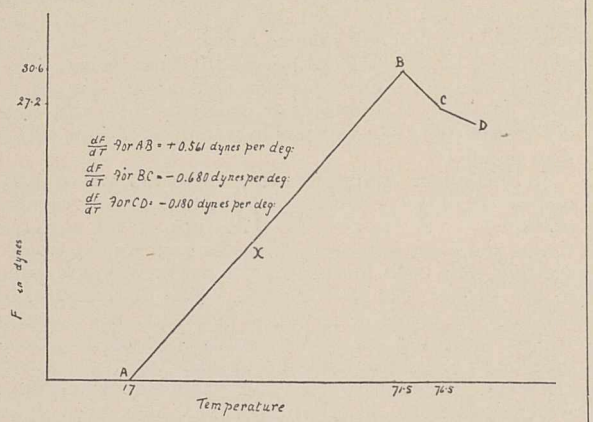

FIG. 1.

Fig. 1 represents a typical $F.T.$ curve for stearic acid, in which this equilibrium two-dimensional pressure in dynes per cm. is plotted as a function of the temperature.

Along the line AB the film in equilibrium with the solid crystal is condensed, the superficial melting-point of the film being at x. At B the crystal melts, and the curve BC represents the variation with the temperature of the condensed film in equilibrium with a lens of the liquid acid. At the third non-variant point C the condensed film expands, and the curve CD represents the temperature variation of the two-dimensional expanded film in equilibrium with the liquid lens.

As in the case of three-dimensional phase equilibria, it is possible to calculate the various latent heats associated with the changes of the bulk solid and liquid into the two-dimensional condensed and expanded modifications. We may apply a modified equation of the type suggested by Clapeyron,

$$\frac{dF}{dT} = \frac{L}{T(A_2 - A_1)},$$

where A_2 is the area of the film, A_1 the area of the acid in bulk, T the temperature, and L the latent heat of the change in question. From the curve AB we obtain 5860 calories as the latent heat of transformation of the acid from the bulk solid to the condensed film, at the point B. From BC we obtain -6840 calories as the latent heat of change of the bulk liquid into the condensed film at the point B. From these two values we obtain 12,700 calories as the latent heat of fusion of stearic acid, a value in reasonably good agreement with 13,500 cited in Landolt Bornstein.

In a similar manner, the other latent heats of transformation may readily be calculated, although the actual area of the molecules in the expanded state cannot be computed so accurately as for condensed films.

Through the kindness of Mr. N. K. Adam and Dr. Garner a number of organic acids and esters in a highly purified state have been placed at our disposal, and we have succeeded in obtaining a number of these $F.T.$ curves and in making similar calculations from the data so obtained. We hope to publish these data *in extenso* in the near future, as soon as certain corrections necessitated by the use of the ring method have been accurately determined.

A. P. CARY,
ERIC K. RIDEAL.

Laboratory of Physical Chemistry,
Cambridge, March 6.

Ectodermal Muscles in a Crustacean.

THE generally accepted view as to the origin of the musculature of the Crustacea is that it is derived from the mesoderm. In Chirocephalus, while the majority of the muscles arise from the mesoderm, there are others that are definitely of ectodermal origin. The dilator muscles of the proctodæum are examples of this type, and probably with these should be classed the dilator muscles of the œsophagus. At the most posterior tip of the body, where the ectoderm folds inwards to form the proctodæal tube, the formation of the dilator muscles can be seen most clearly. Certain ectodermal cells in this region elongate and then, while retaining one end in the outer ectoderm, the other passes inwards with the invaginating ectoderm. This passage inwards is probably not an active migration, but is brought about by the proliferation of the surrounding cells, the latter pushing in between the two ends of the muscle cell. In the elongating cell body one or two fibrils appear that very early divide into segments, giving the typical structure of striped muscle. The final muscle is thus an elongated cell, attached at its inner end directly to the cuticle lining the proctodæum and at the other end to the external cuticle.

A more interesting set of ectodermal muscles is to be found in the trunk region. In this region the limbs appear at first as a series of pouch-like outgrowths and, as a result of this development, the ectoderm in between them forms a series of ventro-lateral ridges projecting into the body cavity. As the limb rudiments enlarge, the inner edges of these ridges become nipped off from the more lateral ectoderm. In this way a string of cells is formed on either side in each intersegmental plane, running from the mid-ventral line to the dorso-lateral ectoderm. Deeply staining fibrils appear in them

almost at once. These spread out dorsally into a fan and, running between the nuclei of the superficial ectodermal cells, end directly against the cuticle. Ventrally they terminate in a narrow bundle against the cuticle of the mid-ventral line. For a considerable time no change other than growth takes place, but ultimately, at the dorsal end, at the level of the inner face of the surrounding ectoderm cells, the fibrils lose their staining capacity and become replaced by a tendinous plate. Below this plate the fibrils now divide into segments converting the strings of cells into typical striped muscles. Above it they persist as a radiating series of "tendo-fibrils," showing no signs of segmentation and ending directly against the cuticle.

On the outer side of this series is another set of muscles having the same median ventral attachment, but having an upper attachment just below—that is, more lateral to that of the first series. These are also entirely ectodermal in origin, and are formed in the same way as the first series.

The important facts that emerge from this development are, first, that certain muscles of the Crustacea are definitely ectodermal in origin, a fact not at all in conflict with what might be deduced from the ancestry of the group; and, secondly, that the "tendo-fibrils" that run from the cuticle through the ectoderm cells to attach to endoskeletal structures may be the remains of the same originally continuous fibrils that divide up elsewhere to give the myofibrils of typical striped muscle.

H. GRAHAM CANNON.

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On the Absorption Spectrum of Aluminium.

IT is well known that the study of the absorption spectrum of elements provides us with the simplest method of determining the normal states of atoms. In the hands of Wood, Bevan, McLennan, and others, the study of the absorption spectrum corroborated that in the case of elements of the first and the second groups, the normal orbits are those designated spectroscopically as $1s$ and $1S$ respectively.

In the case of elements of higher groups, the experiments become more difficult, as most of them have high boiling-points, so that with the furnaces which can be commanded in a physical laboratory, very little vapour can be obtained for absorption work. This difficulty becomes more acute in the case of metals of the third group, all of which, excepting thallium, yield very little vapour up to temperatures of 1200° C.; and, in fact, we are not aware that any successful experiment has been done on the absorption spectrum of aluminium and boron, which are the least volatile elements of this group. At the same time, such experiments are necessary for determining once for all whether for these elements the $2p_1$ orbit is the normal stage, as has been obtained from the analysis of their arc spectra and corroborated by the absorption experiments in the case of indium, gallium, and thallium.

We have recently carried out successfully the absorption experiment with aluminium, using the vacuum furnace designed by Prof. Meghnad Saha for ionisation work. The furnace consists of an Acheson graphite tube heated by a battery of accumulators. The temperature was simultaneously measured by a Wanner pyrometer. We used a cadmium spark, and a copper spark under water as our sources of continuous light. The spectrum was photographed on Ilford ordinary plates sensitised by nujol, as described by Lyman. We found that no aluminium lines are obtained below 1500° C. At 1520° C., the pair $\lambda = 3961$, 3944 come out reversed. At 1650° C., the leading members of $2p_i - md$ series come out reversed. The higher members of $2p_i - ms$ series require a little higher temperature. Another curious feature is that on all plates the $2p_i - ms$ lines and $2p - md$ lines of gallium occur rather prominently. Apparently gallium occurs as an impurity in ordinary samples of aluminium.

From such experiments it is not possible to deduce whether for aluminium the $2p$- orbits are the normal orbits, or whether there is a still larger $1s$ orbit. For at the temperature at which sufficient vapour is available for absorption work, the thermal stimulus is quite sufficient to convert any lower $1s$ orbit to the $2p$-orbits. The vapour pressure of aluminium is evidently very low even at 1520° C., but we could not find any existing data on the subject, except some theoretical considerations by Grüneisen. Our apparatus is suited to the determination of vapour pressure of aluminium over a large range of temperature by using the so-called *Mitfuhrungs-methode* of Pfaundler, and we hope to carry it out at an early date. At any rate, it is quite clear that the $2p - mx$ lines require a lot of vapour for absorption, and if the $2p$- orbits turn out to be the normal orbits of aluminium atom, they do not dominate the spectrum to the same extent as the $1s$ orbits of alkalies dominate their spectra.

KANAKENDU MAJUMDER.
NALINE KANTA SWE.

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The Origin of Sponge-spicules.

IT is to be regretted that Dr. Bidder (NATURE, February 28), before publishing his criticisms of my theory of the symbiotic origin of sponge-spicules, did not await the publication of the detailed evidence upon which that theory is based. I am loth to enter into controversy with him, but as his letter contains much that is misleading, I feel that I can scarcely pass it over in silence. He speaks of the observation (presumably mine) "that the first rudiment of the spicule in Stelletta is a skeleton-crystal on the tetrahedral system." I made no such observation. On the contrary, I endeavoured to show by observations on the silica pearls that the first rudiment is a minute granule resembling a Micrococcus.

Dr. Bidder's "crystallographic explanation," so far as siliceous sponges are concerned, appears to rest on the assumption that the protorhabd, or axial thread, is itself composed of silica. Otherwise it would be difficult to understand his "conjecture" as to the variation of the type of crystallisation with the percentage of water in the "spicopal." His supposed "skeleton-crystal" can be nothing but the radiating axial threads. He admits that the silica afterwards deposited upon it is "in amorphous aggregation." Unfortunately, the best observers, such as Bütschli and Schulze, are in agreement that the axial thread is composed of a protein substance, and there is nothing else that could form the siliceous skeleton-crystal which he imagines to exist. The statement that my scleroplastids "are at first gelatinous but become crystalline" is pure invention. It is well known that the axial thread, formed, as I believe, by elongation of the scleroplastid, retains its original "organic" character in the axial canal of the fully formed spicule, and, so far as I am aware, no one has hitherto ventured to suggest that it becomes crystalline.

Dr. Bidder accuses me of having "strangely changed" the name of a certain sponge to Donatia. If he will study the literature of the subject he will

find that this is the name now generally given by spongologists to the genus in question, and for very good reasons. I have merely followed precedent, and in any case I fail to see what the nomenclature of this genus has to do with the question at issue.

What Dr. Bidder means by saying that the Suberitidæ have triaxon spicules I do not know. I can only say that Suberites has not. In his reference to the "innumerable 'species' of sponges which infest our books," he seems anxious to belittle the work of "classifiers," but if he would pay more attention to this work he might perhaps come to realise that it has plainly demonstrated that sponge-spicules, like other organic products, have a long evolutionary history behind them, that they can be arranged in evolutionary series, and that in their individual development they may actually recapitulate their ancestral history. It is perfectly useless for any one to attempt to discuss this subject merely on the basis of acquaintance with a few of the simpler spicule forms.

ARTHUR DENDY.

King's College, Strand, London,
March 3.

The Action of Silica on Electrolytes.

THE questions raised in Prof. Mukherjee's letter of January 31 are so important that I should like to reply briefly.

(1) I have not found any reason to depart from the views expressed in our paper in the Transactions of the Chemical Society (T. 1923, 123, 2027) that pure silica does not exhibit any absorbing or reacting power towards acids. I have made experiments with commercial "silica gel" and N/500 hydrochloric acid, and at first obtained an indication of absorption, but soon found that this was due to some impurity, as the specific resistance of distilled water was lowered from 500,000 to 35,000 ohms on addition of the gel. It was therefore purified by washing once with hydrochloric acid and then repeatedly with water until the specific resistance rose to 350,000 ohms, and finally dried and heated to 180°. After this treatment, no absorption of acid could be observed, the P_H of the acid being the same (2·69) before and after the addition of 10 per cent. of the gel. An experiment with oxalic acid, using gel which had been purified with nitric acid, also gave a negative result.

(2) It is not clear how previous treatment with acid can destroy any absorbing properties that silica possesses, and I presume that Prof. Mukherjee's hydrated substance comes in contact with acid at some stage of its preparation. However, to make sure, the gel purified with hydrochloric acid was fused with sodium carbonate and the residue tested with silver nitrate; no chloride could be detected.

(3) I do not quite see Prof. Mukherjee's difficulty in understanding the experiment in which we found that, whilst pure silica reduced the P_H of sodium chloride solution to 3·96, the impure silica (which contained alkali) only did so to 5·55. The concentration of the silica suspension used was 20 grams per litre, and it seems quite reasonable that 20 grams of an impure alkaline material should neutralise 10^{-4} grams of hydrogen-ions.

(4) In this connexion I may point out that the hydrogen-ion concentration of a weak acid solution (*e.g.* N/5000 hydrochloric acid) falls to about half its calculated value when left for a few minutes in an ordinary glass vessel. No change is observed if the vessel is coated internally with paraffin wax or is made of silica. Filter papers also must be used with caution, as all those tried change the specific resistance and P_H of distilled water.

This problem is of great interest to us, and if Prof. Mukherjee could at any time spare a small quantity of his pure hydrated silica, we should very much like to make experiments with it. A. F. JOSEPH.

Wellcome Tropical Research Laboratories,
Khartoum, February 21.

The Reported Anti-Relativity Experiment.

UNFORTUNATELY, owing to travelling delays, a modified proof of my response to an editorial inquiry (appearing in NATURE of March 21, p. 433, col. 1) did not reach the printers in time. The experiment reported as having been attempted by Prof. Michelson and Dr. Silberstein can scarcely have been conducted in water, though water-pipes were used. It may probably be conveniently regarded as a large-scale reproduction of an experiment by an Italian professor who inverted my whirling disk experiment on ether (Phil. Trans., 1893) by mounting the whole of the apparatus on a turn-table, including source of light and receiving camera, and looking for a shift of interference bands photographically. In the experiment now reported the turn-table was apparently replaced by the earth. I suggested such an experiment on p. 151, vol. 189, of the Phil. Trans. for 1897. If, as is probable, a positive effect can ultimately be securely demonstrated, it will be for relativists to say whether their position is at all affected; or whether the loop-hole—that rotation is exceptional, because in rotation matter is moving oppositely on opposite sides of the axis—is acceptable.

It may be convenient to reproduce the passage from Phil. Trans., 1897, referred to above:

"It is to be observed that since a motion of the disks relatively to the observer and the light causes no effect, the ether being stationary, it follows that a motion of the light and observer would produce an effect, since they would be moving relatively to the ether. Hence if, instead of spinning only the disks, the whole apparatus, lantern, optical frame, telescope, observer and all were mounted on a turn-table and caused to rotate, a reversible shift of the bands should be seen. . . . My present optical apparatus mounted on a turn-table revolving 4 times a minute should show something, viz.: $\frac{1}{100}$th band shift each way. . . . If the ether is stationary near the earth, that is, if it be neither carried round nor along by that body, then a single interference square, 1 kilometre in the side, would show a shift of rather more than one band width, due to the earth's rotation in these latitudes (see p. 772, Phil. Trans., 1893).

"But as the effect depends on the area of the square, a size of frame capable of mechanical inversion is altogether too small; there may, however, be some indirect ingenious way of virtually accomplishing a reversal of rotation—something, for instance, based on an interchange of source and eye—and if so, it would constitute the easiest plan of examining into the question of terrestrial ether drift."

OLIVER LODGE.

The Glow of Phosphorus.

THE process of the slow luminous oxidation of phosphorus presents anomalies which are still incompletely understood. Thus, the non-occurrence of a glow in pure oxygen until the pressure is reduced to about 500 mm. of mercury, or an equivalent dilution with an inert gas is made, is very striking. No less difficult to explain is the ability of traces of certain vapours to inhibit the luminosity. These

features are also exhibited in the slow oxidation of phosphorus trioxide, and it has been suggested that the phenomena of the glow of phosphorus are due to the trioxide formed in a preliminary non-luminous oxidation. Again, phosphine does not react with oxygen at ordinary pressures, but on reducing the pressure an explosion occurs.

With the view of elucidating these difficulties the nature of the light emitted in these oxidations is being studied spectroscopically. It was recently shown (Emeléus and Downey, J.C.S. Trans. 125, 2491, 1924) that the light from glowing phosphorus, and that from the element burning normally, give the same spectrum. This is continuous in the visible region, and has five bands in the ultra-violet between $\lambda = 2370$ Å.U. and $\lambda = 3290$ Å.U. These observations have now been extended with the following results: the light from glowing phosphorus trioxide, and from spontaneously inflammable phosphine burning in oxygen, give this same spectrum. In the first case the strongest three of the five ultra-violet bands have already been identified. There is little doubt that the remaining bands will be shown on lengthening the exposure. In the second case all five bands have been observed, in addition to bands generally attributed to water at about $\lambda = 3060$ Å.U. and $\lambda = 2800$ Å.U.

The fact that the light from glowing phosphorus and that from phosphorus trioxide both give the same spectrum supports the analogy between these two oxidations, already well established in other respects. These observations, however, cannot be taken as proof of the identity of the chemical processes. They indicate rather that there is some radiating system involved in them all, which gives rise to a definite band spectrum. Such a system may well have a connexion with the chemical anomalies common to the low temperature oxidation of these phosphorus compounds.

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The Structure of the Mercury Line 2536.

AN investigation of the fine structure of the 2536 line of mercury has just been completed as a preliminary to the continuation of the work on the controlled orbital transfers of electrons in optically excited mercury vapour described recently in the Proceedings of the Royal Society. It has been found that the structure photographed by Prof. Nagaoka is not the true structure at all, but an absorption spectrum, or perhaps more exactly a structure caused by the self reversal of the true components, resulting from the circumstance that he worked with an Arons-Lummer type of lamp, in which the light of the arc is obliged to pass out through a column of non-luminous mercury vapour, before entering the interference spectroscope.

The true structure has been observed with a water-cooled vertical quartz mercury arc, the discharge being pressed against the wall of the tube adjacent to the spectroscopic train by a very weak magnetic field. There are five components of uniform intensity, four at sensibly equal intervals, the fifth having a slightly greater separation. The observations were made by two quartz Lummer-Gehrke plates crossed in the usual manner. On passing the light through a cell 1 cm. in thickness containing mercury vapour in vacuo at room temperature, each one of the interference points doubles by reversal and we have a row of ten dots. On increasing the thickness of the absorbing layer some of these coalesce, and we end up with a structure sensibly the same as that described and figured by Nagaoka: I say "sensibly" as there appears to be a slight difference between the absorption of mercury vapour in a separate cell, and that of the vapour in the neck of the Arons lamp, which is in a state of ionisation from its contact with the arc. The effect of magnetic fields on the components has also been studied.

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Les rayons γ de haute énergie et leur effet photoélectrique.

DANS une lettre récente à la NATURE (Feb. 14, p. 226) Mr. D. H. Black attire l'attention sur un rayon γ du thorium B d'énergie élevée. Son interprétation dans le spectre naturel indique sa conversion en rayon β par son action sur les niveaux *K* et *L* d'un élément de nombre atomique 82 ou 83.

Ces faits sont à rapprocher de ceux que M. Jean Thibaud a signalés il y a quelque temps (*Comptes rendus*, tome 178, 1924, p. 1706; tome 179, 1924, pp. 165, 815, 1052, 1322). M. Thibaud travaillant dans mon laboratoire a pu obtenir les spectres excités photoélectriquement par des rayons γ dans les éléments les plus divers; il a montré qu'on observait la conversion de rayons γ de près de deux millions de volts sur les niveaux *K* et *L* d'atomes lourds (uranium, plomb, platine, tungstène). En particulier un rayon γ de 1,775,000 volts, émis par le radium C, se convertit sur des niveaux *L*, d'énergie *140 fois moindre*.

L'effet photoélectrique des rayons γ de haute énergie se produit avec une intensité remarquable sur les niveaux *K* d'éléments plus légers, tels que le cerium, l'antimoine, l'étain, l'argent et même le cuivre et le fer.

M. Jean Thibaud a vérifié très exactement, en étudiant le déplacement des diverses raies photoélectriques lorsque l'on fait varier le nombre atomique du "radiateur" secondaire, que la relation quantique d'Einstein était aussi bien valable pour les quanta très élevés que pour les plus faibles. Il a montré enfin l'identité des spectres β naturels et des spectres β excités pour Ra B + C, Th B + C + C″, Ms Th 2 et confirmé ainsi l'origine secondaire des spectres naturels de ces éléments.

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Radio Reception on Frame Aerials.

I WAS much interested in Mr. Cowper's letter in NATURE of February 21 on radio reception on frame aerials. For some time I have been quite sure that the usual estimates of probable signal strengths are much too low.

On a four-valve (1 H.F. Det. 2 L.F.) it is possible, on a roughly constructed frame 16 inches square, of 30 D.C.C., to receive all B.B.C. stations at loud-speaker strength. The tuning is very acute, and, as Mr. Cowper mentions, with special arrangements for reaction control. This was with B.T.H. B.5 (0·06) valves. I have never tried for American stations, but have no doubt they could be heard.

The station was on the south side of a sheltered valley and the apparatus about 6-8 ft. above the ground. The first station I ever heard was Manchester, so loudly that, until the announcer gave the name, I was quite sure it was either Plymouth, 25 miles, or Bournemouth, 90 miles, distant.

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The Rotor Ship and Aeronautics.

By Prof. L. BAIRSTOW, F.R.S.

THE conversion by Herr Anton Flettner of the sailing ship *Buckau* into a rotor ship was referred to in NATURE of November 22, p. 758, and brief reference was then made to the principles underlying the new proposal for ship propulsion. Since then, details of experiments in wind channels have appeared from which estimates may be made of the forces on rotating cylinders and the power needed to drive them.

Experiments at Göttingen, and the underlying theory, are described by Prof. L. Prandtl in *Die Naturwissenschaften* for February 6, whilst the same material is the basis of a small booklet, "Das Rotorschiff und seine physikalischen Grundlagen," by J. Ackeret.[1] Both these publications contain a bibliography, the earliest reference being to a paper by B. Robins in 1842 (London). Owing to the importance of his investigations, the effect on which the rotor ship depends is spoken of as the "Magnus effect," and is described in a paper published in 1852 in connexion with artillery investigations. Lord Rayleigh's paper of 1877 "on the irregular flight of a tennis ball" deals with the same mathematical theory. Tests for the American National Advisory Committee for Aeronautics have been made and the results published in Technical Note No. 209, a very full abstract of which appears in the issue of *Flight* for January 8, 1925.

The analysis underlying the use of rotating cylinders for rotor ships is the classical hydrodynamical theory to be found in standard treatises.[2] In the application, certain approximations are made and there is some lack of agreement between calculation and observation corresponding with them. The most important assumption is that which supposes the effects of viscosity in a real fluid to be confined to a thin layer on the surface of the cylinder and that, outside this boundary layer, air behaves as an inviscid fluid. The general theory of the boundary layer as given by Prandtl shows it to be thinner and thinner as the speed and size increase and as the viscosity decreases. The exact criterion is a "Reynold's number." For a non-rotating cylinder this "Reynold's" number is Vr/ν, where V is the forward speed of the cylinder, r its radius, and ν the kinematic coefficient of viscosity. When the cylinder is rotating with a circumferential velocity U there will be a separate "Reynold's number" for each value of the ratio U/V.

Any one acquainted with the flow of air or water past bluff obstacles will be aware of the fact that eddies form in their wake and that there is a region of stagnant fluid which does not conform to the hypothesis that the boundary layer is thin, and in fact the classical hydrodynamics is wholly inapplicable to a non-rotary cylinder. The streamlines as calculated are shown in Fig. 1, and give a motion for which there is no force on the cylinder in any direction. The flow round a cylinder in a real fluid differs very greatly from that shown behind the section BB′.

Rotation of a cylinder in stationary fluid produces circulation. Viscosity is called into play to ensure the transmission of the motion of the cylinder to the fluid in contact with it, but in all other respects viscosity is ignored. The resulting streamlines are circles concentric with the cylinder, the velocity in them being inversely proportional to the distance from the centre of the circle.

By superposition on the well-known lines of Clerk

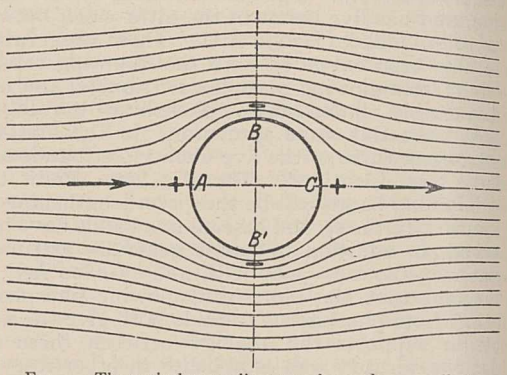


FIG. 1.—Theoretical streamlines round a stationary cylinder. Reproduced by courtesy of *Die Naturwissenschaften*.

Maxwell and others, it is easy to combine the flow shown in Fig. 1 with a circulation of any amount, and the result is shown in Fig. 2. The circulation has produced lack of symmetry above and below a horizontal line through the centre of the cylinder, but has not disturbed symmetry about the line BB′. By an application of Bernoulli's theorem it may be deduced that there is a force along BB′ but none at right angles

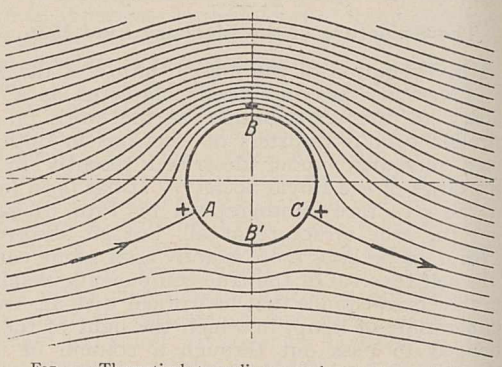


FIG. 2.—Theoretical streamlines round a rotating cylinder. Reproduced by courtesy of *Die Naturwissenschaften*.

to it. Bernoulli's theorem as applied to an inviscid fluid gives a relation between pressure, velocity, and density, which shows that high velocity is associated with low pressure, and vice versa. Above the cylinder, at B, the streamlines are close together, and since the same amount of fluid passes between any two consecutive lines, the velocity is high and the pressure low. Similarly the pressure at B′ is high.

The general theory of inviscid flow with circulation leads to the formula

$$\text{Lift} \equiv \text{Force across the direction of motion} = \rho V U 2\pi r l,$$

where ρ is the density of the fluid, V, U, and r have

[1] "Das Rotorschiff und seine physikalischen Grundlagen." Von J. Ackeret. Pp. 48+7 Tafeln. (Göttingen: Vandenhoeck und Ruprecht, 1925.) 1·80 gold marks.
[2] "Hydrodynamics," Lamb, Articles 68 and 69.

already been defined, and l is the length of the cylinder. Strictly speaking, l should be the length of that part of an infinite cylinder on which the force is measured, but it appears from experiment that a cylinder of moderate ratio of length to diameter can be used if discs of double diameter are attached to the ends; a circulation is then obtained which is equivalent to that on a cylinder of indefinite length.

As the speed of rotation increases, the streamlines change their character progressively up to a limit. When the circumferential velocity is twice the velocity, a limit is reached to the value of the lift divided by ρUV, and in aeronautical language this leads to a limiting value of the lift coefficient defined as

$$\text{Lift coeff., } i.e.\ k_L = \frac{\text{Lift}}{\rho V^2 \times \text{projected area of cylinder}}.$$

This limit, or maximum lift coefficient, is 2π. The quantity is important, because the loading of an aeroplane per unit area of surface at a given speed is proportional to k_L or, conversely, for a given loading the landing speed is inversely proportional to the square root of k_L (max.).

The more efficient aeroplane wings of the day have a maximum lift coefficient of about 0·6 and may reach 0·85; by introducing a number of slots Mr. Handley Page has obtained the highest values known, about 2·0. From figures at Göttingen given by Ackeret, it appears that the maximum lift coefficient for a sail is about 0·4. All these values are much below the theoretical value of 2π, *i.e.* 6·28. Making allowance for partial failure of the theory, it still remains true that the loading per unit area of a rotor cylinder may be ten times as great as that on a sail and several times as great as that on any aeroplane wing in use.

It may be of interest to point out the existence of a conformal transformation by Joukowsky by means of which the circle of Fig. 2 can be transformed into a section very like that of an aeroplane wing. Experiments at the National Physical Laboratory have shown that such a transformation gives a passable representation of facts but that the lift is overestimated by 25-30 per cent. A circulation has been shown to exist of exactly the right amount to explain the measured—as distinct from the calculated—lift. An aeroplane wing, therefore, is able to produce circulation without any movement of its surface corresponding with the rotation of the cylinder. The transformation is important in its aeronautical aspects, but the numerous points of interest which arise cannot be further discussed here.

It is interesting to see how far the predictions of this partial theory are borne out in practice. In some respects there is a considerable divergence between German and American results, and a suspicion that the experiments in the wind channels have not yet been carried out on a scale large enough to reach limiting conditions. The doubts chiefly affect the resistance.

In the American tests, smoke jets were used to indicate the flow of air, and Fig. 3 shows how rotation of the cylinder (clockwise) deflects the air. The symmetry about a vertical line through the centre of the cylinder is not perfect, and the streamlines suggest resistance as well as lift. The extent to which air is carried to the back of the cylinder at the higher speeds of rotation is a notable feature shown by the photographs.

Measurements of lift showed a maximum lift coefficient of 4·5 (theoretical value 6·28) when the peripheral speed was about four times the forward speed. Instead of the maximum value of 6·28 when the peripheral speed was twice the forward speed, observation gave a value of 2·0. These comparisons show to what extent the neglect of viscosity in the theory has vitiated the conclusions.

It will be noticed that high speeds are required at the surface of the cylinder to give the maximum effect.

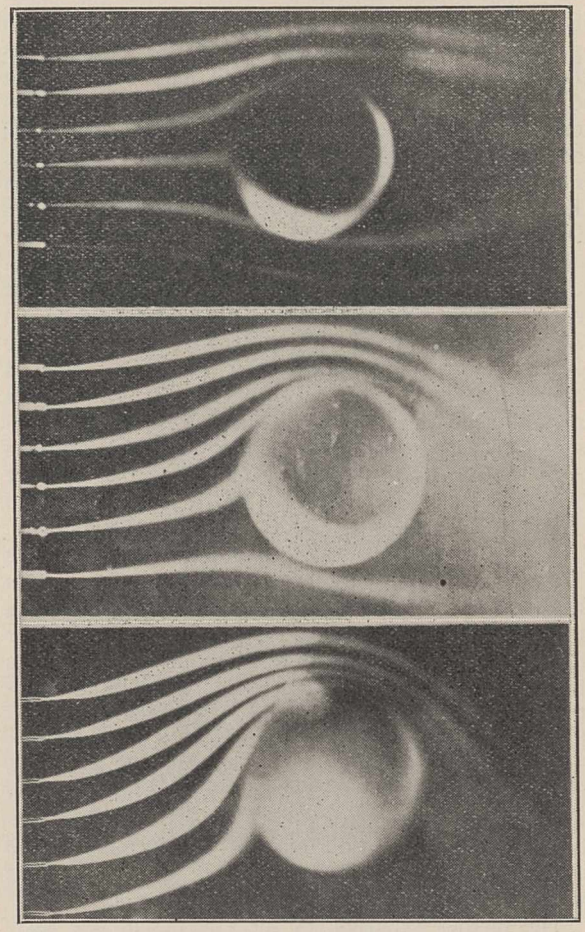


FIG. 3.—Deflexion of air stream by rotating cylinders: top, 600 rev. per min.; middle, 1200 rev. per min.; bottom, 2400 rev. per min. Reproduced by courtesy of *Flight*.

Regarded as an aeroplane wing, such high speed would be required at the moment of landing, and if an alighting speed of 30 m.p.h. is aimed at, the surface of the cylinders would need to move at 120 m.p.h. For transport efficiency when once in the air, the factor of greatest importance is the ratio of lift to drag, and on a rotating cylinder this is obtained when the peripheral speed is about two and a half times as great as the forward speed. Whilst the Göttingen results give a maximum ratio of 3·5, the American figures give 7·5-8, and the discrepancy is very great. The figures are subject to a deduction for the power required to rotate the cylinders, a deduction of rather uncertain amount but of the order of a quarter to a third of the

values stated. The modern aeroplane has a ratio of lift to drag of 9, and some of the light aeroplanes indicate a figure as high as 12 or 14, so that the best of the results on rotating cylinders compare very unfavourably with the aeroplane for efficiency.

Whatever may be the final utility of the rotating cylinder and the commercial fate of the *Buckau*, it may be expected that many attempts will be made to utilise the aspect of fluid motion brought into new prominence by the rotor ship. Whilst it is difficult to see immediate uses in aeronautics, there are certain directions in which speculation suggests the possibility of early benefit by a modified application of the principles involved in the propulsion of the rotor ship.

The Mountain Structure and Geographical Relations of South-Eastern Asia.[1]

By Prof. J. W. GREGORY, F.R.S.

THE greatest mountain system in the world is the Alpine-Himalayan, which forms the backbone of Europe and Asia. Its continuity has been proved from western Europe to eastern India. Its further eastward continuation has long been subject of controversy. According to one view it passed northeastward across central China to Bering Straits; according to another it was bent round against the mass of Chinese Tibet, and passed through western Burma to Sumatra and thence along the southern islands of the Eastern Archipelago. The interpretation of the mountain structure of Chinese Tibet is complicated by being due to movements at two different dates. The later mountains are of the same age as the Alps and Himalaya and are geologically modern. The other group is much older, and its fragments remain as highlands, which are the worn down stumps of the mountain foundations. The older system is represented in Europe by the Hercynian Mountains, and in Asia by the Altaids, members of which cross Chinese Tibet on lines approximately north and south, and continue southward as the Indo-Malayan Mountains. The Himalayan and Altaid Mountains meet in Chinese Tibet, and the mountain lines due to these two systems have to be carefully distinguished. The Himalayan movements have disturbed the grain due to the older Altaid folding and they admit of simplest proof where the rocks were not in existence when the Altaid Mountains were made. For example, the folds and overfolds in the salt-bearing red sandstones of Yunnan must be post-Altaid, as those rocks were not in existence until after the Altaid movements. In other places the evidence is more complex. Some of the folds are too shallow to be Altaid, and the arrangement of the outcrop of the older rocks indicates upfolds on lines with the Himalayan trend.

The further extension of the Himalayan line eastward of Chinese Tibet is indicated by the claim of the French geologists in Tonkin that at the date of the Himalayan movements a band of country in southern China was pushed southward smashing the country in front of it. The existence of a rich mercury field in south-western China is also in favour of the country having been disturbed by intense mountain movements of the Himalayan period. The continuation of the main Alpine-Himalayan axis therefore appears to pass across southern China, and the Burmese-Malayan Arcs must belong to a loop to the south corresponding to the Atlas-Apennine loop around the western Mediterranean and the Syrian Arc beside the eastern Mediterranean.

[1] From a discourse delivered at the Royal Institution on Friday, January 30.

The traditional cause assigned to such folding as that of the Alps and Himalaya is the contraction of the crust owing to the shrinkage of the earth. That theory has been repeatedly criticised in recent years owing to the contraction having been attributed to cooling; but there are more effective and more probable causes of contraction than cooling. That contraction has taken place is proved by the geological evidence. The restriction of the Alpine-Himalayan compression to a long narrow band, varying in latitude from 40° to 48° in Europe, and from 25° to 38° in Asia, is the natural result of that sinking of the northern dome of the world which is shown by the polar flattening. The junction of the northern dome with the tropical belt is naturally one of crumpling and crustal disturbance. This process would produce uplifts in the same zone of the crust around the northern hemisphere, and traces of this continuous upheaval are found. The West Indies and Central America include fragments of mountain chains formed at the same time as the Alps and with a similar trend.

The abrupt ending of the mountain grain of the continents on both sides of the Atlantic indicates the former extension of the land into the ocean. That the land once crossed the whole width of the Atlantic is supported by the biological evidence. Similar animals are found on opposite sides of the Atlantic in corresponding latitudes, and the resemblances of the South American and African faunas are not likely to be due to passage via Scotland and Greenland if there are no representatives of those groups in Europe or North America. The distribution of the ridges and deeps on the North Atlantic floor indicates uplifts in North America and western Europe at the time of the Alpine movements. There is similar evidence of former land extensions across the northern and southern Pacific, such as the occurrence of the alligator in the Yangtze Kiang, the resemblance of the flora of southern China to that of the south-eastern United States, and the occurrence on both sides of the South Pacific of various groups which are unrepresented in the lands on either side of the North Pacific. The biological evidence is supported by the ridges on the Pacific floor and the distribution of the coral islands. The former trans-Atlantic and trans-Pacific connexions must have endured until the time of the Alpine-Himalayan uplifts, for they were broken before the spread of the more specialised mammals and birds, and were available to some living groups of reptiles, amphibians, and specialised invertebrates.

The Indian Ocean was also once occupied by land, the disruption of which has affected the mountain structure of south-eastern Asia. At the end of the

Altaid uplifts the site of the Indian Ocean was covered by a continent which extended from South America across the Old World to Australia. This continent, Gondwanaland, was broken up by successive subsidences; and the gulfs thus formed were gradually enlarged by further subsidences and so developed into the Atlantic and two basins of the Indian Ocean. These movements were accompanied by volcanic eruptions which deluged equatorial Africa and western India under floods of lava, while East Africa was torn asunder by the formation of the Great Rift Valley. If these eruptions and fractures were due to the formation of the Indian Ocean, it appeared strange that no corresponding phenomena were known on its eastern side. The evidence, however, is now clear that in Burma and western China there were volcanic eruptions which, though on a smaller scale, agree in date with the three main volcanic periods of East Africa; while meridional fractures of the same date as those which made the Great Rift Valley formed the great basins of Yunnan in western China. These fractures in Asia produced features different in some respects from those of East Africa, owing to the difference in structure between the continents. East Africa is an ancient solid plateau, whereas Yunnan has an extremely complex foundation due to the intersecting mountain folds. The fractures have therefore been less regular and shorter.

The date of the later movements in Chinese Tibet is indicated by the river system. The drainage of south-eastern Tibet collects into three rivers which flow for 140 miles on parallel courses through a narrow belt, and instead of joining they then diverge, the Yangtze discharging into the China Sea 2000 miles from the mouth of its neighbour, the Salween. The present river system is the result of a long evolution controlled by the mountain-forming movements. The drainage of central and south-eastern Asia in pre-Himalayan times was probably mainly through broad east to west trending valleys due to a gentle buckling of the earth's crust. The Himalayan movements confirmed this system; but during the subsequent settling down of the country the eastward outlet of the Tibetan rivers was reduced and Tibet became a land of lakes, to an extent even greater than it is now. Their level rose until they found outlets to the south, through lines of weakness along the Altaid grain. The Tibetan rivers through these southern outlets discharged to the South China Sea. The upper Brahmaputra or Tsangpo discharged through the Dihang, crossed the site of Assam, and passed through the Hukong Gap to the Irrawadi. The Tibetan section of the Yangtze Kiang flowed through Tali Lake to the Red River of Tonkin. Further earth movements broke up this system and diverted its western member through the valley of Assam as the Lower Brahmaputra to the Bay of Bengal, and the eastern by a series of deep gorges and striking zigzags across eastern China to the South Pacific.

The geographical relations of the mountains of south-eastern Asia therefore indicate that the Alpine-Himalayan System is a crumpled band of the crust, where the in-sinking northern dome of the world pressed against the tropical belt. The east to west ridges on the floors of the North Atlantic and North Pacific may be attributed to the same forces as produced the Alps and the Himalaya; and the east to west trending mountains, of which remnants are the dominant features in the topography of the West Indies and central America, are also an expression of the buckling of the crust of the Northern Hemisphere where the northern dome of the earth meets its tropical and subtropical belt.

Recent Developments in the Nitrogen-fixation Industry.

WHEN the historian of the future writes concerning the influence of scientific discovery and achievement upon civilisation, we may be sure that he will have much to say about the political and economic effects of the development of the nitrogen-fixation industry. Of all the material factors that helped to make the War the greatest and most devastating conflict in human history, the possession by the Germans of adequate plant for making synthetic ammonia, and of adequate personnel for working it, was probably the most important. Since that time the processes for fixing atmospheric nitrogen have been further developed, and the present yearly production of fixed nitrogen is approximately 500,000 metric tons, three-quarters of which is made in Germany.

The arc process, the lineal descendant of Cavendish's initial discovery in 1783, now contributes only a relatively small proportion of the total production, namely, about 36,000 m.t., its high power-requirement rendering it uneconomical save in countries possessing cheap and abundant water-power. The modification of the process involving the use of oxygen-enriched air, which was worked principally in Switzerland and Germany until 1921, had to be abandoned owing to the serious explosions to which it gave rise. The Swiss Nitrum Co., which worked it on a large scale, has recently adopted the Claude process in its stead.

Fixation by means of calcium carbide was developed enormously during the War, but the present outlook for this method is not promising: calcium cyanamide has not come up to expectations as a nitrogenous fertiliser, and the power-requirement, although only about one-fifth that of the arc process, is 3-4 times greater than that of the direct synthetic-ammonia process. The output of cyanamide has declined to about 140,000 m.t. per annum, and about one-half of the world's plant capacity is unutilised. There are, however, still possibilities, for cyanamide can be used as an intermediate product in the manufacture of urea, of ammonia, and of "Ammo-phos," a fertiliser made on a small scale in the United States.

Urea appears to be the nitrogenous fertiliser of the future. It is the most concentrated of its class; it can be transported and used without difficulty; it leaves neither acid nor alkali behind in the soil; and it has given general satisfaction in experimental work. It will probably be manufactured by combining synthetic ammonia and carbon dioxide at high temperature and pressure. Since 1922 a combination of urea and acid phosphate, called "Phosphazote," has been made in Switzerland, and a large works in Norway is to start its production early in the current year.

The Haber process and its modifications, involving the direct union of nitrogen (from liquid air) and

hydrogen in presence of a catalyst, at various temperatures and pressures, now contribute about 65 per cent. of the world's supply of fixed nitrogen. In this process the cost of producing and purifying the hydrogen is a dominating factor; in Germany it is prepared from water-gas (Bosch process), in France by fractionating coke-oven gas (Claude process), and in Italy by electrolysing water (Casale and Fausser processes). Electrolytic hydrogen is very pure, but its production is only feasible where water-power is cheap. The Casale process is being actively worked in Calabria by a company with a capital of 9 million Swiss francs, and in the United States the Hooker Chemical Co. is so satisfied with its success that it has decided to double its plant at Niagara Falls.

Other important factors in the Haber process are the choice of catalysts and the form of marketing the ammonia. In the Fixed-Nitrogen Research Laboratory of the United States Government, improved catalysts have been made which, it is expected, will reduce the cost of ammonia-production by one-half; working on a small scale, at 1500 atmospheres pressure, nearly 80 per cent. of a nitrogen-hydrogen mixture was converted during a single passage through the catalyst. Improved catalysts have also been made for the water-gas reaction ($CO+H_2O=H_2+CO_2$). With these and other improvements it is hoped to reduce the price of ammonia to 5-6 cents per lb.

At Billingham-on-Tees, Synthetic Ammonia and Nitrates, Ltd., has started manufacture on a large scale. A modified Haber process is used, and the ammonia is fixed by the calcium-sulphate method, which was developed, and is still used, in Germany. It is probable that synthetic ammonia will be used in conjunction with the Solvay soda process, the ammonia being converted into ammonium chloride, which preliminary trials have shown to be comparable with ammonium sulphate in fertilising value.

The Bucher process of fixing nitrogen as cyanide has not fulfilled expectations, but it appears probable that the du Pont Co. will make it a success. Instead of passing nitrogen (at 15 lb. pressure) over soda ash, coke, and a catalyst, this company uses producer-gas and a mixture of carbon black and soda ash (plus catalyst) obtained by evaporating to dryness the "black liquor" which results from boiling wood with caustic soda in the manufacture of wood-pulp, and by heating the residue out of air at 250°-350° C. This mass is very porous, and contains 60-65 per cent. soda ash and 40-35 per cent. carbon, mainly colloidal. The yield of cyanide at this stage is 50-55 per cent., and the period of heating is only 70 per cent. of that required in the original process. The reaction-product is leached with water, and 96-98 per cent. sodium cyanide is obtained by crystallisation. The carbon monoxide evolved during heating is mixed with producer-gas and burned under the retorts, which are made of very resistant cast chrome-iron alloy, high in chromium. A valuable decolorising carbon is extracted from the residue after leaching. Cyanide, it may be mentioned, can be decomposed by steam to yield ammonia.

The marvellous growth of the nitrogen-fixation industry has naturally excited those interested in the production of Chilean nitrate, the consumption of which has not advanced *pari passu* with that of the artificial products; but the processes used in Chile are known to be wasteful, the Chilean Government could reduce the export tax of 50*s.* per ton in case of emergency, and the deposits are likely to last much longer than was originally thought probable. In view, however, of the fact that no other nitrate deposits, in any way comparable with those of Chile, have been discovered, it can only be a question of time—a generation or two—before the synthetic products will hold undisputed sway. It is, of course, possible that means may be found of speeding up nitrification in the soil, but even in that event no nation could afford to be without a nitrogen industry for producing explosives. Furthermore, fixed nitrogen is being increasingly used as ammonia for cold-storage plants, as cyanide for gold extraction, and as nitro-cellulose for making celluloid, artificial leather, and similar products. Great developments of the industry may, therefore, be confidently anticipated.

Obituary.

THE MARQUESS CURZON OF KEDLESTON, K.G., F.R.S.

BY the death of Lord Curzon, Lord President of the Council, and formerly Viceroy of India and Secretary of State for Foreign Affairs, on March 20, public life in Great Britain has lost one of its most striking personalities. His long and distinguished career in politics had won him high honours in the State; but in a more restricted circle he was held in equal esteem for his scholarship and his efforts to promote those studies with which his interests and pursuits had brought him into touch.

George Nathaniel Curzon, son of Lord Scarsdale, was born on January 11, 1859. After a distinguished career at Eton and Oxford, which included the presidential chair of the union and led to a fellowship of All Souls, Mr. Curzon, as he then was, embarked on a political career, entering Parliament in 1887, first holding office as Under-Secretary of State for India in 1891, by which time he was already recognised as an authority on the East. It is unnecessary to enter here into the details of his political career, which are well known. His services to the State were recognised by successive peerages of every grade up to the rank of marquess and the orders of the Garter, the Indian Empire, the Star of India, and the Royal Victorian Order.

Apart from politics, Lord Curzon won distinction as a geographer and student of the peoples of the East. Between 1886 and 1894 he visited India four times and twice travelled round the world. In 1888 he travelled through Asiatic Russia, recording his observations in his book "Russia in Central Asia." He followed this with a book on Persia and the Persians, a comprehensive account and perhaps his most considerable contribution to geographical literature, which later was to have considerable effect on policy in the Middle East and is still a work of authority. This appeared after a journey in Persia as correspondent of the *Times* in 1889, in the course of which he travelled more than 1600 miles on horseback and toured the Persian Gulf. A later book, "Problems of the Far East," dealt with conditions in and the prospects of the countries lying

between India and the Pacific. In 1894 he visited the Ameer of Afghanistan—then an undertaking entailing some considerable risk—after tracing the Oxus to its source in the Pamirs. Behind his preoccupation with races and people as factors in international politics, Lord Curzon had a fund of sound geographical knowledge, and in fact, as was shown by essays in his often amusing "Stories of Travel," published in 1923, he was a scientific geographer of no small attainment. In geography and in the study of peoples, as in his work as an administrator, it was characteristic of him to pursue exhaustive inquiry and to master the available data relating to his subject before arriving at any conclusion on his own observations. The result would then be expressed with a lucidity which reflected his clarity of judgment. His contributions to geographical science were recognised in 1895 by the award of the Royal Geographical Society's gold medal, an honour which he prized highly.

As Viceroy of India Lord Curzon did much to promote science in that country. Apart from his lasting reforms in education and his efforts to improve the conditions of agriculture, both being placed under trained officers, he reorganised the archæological service, which had fallen into neglect, reviving the office of Director-General. In 1904 he passed a Monuments Act, and he saved from profanation and decay innumerable temples, tombs of kings, mosques, and other buildings throughout India, including the native states. Native arts and industries were fostered, and he created the Imperial Library in the Metcalfe Hall and was responsible for the Victoria Memorial on the Maidan, Calcutta, a gallery of Indian art and history. His own researches into the history of his predecessors in the Viceregal office were on the point of publication at the time of his death.

It may be recalled that Lord Curzon and Lord Kitchener were the principal guests of the Royal Society at its anniversary dinner in 1898. Within a few days both were due to leave England to take up their new Indian appointments. In a letter to Lord Lister, the president, a few days prior to the banquet, Lord Curzon wrote: "It is the instinct of the hunted animal to fly, but your invitation to me has been expressed so gracefully that I cannot but accept." Lord Curzon made an interesting speech at the dinner, referring, among other matters, to a Viceroy's horoscope. An outgoing Viceroy, he said, is fêted and dined and toasted before he has gone out to his work, and, indeed, before he has done anything at all. Five years later, upon his return, he slips back into Great Britain almost unperceived, and retires, very likely, into an obscurity which may or may not be merited, but is, at any rate, in striking contrast to the plaudits which attended his departure. Happily, in Lord Curzon's case, such prophecy was unfulfilled.

Lord Curzon's interest in the relics of antiquity were not confined to India. It was through his efforts that Tattershall Castle, Lincolnshire, was saved for the nation when about to be demolished, and through him the castles at Bodiam in Sussex, and Montacute in Somerset, were also preserved.

Lord Curzon was the recipient of many honours bestowed by the learned and scientific world. He was president of the Royal Geographical Society from 1911 until 1914. He was elected Chancellor of the University of Oxford in 1907, when he took a prominent part in the movement for "reform from within." He was Lord Rector of the University of Glasgow in 1908, Romanes Lecturer at Oxford in 1907, and Reed Lecturer at Cambridge in 1913. He was an honorary fellow of Balliol, and held honorary degrees from the Universities of Oxford, Cambridge, Glasgow, and Manchester. He was a fellow of the Royal Society and British Academy, and had accepted the presidency of the English Association not very long before his death.

Lord Curzon in India.

Except in so far as it had a direct influence on economic development or on humanitarian problems, Lord Curzon, during his Indian Viceroyalty, showed no marked interest in scientific research. Science did not appeal to him as a branch of culture comparable to history and literature. It is true that, four years before he was appointed Viceroy, he had made a distinct mark as an explorer in the Pamirs, when he solved the problem of the source of the Oxus; but this diversion to physical geography was rather an accidental by-product in a journey mainly devoted to the political aspects of geography and sport. Still, the recognition of this work by the Royal Geographical Society left him with the impression that geography at any rate was a science, and, so far as one could guess from his official and personal activities in India, it gave him the impression also that science was geography. Workers in other branches he seemed to regard as having a limited usefulness in solving political and economic problems, and sometimes in assisting his remarkable work in restoring respect for India's unappreciated relics of archæological and historical value. His action in dispersing the fine collection of fishes (which had been prepared by Col. Alcock in the Calcutta Museum), to provide an opportunity for a preliminary display of the historical collections designed for the Victoria Memorial, revealed his want of appreciation of the claims of those forms of culture that had had no part in his earlier education. Fortunately, no other science workers offered obstacles to his activities, and so they could not share to the full the resentment displayed by the zoologists.

Nevertheless, when Lord Curzon realised that science was necessary for economic progress, he recognised the value of laying sound foundations in research which could offer no prospect of definite results in his own time. In this matter he was fortunate in having as members of his Government two Ministers—Sir Denzil Ibbetson and Sir John Hewett—who realised that the development of pure science was essential to solid advancement in its application. Lord Curzon's institution of the Imperial Agricultural Department, by recruiting into one service a strong staff of chemists, botanists, plant pathologists, entomologists, and other specialists devoted to agricultural problems, has already brought to the Indian cultivator direct returns in increased output annually, many times more than the total cost of the new service from its start.

Although most science workers in India during the years 1898 to 1905 remained outside the Viceroy's wide range of active interests, the wiser among them realised that their position was not without some advantages; his zeal for reform was dominated always by a desire for centralised control and symmetry in system of administration—conditions which may have conduced

to increased efficiency, but were never accomplished without trespass on local sentiment or without interference with individual liberty in research work. Fortunately, he found urgent problems in other fields, even more than enough for his apparently unlimited energy and never-failing sense of duty.

In the *Sunday Times* of March 22, Mr. Newman Flower mentions the fact that the night before his operation, which he knew might be fatal, Lord Curzon wrote minute instructions about his forthcoming book on "British Government in India," and this incident reminded me of a somewhat similar illustration of his remarkable regard for small things in spite of greater distractions. In 1905, when the controversy with Lord Kitchener, which led to his resignation, was at its height, Lord Curzon sent me long notes from Simla about certain marble pedestals in Government House which he had asked me, during the previous Calcutta session, to take a personal interest in and to have erected before the arrival of the Prince of Wales.

It was not until after 1916, when war conditions forced upon one many duties of an unfamiliar nature, that one saw further direct evidence to show the great depth as well as width of Lord Curzon's marvellous activities in railway extension, in university education, in public health, in town-planning, in industrial developments, in army administration, and, most remarkable of all, in the complex problems of land revenue which not even an experienced member of the Civil Service professed to understand for any but his own province. His views were expressed in reasoned notes that left one with the impression that each file in turn covered the one subject in which he had specialised. Five years' experience with the Government of India, where the records of his previous work are filed, left me with two outstanding impressions—first, an inexpressible admiration for his energy, thoroughness, and conscientious devotion to India; and secondly, an equally strong feeling of thankfulness that geology was not one of the subjects in which he had occasion to specialise between 1898 and 1905. T. H. HOLLAND.

PROF. A. VON WASSERMANN.

WE regret to record the death on March 16, at sixty years of age, of August von Wassermann in Berlin. He was born in Bamberg, and having studied in Strasbourg, Vienna, and Berlin, early became associated with the Institute for Infectious Diseases under Koch, and it was here that most of his work was done. He ultimately became Director of the Serum department of Koch's Institute, and in 1913 Director of the large Institute of Experimental Therapy of the vast Kaiser-Wilhelm Gesellschaft zur Forderung der Wissenschaft in Dahlem, Berlin. He was also honorary professor in the University of Berlin and was ennobled in 1910.

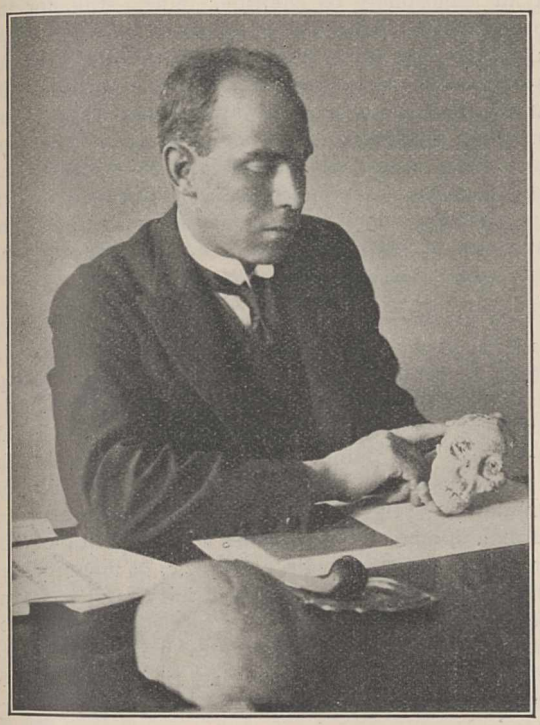
Von Wassermann's scientific life-work was done in the domain of immunity; he saw its rise and zenith and contributed in no small degree to its development. He was an exceedingly clever man, untiring in his diligence, and in the highest degree efficient if lacking in imagination when compared with the greatest workers in his science. Throughout the development of immunity problems he was constantly on the alert, and felt almost every pulsation of advancement of knowledge with extraordinary acumen. Although rarely the first on the field, he was almost invariably among the first to take full advantage of anything new, and he always added something fresh and clever to work already done. He was a typical "Prussian," somewhat arrogant to his inferiors, but withal a man that was liked. He was a brilliant speaker, and a great star at medical gatherings and congresses, where he was always listened to with attention. As an example of his diligence we may cite the "Handbuch der pathogenen Mikroorganismen" which he edited with W. Kolle. This monumental if somewhat uncritical work appeared in two editions, the first in six volumes between 1903 and 1909, the second in eight volumes with nearly nine thousand pages, all of which was published within two years (1912–1913).

From 1906 Wassermann attained world-wide fame, and his name became almost a household word through his discovery of the so-called Wassermann reaction in the diagnosis of syphilis. In its altered form, this test is practised in every pathological laboratory the world over, and is perhaps the most accurate laboratory test applied to the clinical diagnosis of disease. Wassermann's test was the practical application of a fundamental principle discovered by Bordet and Gengou (1901) of Brussels, and it was characteristic of him that he saw almost immediately how Bordet's work could be utilised for human medicine. Wassermann's name will live long in the annals of bacteriology and immunology. W. B.

DR. WILLIAM F. HILLEBRAND, chief chemist of the United States Bureau of Standards, died on February 7 at the age of seventy-one years, and an appreciative account of his life and work by a colleague at the Bureau of Standards has been published in a recent issue of *Science*. William Francis Hillebrand spent two years at Cornell University before taking up chemistry, most of his training in which was received in Europe. In 1872 he went to Heidelberg to study under Bunsen and Kirchhoff, and from there, he and T. H. Norton published in 1875 their paper on the preparation of metallic cerium, lanthanum, and the mixture then called didymium. Hillebrand's later work showed these metals were trivalent and belonged to the rare earth group. He also discovered the pyrophoric properties of cerium filings. From Heidelberg Dr. Hillebrand went to Strassburg under Fittig, and from there to the Mining Academy at Freiburg. Returning to the United States, he was appointed to the staff of the Geological Survey in 1880, and until 1885 was stationed at Denver. Here was plenty of mineral material to exercise his growing skill as an analyst, and the work was continued after his transfer to Washington. In 1908 he became second chief of the Bureau of Standards. Dr. Hillebrand devised general analytical procedures suitable for different types of mineral and rock, and also special methods for the determination of individual elements, which were placed on record in various issues of the Bulletin of the Geological Survey; silicate rocks were dealt with in 1897, carbonate rocks in 1907, both of which were quickly translated into German. Dr. Hillebrand was a member of the National Academy of Sciences, and in 1906 was president of the American Chemical Society; for many years he served as an associate-editor of this Society's Journal and also of the *Journal of Industrial and Engineering Chemistry*.

Current Topics and Events.

OUR readers will no doubt be interested in the photograph we publish showing Prof. Raymond Dart, of the Witwatersrand University, Johannesburg, with the Taungs skull. Prof. Dart, who is well known to anatomists in Great Britain, was trained under Prof. J. T. Wilson, now professor of anatomy at the University of Cambridge, and worked in London at the Royal College of Surgeons, and under Prof. Elliot Smith at University College in 1919, where he paid special attention to problems of the brain and to the skull of fossil man. Before taking up his appointment in South Africa he was one of three selected by Prof. Elliot Smith from his staff, at



Prof. Raymond Dart with the Taungs skull.

the request of the Trustees of the Rockefeller Foundation, to visit the medical schools of the United States. A certain amount of criticism has been levelled at Prof. Dart's nomenclature of the Taungs skull. It is generally felt that the name Australopithecus is an unpleasing hybrid as well as etymologically incorrect. Dr. J. G. de Barros e Cunha, of the Institute of Anthropology, Coimbra, who is among those who take exception to the title on these grounds, also writes to point out that if a new family of *homosimiidæ* is constituted, the generic name should be Homosimis, whereas the generic name, Australopithecus, would require the family name Australopithecidæ. Although it may be a little premature to decide, present information does not force either alternative upon us, as there does not seem to be adequate ground for the creation of a new family. Meanwhile the criticism continues, and in a cable which appeared in the *Times* of March 11, Prof. Dart defends himself with some humour but in a manner which suggests that the niceties of etymology do not greatly appeal to him.

PROF. L. VEGARD sends us the following cable message from Oslo, dated March 20: "Shown by experiments in mixtures of nitrogen and neon at the Leyden Laboratory that auroral line is the limit to which the band N_1 approaches by diminishing size of nitrogen particles." Prof. Vegard described his observations of the luminescence of solid nitrogen, and the structure of the two bands in the green part of the spectrum, called by him N_1 and N_2, in communications to NATURE of September 6 and November 15, 1924.

ALTHOUGH the Coal Conservation Report was issued in 1918, there is still considerable difference of opinion amongst electrical engineers as to the advisability of mapping Britain out into power zones each served by super power stations of high thermal efficiency. It is admitted that there are many small stations which burn fuel extravagantly, but in some of our larger stations the thermal efficiency is about 20 per cent. and is still increasing. This compares favourably with anything that has been done by the super power stations in the United States, where the power zone system is adopted. There is one aspect of the problem, however, to which more attention should be directed, namely, the possibilities of interlinking various supply systems by reversible motor-generators so that one company can help the other during times of heavy load. Even if the systems of supply be alternating current of different frequency, suitable electrical devices called frequency transformers can be used for this purpose. When this is done, in nearly every case the ratio of the average demand on a station to the maximum possible demand is largely increased. The overhead charges are thus considerably reduced and will justify a reduction of price to the consumer. The linking together recently of three power stations in Berlin has had the effect of raising this ratio—the so-called "load factor"—to 57 per cent., and made possible considerable economies. The tables published by the Electricity Commissioners prove conclusively that the larger the power station the higher the thermal efficiency. The main difficulties in the way of getting a cheaper supply of electricity, and a more efficient one from the point of view of fuel consumption, are in connexion with raising the capital required for providing the necessary distribution mains. Various schemes have been suggested for overcoming these difficulties, but no general agreement has yet been attained.

THE pages of American scientific and technical periodicals have for some time provided evidence of considerable activity in the field of colloid chemistry. This is not confined to individual work, but there has been a good deal of concerted action directed towards promoting and facilitating the study of the discipline. The Colloids Committee of the National Research Council some time ago issued a fairly complete bibliography of the subject, and has now put forward a definite scheme for the establishment of a National

Institute for Research in Colloid Chemistry. The scheme itself, some of the general claims of colloid chemistry, and a number of successful applications to technical problems are described in a beautifully printed and illustrated booklet published by the University of Wisconsin. This institution puts forward a number of reasons why the proposed Research Institute should be located in its grounds, one of the reasons being the enthusiastic support given to the lectures and research classes held by Prof. The Svedberg of Upsala during part of the year 1923 and the subsequent "symposium" on the subject. The scheme suggests the raising of a sum of one million dollars, a quarter of which is to be devoted to buildings and equipment and the remaining three-quarters to endowment. A director of research, for whose specified qualifications a salary of 8000 dollars does not seem excessive, a director of the laboratory and two research fellows with salaries of 6000 dollars each, are contemplated. There is very little doubt that the money will be easily obtained, and, whatever view one may take of the possibilities of gregarious research, it is impossible to avoid slightly envious comparisons between the colloids "boom" in the United States and the very inadequate provision for teaching and research on the subject in Great Britain.

THOSE responsible for airship development in the United States and in Great Britain have drawn many comparisons with the development of marine transport. To balance their natural optimism a note of caution may be sounded. The new airships are to displace 140,000 cub. m. volume and 150 tonnes mass of air. A ship of the same volume displacement of water would have a mass displacement of 110,000 tonnes. The air leviathans are, of necessity, bubbles lighter than air. Most marine harbours have protected approaches so that in stormy weather ships pass by degrees from the waves of the open sea to completely protected waters before making actual contact with dock or quay. Where the approaches are bad in certain winds, arriving vessels may have to turn back, an experience not unknown to channel passengers. Unfortunately, all airship harbours are bad in all high winds, and if in spite of weather forecasting an airship is caught outside its shed, it must ride out the storm under power or at the mooring mast. With ships, the maximum hogging and sagging stresses increase until the length of the ship exceeds the maximum wave-length, as is the case with Atlantic liners. There is no authoritative information as to the analogous air stresses, but American experience with the *Shenandoah* is held to confirm the belief that these are much greater than the stresses produced by manœuvring in still air. This, then, seems to be the ultimate standard by which the airship will be tested unless it is to remain in its shed until fair weather is predictable with certainty.

THE first manufacture of fused silica ware was a British achievement, and it is satisfactory to learn that the industry which grew from small beginnings at Wallsend-on-Tyne in the early years of this century is still flourishing and well maintaining its pre-eminent position both at home and abroad. Like many other useful inventions, the applications of fused sand and quartz to the construction of laboratory apparatus and to parts of large-scale plant developed at first with extreme slowness, but circumstances arising from the War provided the necessary impetus for their extension: the cutting off of supplies of German porcelain and the recognition of the value of silica condensing-systems for nitric-acid vapour and of silica basins for concentrating sulphuric acid were mainly responsible for the change. Since the end of the War a demand has arisen for silica cooling and absorption plant in the manufacture of hydrochloric acid, both by the old process and by burning hydrogen in an atmosphere of chlorine. Silica stills for the concentration of pure sulphuric acid have also been in request, as silica is the only material that can satisfactorily replace platinum for this purpose. By far the most important new application is the manufacture of gas globes and of bowls for indirect lighting, more fused silica being used for this than for any other purpose. In the immediate future a considerable demand for it is anticipated for making the envelopes of large thermionic valves and the condensers of "radio" sets.

THE number and variety of laboratory appliances made of fused silica are also increasing, and among the latest of these is a mercury condensation pump, which is fully described in the most recent catalogue issued by the Thermal Syndicate, Ltd., of Wallsend-on-Tyne. This pump, measuring 25 cm. in length, is made entirely of fused quartz, and worked in conjunction with a backing pump giving a vacuum of 0·2 mm. of mercury, it provides a vacuum of 0·000002 mm.; it is operated with only 5 c.c. of mercury, can be heated either by gas or electricity, and is water-cooled. The increased use of fused silica ware for scientific and technical purposes would appear to depend mainly upon its price. It is not easy to manufacture; skilled labour is essential, the necessary electrical equipment is costly, and only very pure raw materials, such as sand from Fontainebleau and quartz crystals from Madagascar, can be used. In spite of these circumstances, considerable progress has been made in reducing production costs, and only a big demand is needed to permit of an appreciable reduction in selling price, and to enable silica ware to compete in price with materials which have hitherto been thought to be much easier to produce. The opacity or translucency of articles made from sand is known to be due to the presence of small air-bubbles and not to impurities in the raw materials. These air-bubbles cannot be expelled because the fused sand is very viscous; melted quartz-crystal, on the other hand, is quite mobile. The translucent material is, however, quite suitable for most objects, especially when these are glazed, and for some purposes, for example, the manufacture of gas globes, it is to be preferred.

THE British Non-ferrous Metals Research Association has just issued a report on the research work in

progress or completed under the auspices of the Association. The record is a striking one. A graph which is attached to the pamphlet shows that the expenditure on experimental research, which in 1921, the second year of the existence of the Association, was only 1500*l.*, will amount during the present year to close on 16,000*l.* The most interesting feature of the report is the attention given to the scientific study of alloys. The Council of the Association has taken a very broad view, and most of the work is devoted to fundamental problems rather than to the solution of immediate workshop difficulties. It has been decided to establish a small central laboratory, attached to the University of Birmingham, for the use of the Superintendent of Research and also for carrying out preliminary investigations, but the policy of the Association is to have its researches conducted mainly in the universities and other specially equipped laboratories of the country. A glance through the pamphlet shows that at least thirty separate research workers are engaged in various laboratories under the supervision of their respective professors or directors. The non-ferrous metal industry is an extensive one, and there are still branches of it which are not represented in the Association; firms which have not yet seen the benefit of co-operative research of this kind cannot do better than study the present pamphlet. One consequence of the present programme, of interest to physicists as well as to metallurgists, will be the exact determination of the physical properties of many non-ferrous metals and alloys, a subject on which information at present is singularly imperfect, as will be realised by any one who consults the standard volumes of tables of physical constants.

"WINDOLITE" is the name given to an aceto-cellulose wire-net reinforced substitute for glass. It offers a very thin film in the meshes of the wire net, and transmits the ultra-violet rays. One sample tested transmitted light right down to 232 $\mu\mu$, while ordinary window glass cuts off rays shorter than about 330 $\mu\mu$. The most active biological rays, so far as the skin is concerned, are about 300-290 $\mu\mu$, and these are the rays which come through with the high sun on clear days. Windolite should be useful for open-air shelters, verandahs, etc. The makers inform us that gardeners find it draws plants less than glass, and that this is not due to great coolness of the garden frame or house. It should be interesting to see how well plants grow under it, and whether the anti-rachitic substance and the growth vitamin A are present more in plants grown with ultra-violet rays than without. The present writer has tried cress, and so far has found no difference on young rats in the growth-promoting power, but that may be due to vitamin A derived from the seeds. Hess in the United States states that market salad has not got anti-rachitic power, but can be given this by radiation. A new glass has also been submitted to us—Lamplough's Vitaglass; this as rolled is a "cathedral glass," but it can be blown clear. It lets ultra-violet rays through down to 275 $\mu\mu$, costs about 3*s.* a square foot, and should be useful for skylights, verandahs, upper parts of windows of hospitals, sanatoria, schools, nurseries, and possibly for greenhouses if fruit and salads are found to be improved in quality by ultra-violet rays. Blown clear it will be useful for bulbs of tungsten filament quartz lamps, allowing us to get some gentle ultra-violet rays from these.

A DESTRUCTIVE tornado struck Annapolis, Missouri, shortly after 1 o'clock in the afternoon of March 18, swept north-eastward across the Mississippi River, traversing Southern Illinois, and at Elizabeth, Indiana, broke into two lesser storms, which tore pathways through Tennessee and Central Kentucky. The *Times* reports that many towns were completely cut off from communication with the outside world, and others were threatened with destruction by fires which broke out among the ruins. Murphysboro, De Soto and West Frankfort in Illinois, Griffin, Owensville and Princeton in Indiana, and Witham in Tennessee are said to have borne the full force of the storm. At South Greenfield, Illinois, a passenger train was overturned by the wind and several persons were killed. In one place about 50 motor-cars were piled in a tangled ruin. Illinois seems to have been the heaviest sufferer, with 645 known dead and 1945 injured. The latest ascertained figure, to March 20, for all five States is 823 dead and 2990 injured, but many bodies are still buried in the wreckage. The storm tore its way over a length of 150 miles. Often its path was only 300 ft. wide. There are places where it uprooted oak trees a foot thick and split apart heavy stone buildings, but left unscathed flimsy cottages and mere shacks.

THE annual report of the Meteorological Office, Air Ministry, for the year ended March 31, 1924, has recently been published. It is the sixty-ninth year of the Office and the fourth year that the cost of the Office has been borne by the Air Ministry. The report shows a large increase in the staff in comparison with a few years ago, as well as an immense increase in the work undertaken. A good deal of reorganisation has been taken in hand. The Office has apparently attained its normal condition and little further development is expected for some years. Details are given of international work, especially in relation to a common system of reports required for purposes of aviation. The Marine Division has achieved fresh work, including the establishment of the *Marine Observer* and the *Weather Shipping* wireless bulletin. Much weather information is gathered for all oceans from voluntary observers. The Forecast Division has made some progress; 84 per cent. of the gale warnings for the whole of Great Britain were followed by gales or strong winds. The ordinary daily forecasts can be obtained, free of charge, by telephone or from broadcasting stations. The Climatological Division deals primarily with the weather of the British Islands, and numerous observations are gathered from all parts of the globe. The Office is interwoven with the Navy, the Army, and the Air Force. Much research is made with regard to the upper air; 8360 single-theodolite pilot-balloon ascents were made during the year, and 236 aeroplane ascents were made by pilots of the

Royal Air Force to determine upper-air temperatures and humidities. The British Rainfall Organisation and observations in connexion with atmospheric pollution afford much valuable material of general utility.

DURING the course of the Pasteur centenary celebrations, held in May 1923, a Pasteur "day" was held throughout France, when badges were sold in aid of the scientific laboratories of the country. Some nine million francs were collected in this way, while the *Matin* raised a further three million francs by subscription. A committee under the chairmanship of M. Émile Picard, permanent secretary of the Paris Academy of Science, was appointed to distribute the fund, and a list of the allocations has recently been issued. Grouping the awards according to subject, they are as follows: 2,143,000 francs to physics, of which 1,000,000 francs is reserved for the construction of a powerful electromagnet for the Paris Academy of Sciences; 1,340,000 francs to chemistry; 1,150,000 francs for astronomy, of which 650,000 francs will be for a photographic instrument and for a reflector of 1·20 m. aperture; 160,000 francs to mathematics, 120,000 francs of which is for the publication of the works of Henri Poincaré; 190,000 francs to meteorology; 245,000 francs to geography and navigation; 333,000 francs to geology and mineralogy; 630,000 francs to zoology; 640,000 francs to botany; 576,000 to physiology and medicine; 105,000 francs to microbiology; 75,000 francs to agriculture; 600,000 francs for the general biology of the Colonies; 510,000 francs for industrial research and institutions. The three million francs collected by the *Matin* is to be invested and the interest used for prizes and grants. The complete list of the grants appears in the *Revue scientifique* for February 28.

THE fourth annual report, just presented, of the National Institute of Industrial Psychology shows a most interesting development of the work in many directions. The application of scientific knowledge and methods to industrial problems cannot fail to have far-reaching results not only for the firm or industry studied, but also for the sciences applied for the elucidation of its problems; in the course of the application of the scientific principles new data will be available whereby knowledge will be extended. The investigations for the year cover a very wide field—coal-mining and chocolate-making, dressmaking and restaurant breakages, to mention but a few. The problems studied have involved—protection from extreme heat, effects of long standing, the mental irritation and worry in connexion with breakages, ventilation and atmospheric pollution. Not the least important part of the Institute's work is concerned with the guidance of children just leaving school; this aspect has been considerably enlarged during the year, owing to a generous grant from the Carnegie United Kingdom Trust, and research work is in progress. The Institute is also conducting an educational campaign by means of lectures and meetings for both scientific and industrial audiences.

THE Textile Institute, the headquarters of which are at St. Mary's Parsonage, Manchester, with London branch office at 38 Bloomsbury Square, has now received a Royal Charter of Incorporation granted by His Majesty's Privy Council by Letters Patent under the date of March 11. The Charter will enable the Institute, in addition to its other powers, to hold examinations and to grant certificates of competency to practise, teach, or profess textile technology. The Institute was formed in 1910 and registered under the Companies (Consolidation) Act, 1908, as a company limited by guarantee. For several years past the question of qualifications in connexion with membership has been under consideration, but it was not until the existing president, Mr. John Emsley, of Bradford, came forward with a definite proposal, accompanied by a generous offer, that it was decided to petition for a Royal Charter of Incorporation. The object of the Institute in adopting this course was to secure not only a higher general status for the organisation, but also that fellowships or associateships which may be granted shall be issued under satisfactory conditions of authorisation. The annual general meeting and spring conference is to take place at Manchester on April 29, whilst the annual conference will be at Edinburgh during Whit-week next. At Edinburgh, the Mather Lecture of the Institute will be given by Prof. A. J. Sargent, of the London School of Economics, whose subject will be "The World Problems of Wool and Cotton."

AT the annual general meeting of the Geological Society of London, held on February 20, the following officers were elected: *President*, Dr. J. W. Evans; *Vice-Presidents*, Dr. J. S. Flett, Sir Thomas Holland, Prof. A. C. Seward, and Sir Arthur Smith Woodward; *Secretaries*, Mr. W. Campbell Smith and Dr. J. A. Douglas; *Foreign Secretary*, Prof. J. E. Marr; and *Treasurer*, Mr. R. S. Herries.

THE Ordnance Survey has published Sheet 44, Mull, of the coloured printed one-inch geological survey of Scotland. The sheet covers an area of involved geological detail and is a beautiful example of fine colour printing. The number of colours used is considerable, and some of them appear in very small area, but the register and general cartographical technique show no flaw throughout the sheet.

WE have received from M. Jacques Boyer, 5 bis, rue Saint-Paul, Paris, a copy of the fourth edition of his "Catalogue de photographies documentaires." It gives a list of the photographic illustrations that he can supply relating to scientific, industrial, and military matters, agriculture, horticulture, geography, aeronautics, automobilism, and portraits of savants and technologists. This last section alone consists of about five thousand portraits, historical characters being taken from the most authentic records. The list of this section is not given. The few sample reproductions included are of excellent quality.

A NEW edition, No. 924, of a catalogue of petrological microscopes issued by Messrs. James Swift and Son, Ltd., 81 Tottenham Court Road, London,

W.1, contains a large and comprehensive collection of microscope outfits for use in petrology, mineralogy, and crystallography. The list includes instruments suitable for elementary students, as well as more elaborate types adapted for the most exacting investigations. A petrological microscope, being an instrument for observing and measuring the optical properties of rocks, minerals and crystals, requires many special fittings and adjustments which are not necessary in a microscope for use in the biological sciences. The models described in the catalogue have been designed primarily for petrological work, and incorporate many of the latest devices for simplifying adjustments and for securing rigidity and accuracy.

MESSRS. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have recently circulated Catalogue No. 390 dealing with nearly 1900 second-hand works on zoology, botany (including agriculture, forestry, fruit-culture and gardening), and geology. As is usual with the catalogues of this bookseller, many choice and rare publications are listed.

MESSRS. W. Heffer and Sons, Ltd., 4 Petty Cury, Cambridge, have just published a lengthy and well-arranged catalogue (No. 248) of second-hand works in the following branches of science :—Mathematics and physics, astronomy and meteorology, engineering, wireless telegraphy, agriculture, husbandry, and farriery, anthropology and ethnology, botany, chemistry, chemical technology and metallurgy, geology, mineralogy and palæontology, zoology and biology, physiology, anatomy and medicine. Upwards of 3500 books are named, and in addition there is a long list of complete sets of scientific serials which Messrs. Heffer have for disposal. The list is to be had upon application.

Our Astronomical Column.

THE BEGINNING OF THE JULIAN DAY.—There is a lamentable state of confusion in the astronomical world as to whether the Julian Day should begin at noon or midnight. Some countries, following the lead of the United States, have decided on beginning at midnight. But the Astronomical Society of the Netherlands continues the noon reckoning, and many people in the British Isles propose to do the same; some of these quote the fact that no change has been made in the Julian Day table of the Nautical Almanac as registering an official decision in this sense. The fact is, however, that no such decision has been reached, and in its absence the wording of the Nautical Almanac remains as before.

While it is possible to make a good case for either noon or midnight, the use of different systems in different countries cannot fail to be a source of great confusion, and it is earnestly to be hoped that an official decision will be registered by the Astronomical Union at its meeting in July. The present year must in any case be one of confusion, but the sooner that state is ended the better.

THE TOTAL SOLAR ECLIPSE OF JANUARY 24.—The *Scientific American* for March describes this as "the best observed eclipse in history." It was certainly the most populous region that the moon's shadow has traversed since modern methods have been introduced, and the article states that thousands of volunteer observers were engaged in observing the exact limits of the zone of totality and similar researches. Five successful colour photographs of the corona were obtained, and the reproduction of one of them is promised in the next issue. "The great spectacle was not marred by so much as a single wisp of cloud."

The times of the beginning and end of totality were telegraphically recorded on two chronographs, one at New Haven, the other in New York; this facilitated the rapid comparison of results, which were thus available in the cable message despatched to Europe the same day. The main feature of the eclipse as a whole was the eager co-operation of thousands of people in a great many directions, including the effect of the shadow on wireless transmission. There is little doubt that the full report will add to our knowledge very considerably.

The errors in the calculated times of beginning of totality, given in NATURE for January 31, were taken from the cabled reports in the *Observer* for January 25. They were very nearly correct, but need a little revision, which can now be made, thanks to a courteous communication from the editor of the *Scientific American*. The observed times were late on the predicted ones as follows; Ithaca, 5 sec.; Poughkeepsie, 2·7 sec.; New Haven, 4·7 sec.; Easthampton, 5·5 sec.; mean, 4·5 sec., practically identical with that given before. The time at Buffalo was noted as 0·3 sec. early, but uncertain owing to cloud.

Easthampton, on Long Island, was occupied by a party despatched by the *Scientific American*. It was at this station that five successful colour photographs of the corona were obtained by Mr. Edward R. Hewitt, who has devised a very rapid process for such photographs.

MOVING ABSORBING VAPOURS AT GREAT HEIGHTS ABOVE THE PHOTOSPHERE.—Observations with the photographic recording spectrometer as employed by Deslandres in 1910 give the changes in appearance of a line emitted or absorbed by a chromospheric vapour and also its radial velocity. Certain filaments are found to develop violent movements, after which they generally disappear or are much weakened. These phenomena are not observed with the spectroheliograph since its narrow second slit is adjusted for a line of the stationary vapour, and when this line is affected by the Doppler effect, it does not pass through it at all. M. L. d'Azambuja, in the *C.R. Acad. Sci. Paris*, January 5, describes six cases which he has observed in the Meudon Observatory from April 1919 to January 1921, using the calcium K_3 line, four of which are similar to that described by Deslandres, and show radial, but no horizontal, movement. The two others, however, show rapid and extensive horizontal movements, and in addition important radial ones. Maps are given showing the forms and positions of these filaments at different times, together with the positions on the solar disc which they would have occupied had there been no horizontal movement. The filaments were seen at first on the spectroheliograms, but not when the radial velocity became large. The maximum velocity towards the observer of one of the filaments was about 25 km./sec., and it was estimated that it must have reached a height of 225,000 km., or about one-sixth of the solar diameter. No trace of it was left about an hour after it was last seen. It is probable that the same phenomena are involved as in the formation of a temporary protuberance at the edge of the solar disc.

Research Items.

INDIAN ARCHÆOLOGY.—A "Note on Prehistoric Antiquities including Antiquities from Mohen-jo-daro" by Mr. Ramaprasad Chanda, Superintendent of the Archæological Section of the Indian Museum, Calcutta, which was written for a visit to the Museum made by the Viceroy in December last, gives a valuable bird's-eye view of the archæology of India as illustrated by exhibits in the Museum. The specimens include palæoliths from the Deccan, the Central Indian Plateau, Rajputana, and Eastern India. These approach most nearly to the Chellean and Acheulean types. Typical neoliths have been collected from nearly all the provinces of India. Of the remains of the Copper Age, which followed the Neolithic in Northern and Central India, the most remarkable are the hoard from Gungeria, Central Provinces, consisting of 424 hammered copper implements and 102 thin silver plates, and a find of nine double axes from the Gulpha River in the Mayurbhanj State. Antiquities found at Mohen-jo-daro and Harappa are now on loan in the Museum, among them being the seals with the unknown pictographic script, the pottery, and other objects which, it is suggested, show Sumerian affinities. It is not generally known that three seals showing this pictographic script were discovered at Harappa in 1872 and in the 'eighties of the last century and were presented to the British Museum, where they are now exhibited.

RACIAL CHARACTER.—An interesting question is raised in two papers published in the Proceedings of the American Philosophical Society, vol. 63, No. 2, which discuss the question of potential equality in the various races of man. In the first, Dr. H. N. Hall maintains that if the test of history be applied to the negro race, and its past examined with the view of predicting its future, it appears that its mental disposition remains unchanged and seems unchangeable. The argument is based upon a study of the culture of the negro and, in this instance, the divine or magical character of the kingship which in Africa, owing to the absence of social or political checks which elsewhere served as a counterbalance to the royal divinity, was incapable of useful development. This was the result of a weakness of will in the negro mind which necessitated the support of a superior. Dr. Goldenweiser, on the other hand, argues that neither physically nor biologically are there any differences in the races of man which permit a grading into a progressive series from the animal upward, as, *e.g.*, in the case of hairiness, which is extreme in the Australian and European, but slight only in the Negro, Mongol, and American Indian; nor has psychology yet furnished any evidence to assist in grading, while the tests of culture, religion, and morality depend upon a bias determined by our own point of view.

POLLINATION AND COMMERCIAL FRUIT GROWING.—Among the many factors that affect the good or bad cropping of fruit orchards, it has become recognised that self-sterility or self-fruitfulness plays a very considerable part. Numerous experiments have shown that comparatively few varieties of the more important fruits are able to produce good crops unless they are cross-pollinated from another variety growing near by, and to this fact the poor cropping power of certain orchards is largely to be attributed. C. H. Hooper, in "Fruit Pollination in Relation to Commercial Fruit Growing" (Fruit Bull. 10, S.E. Agric. Coll., Wye), sets out the analysed results of his own and many other records, the compiled lists affording definite guidance to fruit planters. The smaller soft fruits all appear to be perfectly self-fruitful, but most need the agency of insects to effect cross-pollination from other plants of the same variety, strawberries being almost the only crop which is chiefly fertilised by wind. In the case of apple, pear, plum, and cherry, however, many varieties are unable to mature fruit with their own pollen; every orchard should thus contain at least two varieties flowering at approximately the same time and capable of cross-fertilisation. The difference between the earliest dates of flowering of varieties of the same fruit is considerable, averaging about twenty days for apples, twelve for pears, nineteen for plums, and three weeks or more for cherries. The chief varieties are listed according to whether they are earliest, early, mid-season or late, and an indication is given of the degree to which each is self-sterile or self-fruitful. In addition, examples are given of varieties that have been proved by experiment to fruit well together, and the recommendation is made that if trees of one variety only have been planted, about one tree in eight should be regrafted or replaced by another variety flowering about the same time. For apples, Bramley's seedling is suggested as a specially good variety with which to regraft. The importance of insects in fruit pollination is emphasised, and bee-keeping is recommended for growers with large areas of a certain fruit. Many other factors are recognised as influencing fruitfulness, but the question of imperfect fertilisation of the flower is less usually recognised, and is of sufficient importance to justify special attention being directed to its possible occurrence in cases of persistent poor cropping.

THE PRACTICE OF ENSILAGE.—Silage has now become of considerable importance as a stock food, after a somewhat chequered history, and Amos (Journ. Min. Agric. 31, Nos. 8, 9, 11) outlines the present-day knowledge of the process of ensilage and the methods practised in Great Britain. The quality of silage varies much with the conditions of manufacture, sweet, acid and green "fruity" silage all being recognised as desirable types, whereas sour and musty silage cause much loss, as stock often refuse to eat them. Almost all herbaceous plants, with the exception of those of the cabbage tribe, can be made into silage, though all are not equally suitable. Tares and vetches, mixed with a supporting crop of oats, rye or beans, give most satisfactory results, providing silage of excellent food value, readily eaten by stock. In other parts of the world maize has proved of the greatest value for silage from every aspect, but as it is very sensitive to frost it is necessary, in Great Britain, to select special varieties bred and selected for habits of quick maturity, Saltger's North Dakota and Longfellow being recommended in place of the White Horse Tooth generally grown. Sunflowers, rotation grasses, clovers and meadow grass can all be made into silage when occasion demands, but sunflower silage is less palatable than the others. A silage crop should be cut in a state of maturity rather more advanced than for haymaking, and second crops of seeds may be ensiled just after the corn harvest, maize being left to the last. The best silage results from a crop which is ensiled immediately after cutting, and careful organisation of labour is necessary to attain this end. Care is needed in filling the silo to obtain uniform shrinkage and to avoid undue spoiling and wastage in the upper layers. Various methods are advocated to reduce this wastage, but none seem to be of real economic value, and a suitable cover for the top of a tower silo remains to be invented.

BIG BUD OF THE BLACK CURRANT.—We have referred on two occasions (NATURE, May 26, 1923, p. 719, and March 22, 1924, p. 439) to an experiment being conducted at the Crichton Royal Institution, Dumfries, on the eradication of big bud of the black currant, due to a mite. In 1922 the plot of 400 affected bushes was cut down and thoroughly fired. The bushes made good growth and flowered in 1923, and again in 1924, but failed to fruit, and have shown marked indications of reversion. Finally, last October, 60-80 per cent. of the bushes showed re-infection by the mite (Annual Report for 1924, Crichton Royal Institution, Dumfries, p. 23). The experiment, therefore, which gave much promise of success during the first year, has proved a failure, and the bushes have now been destroyed.

THE CONTROL OF TSETSE FLIES.—In the *Bulletin of Entomological Research*, vol. 15, Jan. 1925, Dr. W. A. Lamborn gives an account of an interesting experiment which he has carried out in Nyasaland. In this instance an attempt has been made to ascertain whether it is possible to obtain some measure of control of the species of tsetse fly, *Glossina morsitans*, by artificially increasing the existing numbers of an apparently promising parasite in the fly area. The parasite is the small chalcid *Syntomosphyrum glossinæ* Waterst. which lays its eggs in the puparia of the Glossina. The resulting larvæ devour the tissues of their hosts, thereby destroying them. The chalcid is a favourable subject for the experiment, since it is a very prolific and rapid breeder, and is readily dealt with under artificial conditions. It has the further advantage of being easily reared from puparia of flesh flies (Sarcophaga) and other Diptera. A stock of this parasite was built up in the first instance from eleven females bred out from a single Glossina puparium. These parasites were introduced to a number of Sarcophaga puparia, and the resulting chalcids were then utilised to parasitise a still larger number of the host. Eventually, a large stock of parasitised puparia were deposited in the breeding places of the tsetse fly, so as to ensure that the emerging chalcids would be liberated in a favourable environment. It was estimated that, on an average, 67 examples of the Syntomosphyrum issue from each puparium, and that more than 277,000 parasites (mainly females) had emerged from the distributed examples. Prior to the experiment the normal parasitisation of the Glossina in the area under consideration was found to be only 0·4-0·6 per cent. In the year following the distribution, the parasitisation had risen to 8·7 per cent. This result, although encouraging, is still a far step from having effected a degree of control of real practical value; nevertheless, it suggests that possibly a still larger output of the parasite might be worthy of trial.

OBSERVATIONS ON BRITISH COCCIDÆ.—Under this title Mr. E. E. Green publishes in the *Entomologist's Monthly Magazine* for February his ninth contribution of the series, on British scale-insects. In the present paper four new species are described and figured, and among them *Kuwania pini* n.sp. is notable as providing the first record of a coccid occurring on pines in the British Isles. *Pseudococcus phalaridis* n.sp. from Frimley, Surrey, is recorded as being preyed upon by the larvæ of a fly which was identified by Mr. J. E. Collin as *Ochthiphila polystigma*. This enemy proved so efficient that, a little later on, the particular colony of the new species of coccid had been practically exterminated. Mr. Green suggests that this fly might possibly prove useful to check the ravages of the allied coccid, *Trionymus sacchari*, upon sugar-cane in Egypt and elsewhere. Among other scale-insects the occurrence of *Eriococcus hoheriæ* Mask. on *Hoheria populnea* in the Scilly Isles is of interest since it is the first record of this insect being found away from its original home (New Zealand). It has doubtlessly been imported with the plants from that country. The many recent additions made to our knowledge of British scale-insects by Mr. Green is but one example of how much work there still remains to be accomplished in working out the more obscure families of the British insect fauna.

LIGIA NOVÆ-ZEALANDIÆ IN SOUTH AMERICA.—Prof. C. Chilton records (*New Zealand Journ. Sci. and Technol.*, vi. p. 287, 1924) the occurrence at Valparaiso of the shore isopod, *Ligia novæ-zealandiæ*, a species which is found also in New Zealand and Juan Fernandez. These isopods carry their eggs in brood pouches under the body until the young are hatched in a form resembling the adult, and hence it is unlikely that they could cross large tracts of ocean. The existence of this species in the three places referred to is held to be additional evidence in support of a former land connexion between them. The shore amphipod, *Orchestia chilensis*, which lives under similar conditions to the Ligia, is also found on the shores of Chile, Juan Fernandez, and New Zealand.

THE DEVELOPMENT OF THE MALE GENITALIA OF HOMOPTERA.—An extensive literature has grown up around the subject of the structure and homologies of the male genitalia of insects. The nomenclature of the different parts is highly involved and it is often extremely difficult to trace their homologies in different orders. In the *Quarterly Journal of Microscopical Science*, vol. 69, part 1, Dec. 1924, Dr. Hem Singh-Pruthi has an important contribution to this subject with particular reference to the Homoptera. In these insects he finds that the male genitalia consist of two pairs of lateral appendages, the sub-genital plates and the parameres, and a median copulatory organ, the ædeagus. They are all borne by the ninth abdominal segment. They develop from two pairs of appendages only, an outer and an inner, which appear as diverticula of the ventral region of the ninth segment. The outer pair develops into the sub-genital plates, and the inner by longitudinal fission becomes two pairs; the inner one of the two pairs so obtained, by the fusion along the median line of its components, forms a single organ, the ædeagus, while the outer is transformed into the parameres. Thus the pair of appendages developing into the sub-genital plates does not belong to the eighth segment, as was believed by Kershaw and Muir, but to the ninth; there are no appendages on the eighth in the nymphs or in the adult; nor is there any evidence in favour of these authors' view that the male gonopore in Homoptera, unlike that in most orders of insects, lies between the eighth and ninth sterna; it is in its usual place, behind the ninth sternum. The sub-genital plates seem to be the coxites of the ninth sternum; and both the ædeagus and the parameres, derived from a primitively single pair of appendages, correspond to the endopodites.

METEOR CRATER, ARIZONA.—A letter to the *Engineering and Mining Journal-Press* for February 7, from Mr. L. F. S. Holland, superintendent with the Company the recent drilling operations of which under the rim of Meteor Crater have aroused widespread interest, prompts us to refer once more to the origin of this puzzling "crater" (see NATURE, February 14, p. 244). Mr. Holland is chiefly concerned in correcting the many false impressions that have been spread abroad by enthusiastic but largely misleading journalism. He confirms the presence of platinum in the

iron meteorites of the neighbourhood, giving the average as one ounce of platinum to five tons of meteorite. An American Sunday paper has published a photograph of an apparently large diamond alleged to have been embedded in an Arizona meteorite. Possibly the magnification was not stated, but the truth of the matter is that, while diamonds do occur, they are invariably of microscopic dimensions. Of more importance is Mr. Holland's belief that the crater can be best explained by the impact of a shower of meteorites. However, he doubts whether the recent boring went far enough to prove or disprove Barringer's latest theory that the main mass of the meteoric shower became embedded under the southern rim at an angle with the surrounding plain.

THE PETROLOGY OF PENMAENMAWR.—The differentiation of the magma which is now represented by the interesting intrusion of Penmaenmawr is discussed by H. C. Sargent in a recent paper (Proc. Liverpool Geol. Soc. vol. xiv., 1924, pp. 82-98) which supplements his earlier work on the various rock-types. Below the 1000-foot contour the rock is a very fresh enstatite-porphyrite with labradorite as the dominant mineral. Above this level the plagioclase becomes less calcic, gradually reaching oligoclase, while quartz and orthoclase, mainly present as micropegmatite, steadily increase upwards. The author ascribes the differentiation to the inhibition of reaction between the earlier-formed crystals and the residual liquid (shown by the existence of zoned felspars), accompanied by the straining-off of the more siliceous and alkaline material in which the volatile constituents would also be concentrated. He considers it is not safe to assume that sinking of crystals has been an important process, as the grain-size shows no marked variation with height. But the process outlined would not provide an upper concentration of quartz and orthoclase unless the other minerals became concentrated downwards, so that relative movement of crystals and residual liquid is logically implied. The influence of volatile fluxes is shown by the increasing turbidity of the felspars as they are traced upwards, by the production of bastite, epidote, and other alteration-products, and by the scarcity of biotite in the higher horizons. It is clearly pointed out that these features cannot be due to weathering. In the upper part of the adjoining Craig Lwyd area hornblende is abundant, but so far no explanation is forthcoming to explain this mineralogical difference. There seems to be a lateral as well as a vertical differentiation, the south-eastern portion being richer in lime and the north-western richer in potash, thus suggesting that the intrusion may have come from the south-east. Part II. of the paper, not yet published, may throw further light on these speculations.

THE AGES OF RADIOACTIVE MINERALS.—The measurement of geological time by methods based on the decay of radioactive substances is now receiving renewed attention in the United States. The National Research Council has appointed a committee under the chairmanship of Prof. A. C. Lane, to investigate the subject, and the committee has performed a valuable preliminary service by issuing a bibliography of the literature by R. C. Wells. In Canada the Geological Survey has assigned to H. V. Ellsworth the task of applying the methods to Canadian problems. A first paper from his pen is now published in the *American Journal of Science* for February 1925, and gives the results of several new analyses, and a valuable discussion of the principles involved. Hitherto it has been found that when thorium is a noteworthy constituent of a series of minerals, the lead-ratios derived from them are too variable to be trusted, and the tendency has therefore been to ignore such minerals in the expectation that sooner or later the discrepancies associated with thorium would be explained. This course has been followed without detriment to the development of the subject, since for uranium minerals in which thorium was not an important constituent the results have been concordant among themselves and with the geological evidence. Ellsworth, however, in calculating the ages of a series of uraninites from the pegmatites of Ontario, has taken thorium fully into consideration with results that are a little more consistent than they would have been had thorium been ignored. The ages vary from 1115 to 1189 million years, with an outside figure based on considerably altered material of 1299 million years. These values agree very closely with those obtained from minerals of Middle pre-Cambrian age occurring in Scandinavia, Africa, India, and the United States. Before any further advance can be made, apart from the accumulation of analyses, it is essential that the half-periods of thorium and uranium should be re-investigated in relation to the possibility of isotopes of the parent elements, and that the genetic connexion of thorium and uranium, if there be one, or has been one, should be disentangled from the conflicting evidence.

VELOCITY OF DIFFUSION, VISCOSITY, AND EXTERNAL PRESSURE.—Messrs. E. Cohen and H. R. Bruins describe, in the *Zeitschrift für physikalische Chemie*, January 20, a new apparatus for determining the viscosity of mercury at high pressures. The ratio of the viscosity at 1500 atmospheres pressure to that at one atmosphere is found to be 1·048, at temperature 20° C. In their previous investigation into the effect of pressure on the velocity of diffusion of cadmium in mercury, at the above temperature, it was found that the ratio of the velocity of diffusion at one atmosphere to that at 1500 atmospheres is 1·051. It follows then that, within the limits of accuracy of the diffusion measurements, the product of the viscosity and velocity of diffusion is the same at one and at 1500 atmospheres. This agrees with the results of previous investigations of the authors, which showed that the velocity of diffusion at atmospheric pressure was inversely proportional to the viscosity, even when the molecules of the diffusing substance and of the medium into which diffusion took place were of equal size.

STARK EFFECT IN METALLIC ARCS.—In the *Japanese Journal of Physics*, vol. 3, p. 45, H. Nagaoka and Y. Sugiura describe an investigation of the Stark effect produced in the electric arc for a number of metals. It was first necessary to stabilise the arc, and this was done by introducing a capacity of more than one microfarad and a large self-inductance between the electrodes, and using a P.D. of 500 volts obtained from a direct current generator. By employing carbon as the cathode and the metal under test as the anode, arcs of 7 cm. in length were maintained with perfect steadiness. The potential changes along the arc were examined, and the electrodes were found to be the seats of strong electric fields due to the presence of an electric double layer which is formed when the current surpasses a critical value. Using a small drop of metal at the anode, fields of the order of 10^5 volts per cm. were obtained, and the Stark effects in these fields were studied. It was found that, with several metals, lines belonging to the same spectrum series were similarly affected, the nature of the change being different for different series, and that the effect increased with the term number.

Mining Research.

THE Executive Board of Mining Research of the University of Birmingham has just issued a report on the work of the Mining Research Laboratory for the years 1921–1924, the report being signed by Dr. J. S. Haldane, who is the chairman of this Board. The report gives an interesting summary of the various researches which are being undertaken, some of which deal with problems of very great importance to the coal industry. Necessarily some of these researches are purely scientific, whilst others are essentially practical, but it is quite obvious that the results of even the first named are likely to find important practical applications. A great deal of work has been done upon the absorption of various gases by coal, and the effect that these phenomena may have upon the spontaneous combustion of coal has been carefully investigated. A certain amount of work has been done on the application of wireless electricity to underground problems, but no definite conclusions appear to have been reached, and the work has, for the present at any rate, been laid aside. A most interesting group of physiological experiments has been carried out by means of an experimental chamber by which it is possible to test the effect of various gases upon men at rest and at work; as the result of these experiments, accurate information as to the effect of carbon monoxide upon those exposed to its influence has been rendered available, and it has been shown that this poisonous gas is absorbed far more readily by men doing work than when they are at rest. Another series of these experiments has tested the suggested new method of treatment for carbon monoxide poisoning as well as for asphyxiation, the value of carbon dioxide for this purpose having been shown by these researches, with which the name of Dr. Haldane is closely associated.

Another set of researches, the ultimate results of which may be of very far-reaching importance, are those upon the discoveries of Dr. Bergius dealing with the hydrogenation of coal. It has been found that when coal is mixed with a suitable liquid such as phenol, and heated to approximately 400° C. in an atmosphere of hydrogen under a pressure of 155 atmospheres for a considerable length of time, hydrogen is absorbed and a quantity of coal, in some cases up to 40 per cent., is converted into an oil-like liquid. The various constituents of coal have been tested, and it is found that clarain and durain are hydrogenated with comparative facility, but that fusain is very little affected. The possibility of hydrogenating coal under these conditions has thus been definitely confirmed, and substantial yields of liquid products have been obtained, though the nature of these liquids has not yet been fully investigated; it is stated that they appear to contain oxygen, and that it is a question yet to be determined whether it is possible to eliminate this oxygen by further hydrogenation and thus to obtain hydrocarbons. Attention is directed to the fact that the behaviour of clarain and durain is approximately the same, and that the liquids obtained by treating these constituents give almost identical analytical results, and it is suggested that this fact would appear to support Prof. Wheeler's contention that clarain and durain contain constituents of similar chemical type. Although up to the present the results obtained by the hydrogenation of coal have a purely scientific interest, it must be remembered that they only represent the initial stages of a very complex investigation, and that it is quite possible that the ultimate outcome of this may produce results of the utmost economic importance.

Researches on the spontaneous combustion of coal have occupied a considerable portion of the work of the Mining Research Laboratory. It will be remembered by those interested that the Mining Research Laboratory of the University of Birmingham was established to continue the work originally started in the Doncaster Research Laboratory, which was established with the definite object of investigating spontaneous fires in the collieries of that district. It is, however, only proper to point out that whilst the investigation was due in the first instance to the necessity for combating the dangers to which the coal of the district was especially liable, the Doncaster Coal Owners' Committee from the outset placed all its laboratory results freely and fully at the disposal of the entire coal mining industry, and took care to publish all the results obtained by its laboratory staff. This work has been continued at Birmingham, and the oxidisability of different types of coal has been recently studied, as also has the liability of the various constituents of coal to spontaneous combustion. The results have clearly shown that fusain is relatively insensible chemically, and that its oxidation is negligible as a source of heat in initiating spontaneous combustion. On the other hand, it is pointed out that bands of fusain, on account of their open physical structure, may play an important part in aiding spontaneous combustion by forming channels through which supplies of air can readily reach the more oxidisable constituents of the coal.

A number of researches, all bearing on the investigation of the oxidation of coal, are being carried on, and it is worth noting that they are being assisted by a grant from the Miners' Welfare Fund, made on the recommendation of the Safety in Mines Research Board of the Mines Department. It is, of course, of the greatest importance to the industry that all the mining research now carried on throughout Great Britain should be co-ordinated by a central authority, not with the view of controlling the work, but mainly to see that no excessive overlapping occurs and to take care that provision may be made for filling up any important gaps in our knowledge which may be left between a number of individual lines of research. It is interesting to note that a number of respirators, most of which have originated in the United States, and are designed to enable men to live for a certain time in an atmosphere of carbonic oxide by oxidising this gas to the relatively innocuous carbonic acid, have been examined, and the results are now being published in the Transactions of the Institution of Mining Engineers.

Finally, we have a group of researches conducted in order to determine the effect of specially hot and deep mines, this work now being carried out in conjunction with a committee of the Institution of Mining Engineers, financed by grants from the Department of Scientific and Industrial Research and the Miners' Welfare Committee on the recommendation of the Safety in Mines Research Board of the Mines Department. Nine reports have already been published as communications to the Institution of Mining Engineers, a form in which they are conveniently available for men engaged in mining operations in all parts of the world. The work is being continued, and there is still a large field open for research.

It will be obvious from this brief summary of the report that the Mining Research Laboratory of the University of Birmingham is doing work of the utmost value to the mining industry; by far the greater part of this work bears directly upon the safety, health, and welfare of men engaged in the coal mining industry.

Diagnosis of Ankylostomiasis.

THE publication before us[1] aims at giving a connected account of copious and careful work already published in the *Indian Journal of Medical Research*, and since in certain instances it is only the conclusions originally drawn which are now reproduced, their validity cannot be estimated except by reference to the original record.

Since all scientific work on ankylostomiasis must rest on accurate diagnosis, great attention is paid to the direct methods by which this is obtainable, namely, to detection of ova and collecting of worms. The former was undertaken mainly by microscopic examination of the centrifugal deposit from a strained fæcal suspension, but partly by a special modification of the commonly used concentrative principle inherent in the employment of a heavy salt solution in which hookworm ova float and other fæcal matter sinks.

For the particular floatation technique described, it is claimed that it loses only 7 per cent. of ova as against a loss of 50 per cent. or more entailed by other methods, the control employed being apparently the first-mentioned technique. Regarding the control, Mhaskar himself finds it inaccurate in that, in the one instance noted, subsequent floating of a counted smear increased the countable ova by 14 per cent. The extraordinary inadequacy of these controlling counts is, however, shown by the reviewer's figures, hitherto undisputed, indicating that the average addition required to this particular form of control is not 14 but more than 30 per cent. He finds, too (the report is now in the press), that in his hands Mhaskar's floatation technique indicates an ovum content from one-tenth to one-sixth of that which another, namely, direct centrifugal floatation, shows to be certainly present.

It is of interest to refer here to a compilation by Dr. Khalil,[2] who advocates a technique embodying yet another modification of the floatation principle, a saturated solution of common salt being used to float up ova in the inverted cone formed by an Erlenmeyer flask, coarse fæcal matter having first been strained off through a fine sieve. Clearly the intention is that the rising hookworm eggs should become concentrated upon a small area, their removal to a small examination area being thus facilitated. The technique is held to ensure detection of mild infections. It is entirely uncontrolled.

Now the only recorded effort hitherto made (by the present reviewer) to control the effects of floatation in an inverted cone showed that the number of ova recovered from the surface was, on the average, one-tenth of those which a control count indicated as present in the fæces employed; and it has since been shown, as noted above, that that particular control underestimated the ovum content by an average of more than 30 per cent. It is not then possible, without evidence offered of the ovum content of the fæces used, to accept as accurate this new gravity floatation method in an inverted cone. Presumption of its inaccuracy lies in the many instances here reported where it detected a solitary ovum, whereas, as the available evidence suggests, there were indeed present some twenty or thirty, detectable by adequate means; and in the fact that while 40,000 examinations by the admittedly inadequate smear or centrifugal precipitation methods showed an infection percentage in different parts of lower Egypt of 48 to 97, that obtained in the one village tested by the new technique was only 16·6.

[1] Report of the Ankylostomiasis Inquiry in Madras. By K. H. Mhaskar. Indian Medical Research Memoirs, Volume No. 1. October 1924.

[2] Ankylostomiasis and Bilharziasis in Egypt. Reports and Notes of the Public Health Laboratories, Cairo, No. 6. 30 P.T.

The particular importance of accurate and controlled examinations in Egypt lies in its being apparently the only country in the world where extensive human hookworm infection is limited to *Ancylostoma duodenale*. It offers, therefore, unique opportunities for determining whether, as, for example, in ovum output and reaction to treatment, ancylostomiasis and necatoriasis differ—whether there be one ankylostomiasis or two.

Regarding diagnosis by collecting the worms passed after the administration of an anthelmintic, Mhaskar failed to find males in a tenth of cases which were passing fertile eggs, and females in 71·6 per cent. of 500 cases, also passing fertile eggs. His conclusion that intensity of infection cannot be gauged by the number of ova found on a slide, though inevitable on his premises, is not necessarily correct.

It is further concluded, without qualification, that betanaphthol thymol and carbon tetrachloride have a fleeting effect on oviposition, their administration rendering diagnosis by search for ova untrustworthy for four days. But the original table, if analysed, shows that in 227 cases treated, 129, or 57 per cent., were not cured; and of the uncured 18, or 14 per cent. only, showed this temporary inability of the diagnostic method employed to detect ova. On the other hand, of the 98 cases reasonably presumed cured (for ova were not found in their stools after the third day) 48, or 51 per cent., showed ova during one or more of the first three days. Clearly all factors have not been considered in drawing these conclusions.

The line of treatment used for tea estate labour illustrates vividly the features of the procedure at present fashionable. In one group of estates there was instituted the popular mass treatment without diagnosis. Betanaphthol was administered by scooping it up in a measured spoon. It was concluded that as regards 50 grain doses for an adult "it is safe, and even a mistake in excess of the maximum dosage advised is not followed by any serious inconvenience; not much care is required in prescribing this drug, nor is any after-supervision necessary." There is no cross reference under this comment to the following incident. On the next set of tea estates, examination of 104 fæcal specimens showed 94 infected. Mass treatment was accordingly administered without further diagnostic examinations. Of 1400 persons treated as described with betanaphthol, 2 died and 37 became gravely ill, with the symptoms of poisoning already described in the *Indian Medical Gazette* by Orme and by Corteling, and for Brazil by Smillie. Two men, that is, died of poisoning by a drug administered for an infestation, of their individual possession of which there is no evidence. The betanaphthol was proved to be chemically pure.

In the matter of prevention, which is of course summed up in the word soil-infection, it is shown that larvæ identified as those of hookworms persisted in trenched nightsoil for 13 to 14 weeks, and in the surrounding soil for 6 to 9 weeks; but it is concluded that larvæ do not migrate from the place of development. Larvæ found in the soil after 16 weeks were held in all cases to be non-parasitic, for it is stated that, apparently in some 14 experiments, counted numbers of these larvæ were placed in a drop of water left lying on the skin of the forearm for half an hour, and that every one of these larvæ was afterwards pipetted off and accounted for.

The valuable work here detailed merits close examination, however much one may feel compelled to dissent from the main conclusions.

CLAYTON LANE.

University and Educational Intelligence.

CAMBRIDGE.—The report of the Appointments Board for the year 1924 presents interesting reading. The number of appointments found for graduates of the University has increased to 400. The chief groups are educational appointments, 123; manufacturing and technical appointments, 103; administrative appointments in commerce and industry, 90; agriculture and forestry, 25; and colonial administration, 16. The board notes a dearth of candidates for the great public services overseas.

The annual report of the General Board of Studies on the progress and condition of certain University departments for the year 1923-24 refers to a number of facts already noted in these columns. A general slight decrease in the number of students in the scientific departments is noted. Sir Frederick Gowland Hopkins points out that the amount available for research from the Dunn Bequest, 2400*l.* per annum, did not suffice to meet the needs of his 40 research workers and that the maintenance of research on this scale had involved his department in financial difficulties. Prof. Seward reports his inability to find money for the stipend of the curator of the Botanical Museum. Prof. Inglis reports that arrangements have been completed for the course for officers of the Royal Engineers to be extended to two years so that these officers would take the Mechanical Sciences Tripos. Prof Dean emphasises the value in the teaching of pathology of its recognition as a subject in Part II of the Natural Sciences Tripos. It has brought the subject from the pass standard of the medical curriculum to the honours standard of the Tripos. Increased accommodation has led to much improvement in the arrangements of the Museum of Zoology, especially in the case of the entomological collections.

Sir Humphry Davy Rolleston, Bt., president of the Royal College of Physicians, has been appointed Regius professor of physic in succession to the Right Hon. Sir Thomas Clifford Allbutt.

EDINBURGH.—At the meeting of the University Court on March 16, intimation was made that His Majesty, on the advice of the Secretary for Scotland, had appointed Dr. John Fraser to be Regius professor of clinical surgery in succession to Sir Harold Stiles, who resigned on March 20.

Leave of absence for May and June was granted to the professor of materia medica to enable him to deliver the Dohme Memorial Lectures at Johns Hopkins University, Baltimore. Prof. Cushny proposes to deal in these lectures with the subject of optical isomers in biology.

The Munro Lectures on anthropology and prehistoric archæology will be delivered by Sir Arthur Keith in May next.

Mr. K. G. Fenelon, lecturer in economics, was appointed in connexion with the educational courses for railway staffs to deliver the course of lectures for 1925–26, the subject being railway economics.

A letter was received from the Forestry Commission stating that the Commissioners had had under consideration the question of mycology in relation to forestry work, that they regarded it as a matter of urgency that a means should be found to combat fungoid diseases, which were causing the department serious loss in its nurseries and young plantations, and that they were prepared to make to the University in respect of the year commencing April 1 next a grant not exceeding 500*l.* for research in this connexion to be carried out by the Botanical Department of the University. The Court welcomed the proposal and concurred in the arrangements suggested.

LONDON.—Keddey Fletcher-Warr Studentships, each of the value of 200*l.* a year for three years, have been awarded to Mr. D. C. Harrison (King's College), for research in biochemistry, and to Dr. N. A. V. Piercy (East London College), for research in aeronautics.

ST. ANDREWS.—At a meeting of the University Court on Friday, March 20, Mr. William W. McClelland, principal lecturer in education in Edinburgh Training Centre and lecturer in the University of Edinburgh, was appointed to the Bell chair of education, the duties of the chair embracing the University lectures in education at St. Andrews and Dundee. Prof. McClelland will also act as Director of the St. Andrews Provincial Committee for the Training of Teachers.

Prof. A. E. Taylor, formerly professor of moral philosophy at St. Andrews, now occupying the chair of moral philosophy at Edinburgh, has been appointed to deliver the Gifford Lectures in the session 1926–1927.

THE governing body of the Northampton Polytechnic Institute, St. John Street, Clerkenwell, E.C.1, is inviting applications for the headship of the electrical engineering department. Particulars of the appointment and forms of application are obtainable from the principal. Completed forms must be returned by April 18 at latest.

A SENIOR lecturer in dental anatomy, physiology, and histology will shortly be appointed by the University of the Witwatersrand, Johannesburg. Particulars and forms of application may be had from the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2. Completed forms and testimonials (in each case three in number) must be sent in by April 11 at latest.

A REPORT on facilities for advanced study and research in the universities and university colleges of England and Wales is published in the March number of the *University Bulletin*, the organ of the Association of University Teachers. The report is the work of a committee comprising the Principal of the University of St. Andrews and nine professors of the Universities of Oxford, Cambridge, London, Leeds, Liverpool, Sheffield, and Bristol, the Imperial College of Science and the University College of Wales. The committee adduces the usual reasons for the improvement of salaries, the lightening of the teachers' load of routine work, and the granting of special leave of absence for the purpose of pursuing an investigation or completing a piece of original work, and states that no teacher should be expected to give more than half his working day to routine University duties. It is suggested that in each territorial region a joint body representing the University and the secondary schools of that region might with advantage be set up for the purposes of such co-ordination of curricula and adjustment of university entrance requirements as would tend to free the universities for their proper work. The institution of research professorships is regarded with disfavour by all the local branches of the association, and the committee agrees that it is not to be recommended as a general policy though useful in special circumstances. Special attention is directed to the policy adopted by the University of Birmingham of maintaining a research fund administered by a joint standing committee. The same number of the *Bulletin* contains articles on library co-operation, examinations, the University of London, and income tax on salary earned abroad—showing that this journal no longer confines itself mainly to recording the activities of the Association of University Teachers.

Early Science at Oxford.

March 30, 1686. Dr. Plot communicated coal from Amrath in Pembrokeshire, which being spit on gave an Ink for writing, as was found true by experiment before ye Society.

March 31, 1685. Mr. President was pleased to give the Society a more full account of his extracting the Root of a Number of 53 places in the darke, by the help of Memory.

Upon occasion of a Discourse at a meeting of the Philosophicall Society at Oxford (March 24, 1684–5) concerning the advantage, which those may have (as to Memory, & the application thereof) who want their sight, Dr. Wallis confirmed it by this consideration, that even we, that have our eye-sight, can yet with more advantage apply our Memory (in matters of intent consideration) by night, in the dark, when all things are quiet, than by day, when sights and noises are apt to divert our thoughts: And gave instance in his application of his own memory, by night, (in performing Arithmeticall operations in great numbers) better, than by day he could have done: and, even by day, we may better do it with our eyes shut, than open.

Having had the curiosity heretofore to try, how far ye strength of Memory would suffice me to performe some Arithmeticall Operations (as Multiplication, Division, Extraction of Roots &c) without the assistance of Pen, & Ink, or ought equivalent thereunto; And finding it to succeed well for instance in extracting the Square Root from numbers of 8, 10, 12, or more places: I proceeded to try it (with successe) in numbers of 20, 30, or 40 places. On December ye 22d, 1669, I had (by night, in the darke) extracted the Square Root of 3 (with cyphers adjoyn'd) continued to ye twentieth place of Decimall Fractions. I did that same night (by darke, in bed, without any other assistance, than my memory) propose to my self (at all adventures) this Number of 53 places

2,4681, 3579, 1012, 1411, 1315, 1618, 2017, 1921,
2224, 2628, 3023, 2527, 2931,

and found its Square Root of 27 places to be

157, 1030, 1687, 1482, 8058, 1715, 2171 feré.

These numbers (having fixed them in my Memory, by repeating the same operation a night or two after) when a friend made me another visit, March 11th following, I did dictate to him from my memory (having not before committed them to writing) for him to write down and examine: And did afterwards write them down myself.

April 3, 1688. Mr. Walker shewed the Society some drop Microscopes, and the manner of makeing them.

Mr. Charlet acquainted the Society of a Cock with three legs, and two anus's at William Greenhill's Esqr. at Abbots Langley near St. Albans.

Several formed Stones were shewed the Society viz. *Cornua Ammonis, Mytiloides, Solenites, Conchites;* several Stones called St. Cuthbert-beads, and other stones exactly of the figure of a Cocks Spur, which, as Dr. Plot related, are only the pointes of those Stones called St. Cuthbert-beads, most of which were found in the Quarries on the side of Wotton-under-hedg-Hill in Glocestershire, as also a great hollow mass of Iron Oar, brought from St. Vincents Rocks near Bristol, which in the concave was beset with hexangular crystalls; as also some masses of Lead Oar. Oar found on Lye-Down near Bristoll, from which it is said they extract Silver in a Cup alle standing under the aforesaid Down.

Upon the sight of which the President acquainted the Society that at Stanton-Prior *Cornua Ammonis* were the natural stones of ye place.

Societies and Academies.

LONDON.

Royal Society, March 19.—Sir William **Hardy** and Ida **Bircumshaw**: Boundary lubrication: plane surfaces and the limitations of Amontons' law (Bakerian Lecture). When the slider has a plane face the coefficient of friction is a function of the load, decreasing as the load increases, until a point is reached beyond which the coefficient is independent of the load. When it has a spherical face, the coefficient is always independent of the load. The coefficient is a measure of the efficiency of the lubricating layer with respect to one variable—the load. Recollecting that the pressure between the bearing surfaces must be very great when the slider has a spherical face, the above results show that with low pressure the efficiency of the lubricant increases as the pressure increases until a limit is reached, beyond which Amontons' law holds. It is probable that, during the first period, when Amontons' law does not hold, the slider is floating on a layer of lubricant the thickness of which is a function of the pressure, whilst in the second period, where Amontons' law holds, all lubricant which can be squeezed out has been squeezed out, and a layer of constant molecular composition has been reached. In the first period friction is adjusted to the load by variations in the thickness of the layer of lubricant, and in the second period by the elastic forces between the atoms.

Linnean Society, February 5.—G. P. **Bidder**: Growth and death. A water-borne organism may grow indefinitely, but swiftly moving land-animals must maintain a relation between their weight and the cross-sectional area of their bones and muscles. Men and plaice before puberty alike show additions to their weight in approximately geometrical progression for equal intervals of time; alike after sexual maturity they show an approximately arithmetical progression. In the plaice the annual increment remains to a great age positive. In man the arithmetical progression shows a difference with negative sign, and from 28 (the age of greatest reproductive fertility) onwards there appears to be a constant net loss of protein material, amounting annually to $(0{\cdot}8 \pm 0{\cdot}15)$ per cent. of its weight at 28. The mechanism of the adult body is set after sexual maturity to a certain annual balance of profit and loss: for water-borne animals this may be a positive increment and life may be eternal; for terrestrial animals the length of life depends on the nearness to equality of profit and loss. A positive annual increment, however small, will eventually bring about death from gigantism; it is not improbable that this has been, and possibly is now, the form of death in some quadrupeds. A negative annual increment, however small, determines a date at which all capital resources will disappear. We die, therefore, as an alternative to becoming giants.

Faraday Society, February 16.—A. J. **Allmand** and V. S. **Puri**: The effect of superposed alternating current on the anodic solution of gold in hydrochloric acid. The only well-known case in which a superposed alternating current is used in technical electrolysis is furnished by the Wohlwill modified gold refining process. Pure gold anodes in hydrochloric acid solution were employed, using direct current alone, and also the same with alternating current superposed. Anode potentials have been measured throughout.—C. H. **Desch** and Eileen M. **Vellan**: The electrolytic deposition of cadmium and other metals on aluminium. Where lightness is of importance, as

in aeronautical work, the deposit should be thin, and the choice of metals is further limited by the tendency of many deposits to detach themselves. Preliminary experiments having shown that cadmium was better in these respects than copper or nickel, an investigation into the best conditions of deposition was undertaken. Other methods of protection are on the whole more useful, but comparison with other metallic coatings shows a great superiority in favour of cadmium, even under the severe test of exposure to a salt spray. The deposit has a pleasing appearance and a good colour.—W. M. **Thornton** and J. A. **Harle**: The electrolytic corrosion of ferrous metals. The most direct way of subjecting a metal to the influence of active moist gas is by electrolysis. Since rust is almost entirely oxide, it is only necessary to make the specimen the anode of a cell containing slightly acidulated water in order to obtain conditions of exposure to moist oxygen which are perfectly under control. Not only have pure metals definite rates of corrosion according to Faraday's laws, but also every ferrous alloy examined has a specific rate of electrolytic corrosion by which it can be identified with certainty. This may prove a basis for a systematic comparison of the behaviour of ferrous alloys under all conditions of exposure which result in oxidation. —S. **Glasstone**: Overvoltage and surface forces at the lead cathode. The addition of ethyl or methyl alcohol, or acetic acid, to aqueous solutions with various hydrogen ion concentrations lowers the surface tension and also the overvoltage. Substances like iso-amyl alcohol, which are sparingly soluble in water and lower its surface tension considerably, cause the overvoltage of a lead cathode first to increase and then to decrease as increasing amounts are added. A complete theory of overvoltage must take into account the surface forces involved in bubble formation.—M. **Shikata**: The electrolysis of nitrobenzene with the mercury-dropping cathode. Part I. The reduction potential of nitrobenzene. Nernst's formula, modified by the adsorption isotherm, was verified in acid and alkaline solutions. An abnormal reduction potential in alkaline solution was found and "neutral salt actions" were observed. The reduction due to the simple deposition of hydrions, and to the ionic splitting of water in neutral solutions, was distinguished by the current-voltage curves. Part II. The influence of the cathodic potential on the adsorption of nitrobenzene. A maximum reduction current followed by a minimum, due to certain potentials, were observed in the reduction of nitrobenzene. The formation of a maximum reduction current was explained by the de-sorption due to the applied polarisation potential of the mercury drops. Observed influences of neutral salts upon the R.P. and on adsorption were explained by the "salting-out" action. The method is applicable to quantitative and qualitative micro-analysis.—J. R. H. **Coutts**: The law of distribution of particles in colloidal suspensions: a note on the specific volume of a gamboge suspension. Measurements of the specific volume of a dilute gamboge suspension, to an accuracy of about 1 in 60,000, verified the assumption made by Porter and Hedges, namely, that no significant contraction or expansion takes place in the formation of such a suspension.—W. W. **Barkas**: On the distribution of particles in colloidal suspensions. The results of measurements made in centrifuged solutions of gamboge, silver and copper, of the sizes of particles given by the formula of Porter and Hedges as compared with the sizes given by the law of centrifuging developed by E. Talbot Paris, are discussed. The same values of the radius are given for copper by the two methods; for silver the radius from the distribution is higher, and for gamboge lower than from the centrifuge. The radius given from the distribution of uncentrifuged solutions is in similar agreement with that given from the rate of fall of the cloud particles by Stokes's Law. If the solution under examination could be effectively shielded from changes in temperature, the determination of the distribution would give an accurate measure of the mean size of the particles in a solution, provided their density was known. Over a considerable range of concentrations, the level at which the distribution is sensibly uniform is quickly reached and the limiting concentration is directly proportional to the number of particles present in the solution.

Royal Statistical Society, February 17.—E. S. **Russell** and T. **Edser**: The fishery statistics of England and Wales. The number of fishermen engaged in the sea industry is about 40,000, and all the waters of the continental slope, from the Barents Sea down to the Atlantic coast of Morocco, are visited by English trawlers in their search for fish, and to the north-westward the waters round Iceland and Faroe are regularly frequented. The value in 1923 of the catch of bottom-living or demersal fish, the great bulk of which is brought in by steam trawlers, was 12,500,000*l*. To this must be added the value of a catch of pelagic or surface-living fish caught mainly by drift nets, which amounted in 1923 to 1,500,000*l*. The principal pelagic fish is the herring, of which more than 3,000,000 cwt. was landed in 1923. Statistics of real value date back to 1886, and marked improvements were made in 1903 and 1906. It is now possible to allot catches to rectangular areas of 1° of longitude by 1° of latitude, and the catch per 100 hours' fishing can be worked out for steam trawlers and certain other classes of vessels. An international system of groups of these rectangular areas has been evolved and is accepted by the nations adhering to the International Council for the Exploration of the Sea.

Royal Meteorological Society, February 18.—Miss L. D. **Sawyer**: The effect of pressure distribution upon London's sunshine in winter. The results were based on an analysis of the pressure types during the five winters ending 1921-22, and the amount of sunshine recorded in different parts of London each day. Near the centre of a depression the average sunshine is less than 0.5 h. per day, and near the centre of an anticyclone the figures are equally poor except with E.S.E. breezes. If the pressure centre is at least two or three hundred miles away, the average with anticyclonic conditions is about two and a half times as great as with cyclonic, while a "neutral distribution" (neither cyclonic nor anticyclonic) is almost as sunny. Records show that Hampstead and Greenwich are both almost as sunny as South Farnborough when the air reaches them before passing over London, but Hampstead loses more than an hour a day with S.E. winds and Greenwich as much or more with N.W. winds.—S. **Chapman**: On the changes of temperature in the lower atmosphere, by eddy conduction and otherwise. For a number of years hourly observations of the temperature of the air have been made on the Eiffel Tower, at the base, the top, and two intermediate heights, *i.e.* of the change of temperature in the lowest stratum of the atmosphere, 300 metres, or nearly 1000 ft. thick. Eddy conduction is not the predominant cause of the temperature changes, and the effect of the remaining (major) cause, probably radiation, is far from being constant with respect to height. The temperature changes wrought by conduction are greatest at midday and small at night; those produced by radiation are greatest soon after dawn (when the air is being heated rapidly) and

in the late afternoon (when the air is cooling).—N. K. **Johnson** and O. F. T. **Roberts**: The measurement of the lapse rate by an optical method. Theoretical expressions have been deduced by various authors connecting the apparent vertical displacement of a horizontal ray with the length of the ray path and the vertical gradient of temperature in the atmosphere. The results of the observations confirm the theory within the limits of accuracy of the measurements. With certain limitations, the optical method affords a practical means of determining the vertical gradient of temperature.

Geological Society, February 20.—J. W. **Evans**: Regions of tension, evidenced by joints, slip-faults, and dykes (Anniversary Address). The different causes of local tension were given, including torsion; but although the latter was found by Daubrée to give systems of fractures at right angles to one another, these might also be produced in any area with maximum and minimum directions of tension. Western Europe is largely characterised by tension towards the south-west, but north-westward tension prevailed in north-western Ireland and north-western Scotland. The south-westward tension appears to represent a slow drift towards the Atlantic "deep" in the Bay of Biscay running north-westwards from Cap Breton, and the north-westward tension seems to represent a drift towards the "deep" trending north-eastwards between Rockall and Ireland. These "deeps" themselves are to be attributed, not to "foundering," but to a drift of the "sial" masses of the Central Atlantic banks to the south-west and north-west respectively.

EDINBURGH.

Royal Society, February 9.—W. L. **Calderwood**: The relation of sea growth to the spawning frequency in *Salmo salar*. From the systematic study of scales of salmon and the calculation of age lengths, the growth of fish which return from the sea to spawn in early life is contrasted with the growth of those which remain for several successive years to feed and grow to a large size without spawning. The first and frequently the second year's growth in the sea determines which habit is followed.—F. J. **Cole**: A monograph of the general morphology of the myxinoid fishes based on a study of Myxine. Part VI. Blood vascular and lymphatic systems of Myxine. The anatomical relations of the two systems and the circulation of the blood from one to the other is described. An extensive true lymphatic system is present as apart from the so-called veno-lymphatics which belong strictly to the venous system. A fourth (cardinal) heart is described. The liver is an hepato-pancreas, the pancreatic tubules being associated with the branches of the portal vein in the liver parenchyma.—Sir Thomas **Muir**: Theory of compound determinants from 1900 to 1920.

MANCHESTER.

Literary and Philosophical Society, February 3.—W. L. **Bragg**: (1) Model illustrating the formation of crystals. When a solution of a salt is evaporated, positively and negatively charged ions, which are at first distributed in the solutions, pack themselves into a regular pattern. A series of electro-magnets hung by long wires represent these ions. They can be charged with opposite polarities by passing an electric current through them. At first they swing about freely in all directions, then as the attractive force increases they group themselves into pairs (molecules), and these pairs pack together to form a regular crystalline body in two dimensions. A slight variation of the experiment shows the difference between acids and bases and the formation of complex acid groups according to the theory of Kossel. (2) Exhibit of diffraction gratings constructed to illustrate the effect of crystals on X-rays. By ruling gratings in which the lines are complex, many of the diffraction effects observed in crystals may be simulated. The gratings are made by taking a contact print from a glass plate ruled with a number of fine lines such as is made for the half-tone printing process. Instead of taking one print, two or more are taken, the plate being moved a very small distance between each exposure, and the times of exposure varied. Thus each line in the grating has several components of different intensities just as each molecule in the crystal is composed of several atoms, all the components or atoms scattering the light or X-rays respectively. Very striking diffraction effects exactly like those got in X-ray analysis are obtained.—R. W. **James** and W. A. **Wood**: The structure of barium sulphate. Examination of the spacings of the different planes shows that the space-group is V_h^{16} and that the unit cell contains four molecules and has the dimensions $a = 8{\cdot}852$ Å, $b = 5{\cdot}430$ Å, $c = 7{\cdot}132$ Å. By examining the intensities of the different spectra it has been possible to place the atoms with some accuracy. The intensities of the spectra of lower order are consistent with the assumption that the SO_4 group is a tetrahedral arrangement of oxygen atoms around a central sulphur atom, the distance sulphur to oxygen being about 1·5 Å. The barium and sulphur atoms lie on the reflexion symmetry planes of the structure which are parallel to (010), and necessarily two of the oxygen atoms lie on these planes also.—E. C. S. **Dickson**: Experimental demonstration of the Magnus effect: principle of the Flettner rotor ship.

PARIS.

Academy of Sciences. February 9.—Charles **Richet**, M. **Öxner**, and J. **Richard**: Cooked food and raw food in feeding fish. An account of experiments carried out at the Oceanographic Institute of Monaco on *Cantharus griseus*. The fish fed on raw meat showed no differences from those fed on cooked meat up to the 50th day, but after that period the former steadily gained in weight on the latter.—H. **Vincent**: The pathogeny and conditions of maintenance of the coli bacillus. The blood of animals immunised against the *B. coli communis* is rich in the antibody, but the urine contains little or none. The immunity does not extend to the kidney or bladder.—G. **Friedel**: Remarks on a recent communication relating to the fatty acids. With reference to a recent note of M. Trillat, the author emphasises that the smectic state as defined by him is very different from the crystalline state, and the term cannot be applied to crystals.—Georges **Giraud**: The generalised problem of Dirichlet; Non-linear equations of m variables.—F. **Defourneaux**: Some applications of electrospherical polynomials to the theory of numbers.—Maurice **Fréchet**: Abstract spaces.—Vladimir de **Belaevsky**: The rupture of the Bouzey dam. The deformations of a reduced model ($\frac{1}{50}$) of the Bouzey dam constructed in xylonite have been studied by an optical interference method. From the results of the measurement the conclusion is drawn that the bursting of the Bouzey dam in 1895 was produced by rending.—Henri **Malet**: The idea of the variation of mass, deduced from the formula of the addition of the velocities taken by itself.—Maurice **Le Besnerais** and Raoul **Ferrier**: The electrical constitution of the ether.—Marcus **Brutzkus**: The realisation of chemical reactions in compressors.—

F. **Croze**: The structure of the line spectrum of ionised oxygen.—B. **Szilard**: A new method of examining the interior of pearls. The pearls, immersed in thick cedar oil, are viewed directly by the microscope. Pearls formed on a nucleus of mother of pearl can be readily distinguished by this method from natural pearls.—Nobuo **Yamada**: Particles from polonium with a long path.—Fred **Vlés** and Edmund **Vellinger**: The physico-chemical properties of gelatin; the rotatory power. The results of measurements of diffusion, multi-rotation and rotatory powers of solutions of gelatin are given, the variable being the hydrogen ion concentration.——**Lespieau**: The glycol CH : C . CH(OH) . CH_2 (OH). This glycol was obtained from the chlorhydrin CH : C . $CH(OH)_2$. CHCl as starting point, through the ethylene oxide CH : C . CH_2—CH_2 (with O bridging). Its formula was established by its combination with phenyl isocyanate and by titration with bromine. It is remarkable as being the first true acetylene derivative failing to give a precipitate with ammoniacal cuprous chloride.—Marcel **Godchot**: Octohydro-phenazine.—Charles **Chéneveau**. The formation of natural dull amber. A transparent pine resin can be rendered opaque by treatment with water at 50° C.; under similar conditions peach and cherry gums do not turn opaque, but swell up and form a gel. During the tertiary period the influence of the temperature of the Baltic regions, then tropical, together with the effect of time, would be sufficient in the presence of water at atmospheric pressure to convert the transparent resin into opaque resin.—L. **Royer**: New observations on the orientation of ammonium iodide by muscovite mica.—Ch. **Lormand**: Analysis of the thermal waters of Chaudesaigues (Cantal).—C. **Dauzère**: The atmospheric vase and the sea of clouds. Observations made at the Pic du Midi.—R. **Kuhner**: The nature of the cystids in the Basidismycetes.—A. **Hée** and R. **Bonnet**: The influence of the dissolved oxygen content of the water on the respiration of submerged plants. For the four species of plants studied (*Myriophyllum epicatum*, *Elodea densa*, *Cabomba caroliniana*, *Elodea canadensis*) the intensity of the respiration was not sensibly modified by variations in the dissolved oxygen in the water between 3 cc. and 24 cc. of oxygen per litre.—E. **Michel-Durand**: Under what form do the tannins exist in Spirogyra? The tannins of these plants are almost completely extracted by acetone and amount to about 3 per cent. of the dry weight. The insoluble tannin compounds, normal in higher plants, are absent from Spirogyra.—Henri **Piéron**: The differential characteristics of the working of the retinal cones and rods.—Jules **Amar**: The stages of vital coagulation.—Jean **Roche**: The respiration of the tissues in avitaminosis and inanition. A recent theory, put forward independently by Hess and Abderhalden, attributes to the vitamins a rôle of primary importance in the mechanism of cellular oxidations. According to this theory, avitaminosis is an impoverishment of the cells in respiratory ferments. Experiments on tissue respiration described have given results in opposition to this theory.—P. **Fredet** and René **Fabre**: Study of the localisation in the organism of the alkyl derivatives of malonyl urea. In injections of diethylmalonyl urea (veronal) and allylisopropylmalonyl urea, it has been proved that these compounds fix themselves selectively on the nervous centres, brain and spinal column.—Mme. **Phisalix**: Autopsy of a reticulated python (*Python reticulatus*) measuring 5·75 metres in length.—Robert **Weill**: The nematocysts and spirocysts of the Cœlenterata. Mode of working and differential characters.—O. **Duboscq** and P. **Grassé**: The parabasal apparatus of the Flagellæ and its signification.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 10, No. 12, December).—H. B. **Wahlin**: The mobilities of the positive ions in helium. The mobility of the positive ion in air decreases if the ion is allowed to "age" before it enters the field in which its mobility is to be measured, due probably to the fact that ions consist of clusters of molecules and not of single charged molecules. A similar result was obtained in helium, but the mobility curves show two definite breaks, due possibly to the presence of two types of aged and two types of unaged ions.—G. P. **Baxter** and H. W. **Starkweather**: The density of oxygen. Little novelty of method is claimed. Three globes were used and weighed by direct comparison with similar exhausted sealed globes. Oxygen was prepared by: (1) electrolysis of dilute sulphuric acid; (2) electrolysis of aqueous sodium hydroxide; (3) heating potassium permanganate; (4) heating potassium chlorate and manganese dioxide. The average value for the density found from the three series of experiments considered most trustworthy is 1·42901 corrected to 0° C. and 760 mm. at sea-level, lat. 45°, and this is also the average for the whole set of 22 experiments, each of which consisted of three determinations. The value generally accepted hitherto is 1·42905. The new density gives the limiting value of the molal volume under standard conditions as 22·415 litres.—C. T. **Brues**: Observations on the fauna of thermal waters. The observations refer chiefly to the thermal springs of the Yellowstone National Park. Characteristic of the conditions are the high temperature, presence of unusual quantities of inorganic salts, deficiency of dissolved oxygen, and excess of carbon dioxide. Plants without chlorophyll exist in water at 70°-89° C., and green algæ at 60°-77° C.; animal life is found in water at 46°-52° C., but is scarce above 40°-42° C. The present fauna includes Protozoa, Arthropoda, Mollusca, and cold-blooded vertebrates, and is generally similar to a brackish-water fauna. This seems to be due to their both deriving from fresh-water organisms.—W. E. **Castle**: On the occurrence in rabbits of linkage in inheritance between albinism and brown pigmentation. A race of rabbits with brown pigmentation of the coat gave 25 per cent. pink-eyed and white-coated young with brown at the extremities (Himalayan albinism). Brown is recessive to black pigment and Himalayan albinism to brown. The two recessive characters are relatively loosely linked in inheritance. Previous cases of linkage in mammals show less than 20 per cent. of crossing over; here more than 40 per cent. occurs.—**E. Hille**: A general type of singular point.—J. W. **Alexander**: Topological invariants of manifolds.—F. G. **Benedict** and Cornelia Golay **Benedict**: (1) The neutral bath and its relation to body heat. Oxygen consumption was used as an index of the basal metabolism of four trained subjects, one woman and three men, first in the laboratory at 15° C. and afterwards in a bath of water at 33°-38° C. (neutral bath used as a sedative in psychiatric clinics). The oxygen consumption of the men showed an increase, while that of the woman was practically unchanged. The bath does not tend to lower the metabolism, and the heat production under these conditions is independent of the heat lost to the environment and therefore of the surface area.—(2) Body posture and minor muscular movements as affecting heat production. Oxygen consumption while standing was about 10 per cent. greater, and while sitting 2-3 per cent. greater, than while lying down. Movements such as raising one arm or crossing the legs at intervals of less than 1 min. also cause increases, and must therefore be proscribed while measuring basal metabolic rates.

Official Publications Received.

University of Illinois Engineering Experiment Station. Circular No. 12: The Analysis of Fuel Gas. By Prof. S. W. Parr and F. E. Vandeveer, Pp. 41. (Urbana, Ill.) 20 cents.

The Use of Fish for Mosquito Control. Pp. 120. (New York: The Rockefeller Foundation.)

British Museum (Natural History). Picture Postcard Set G. 7: Restorations of Extinct Reptiles. Series No. 1. 10 cards in Monochrome. (London: British Museum (Natural History).) 1s.

British Museum (Natural History). Report on Cetacea stranded on the British Coasts during 1923 and 1924. By Sir S. F. Harmer. Pp. 34 +1 map. (London: British Museum (Natural History).) 3s.

International Geographical Union. Report for the period July 1922–December 1924, with Lists of the National Committees and the Statutes, etc. Edited by Sir Charles Close. Pp. 64. (London: Printed by Harrison and Sons, Ltd.)

Geological Survey of Uganda. Memoir No. 1: Petroleum in Uganda. By E. J. Wayland. Pp. 61+4 maps. (Entebbe.) 5s. net.

Agricultural Research Institute, Pusa. Bulletin No. 147: List of Publications on Indian Entomology, 1922. (Compiled by the Imperial Entomologist.) Pp. 42. 7 annas. Bulletin No. 155: List of Publications on Indian Entomology, 1923. (Compiled by the Imperial Entomologist.) Pp. 59. 11 annas. (Calcutta: Government of India Central Publication Branch.)

Catalogue of Indian Insects. Part 4: Trypetidæ (Trypaneidæ). By R. Senior-White. Pp iii+33. 8 annas. Part 5: Nitidulidæ. By S. N. Chatterjee. Pp. vi+40. 10 annas. (Calcutta: Government of India Central Publication Branch.)

Ministry of Finance, Egypt. Survey Department: Geological Survey of Egypt. Palæontological Series, No. 6: Catalogue des invertébrés fossiles de l'Égypte représentés dans les collections du Musée de Géologie au Caire. Par R. Fourtau. Terrains Jurassiques. 1re partie: Echinodermes. Pp. xi+39+5 planches. (Cairo: Government Publications Office.) 5 P.T.

National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended 31st December 1924, to be presented at the Fourth Annual Meeting of Members to be held at the Offices of the Institute, 329 High Holborn, London, W.C.1, on Wednesday, 25th of March 1925, at Five p.m. Pp. 17. (London: 329 High Holborn, W.C.1.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 36: A Short Account of the Statistics of the Sea Fisheries of England and Wales. By T. Edser. Pp. 27. (Copenhague: Andr. Fred. Host et fils.)

Report of the Rugby School Natural History Society for the Year 1924. Pp. 42. (Rugby.)

Diary of Societies.

SATURDAY, MARCH 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Doncaster), at 11 A.M.

MIDLAND INSTITUTE OF MINING ENGINEERS (at Danum Hotel, Doncaster), at 2.15.—Prof. J. A. S. Ritson and W. L. Grassham: Notes on Devices to prevent Overwinding.—J. H. Cockburn: Mines (Working Facilities and Support) Act, Part I., 1923.—Dr. E. W. Smith and F. S. Townend: Manufacture of Coke-oven Coke.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. H. Ashworth: The Nervous System and some Reactions (I.): Of Ciliate Protozoa and Sea Anemones.

MONDAY, MARCH 30.

INSTITUTE OF ACTUARIES, at 5.—R. D. Anderson: Apportionment of a Trust Fund between Life Tenant and Reversioner.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—Informal Discussion on Road *v.* Rail Transport.

JUNIOR INSTITUTION OF ENGINEERS (North-Western Section) (at 16 St. Mary's Parsonage, Manchester), at 7.15.—Informal Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Great Northern Hotel, Leeds), at 7.15.—G. F. Pickering: Examination of Oxidation Products from Fatty Acids and Oleines.—Prof. N. M. Comber: The Laboratory Examination of Soils.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—A. B. Pite: The Architectural Treatment of Ferro-Concrete.

TUESDAY, MARCH 31.

ROYAL DUBLIN SOCIETY (at Royal College of Surgeons, Dublin), at 4.15.—Prof. H. Pringle: The Identity of Vitamin A. The Comparative Effects of Human and Cow Milk.—Prof. J. Wilson: The Variations in the Quantities of Food required by Cattle for Maintenance and Fat Production with various kinds of Rations.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. H. Cameron: Some Forms of Vomiting in Infancy (Lumleian Lectures) (II.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. S. Eddington: The Internal Constitution of the Stars (II.).

ROYAL SOCIETY OF MEDICINE, at 5.30.—Dr. W. Langdon Brown, Prof. Swale Vincent, L. Pugh, Dr. H. Gardiner-Hill, K. Walker, Dr. L. Williams, Dr. H. Crichton Miller, J. E. R. McDonagh, and others: Special Discussion on Endocrine Therapy.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 6.30.—Annual General Meeting.—At 7.—A. Pereira: Personal Reminiscences of the Mount Everest Expedition, 1924.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Annual General Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.15.—Dr. R. Lessing: The Inorganic Constituents of Coal.

HULL CHEMICAL AND ENGINEERING SOCIETY (at Grey Street, Hull), at 7.45.—Capt. T. G. Leggott: Modern Engineering Development.

WEDNESDAY, APRIL 1.

WOMEN'S ELECTRICAL ASSOCIATION (at 26 George Street, Hanover Square), at 3.—Miss M. Partridge: What is Electricity?

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Major A. G. Lee and A. J. Gill: The Leafield Coupled Arc.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—Annual Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—Col. T. F. Purves: The Post Office and Automatic Telephones.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—W. Dickson: Quantitative Estimation of Cotton, Linen, and Wood Fibres in Paper Pulp.—Dr. J. C. Drummond: Vitamins in Bread.—G. D. Elsdon: Proposed Standards for Lemon Cheese. Discussion on the Desirability of Standards for Food Products.—Dr. P. H. Prausnitz: Demonstration of Laboratory Filters made of Sintered Glass and their Various Uses.

ROYAL SOCIETY OF ARTS, at 8.—W. Nunn: Siam: Its Prospects and Possibilities.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Sir Charles Ballance, L. Colledge, and L. Bailey: Some Results of the Experimental Anastomosis of Certain Nerves with Neighbouring Nerves (with Cinematograph Demonstration).

THURSDAY, APRIL 2.

ROYAL SOCIETY, at 4.30.—Prof. H. E. Armstrong: Studies on Enzyme Action. XXIII. The Oxidase Effect and the Phenomena of Oxidation in General. Carbonic Oxide.—N. K. Adam and G. Jessop: An Explanation of the so-called Intertraction Phenomenon between Solutions and the Molecular Significance of Negative Surface Tension.—*To be read in title only*:—Dr. Jane Sands: Investigation of Oxidation in the Blood of Earthworms.—R. Snow: Conduction of Excitation in the Leaf of *Mimosa Spegazzinii*.—Dorothy Adams: Investigations on the Crystalline Lens.

LINNEAN SOCIETY OF LONDON, at 5.—W. C. F. Newton: The Cytology of the Genus Tulipa.—W. R. B. Oliver: Biogeographical Relations of the New Zealand Region.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. H. Cameron: Some Forms of Vomiting in Infancy (Lumleian Lectures) (III.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—T. Thorne Baker: Chemical and Physical Effects of Light (II.): Transmission of Light Images by Electricity.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Ben Greet: Plays for Children.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. M. Sayers and others: Discussion on Electricity Supply Tariffs.—G. Wilkinson and R. McCourt: Electricity Supply Tariffs: Their Simplification by Discrimination.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Watergate House, Adelphi), at 7.30.

CHEMICAL SOCIETY, at 8.—C. S. Gibson and J. L. Simonsen: The Formation of *d*-2:2:4-trimethyl*cyclo*hexan-3-one-1-carboxylic Acid from *d*-camphorquinone.—W. H. Gray: Aromatic Esters of Acylecgonines.

FRIDAY, APRIL 3.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. J. Freeman, Dr. B. Kelly, and others: Discussion on Paroxysmal Rhinorrhœa, or Vaso-motor Rhinitis.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Acromegaly and Allied Disorders of Growth.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Prof. W. A. Craigie: Dictionary Evening.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Annual Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual Meeting) (at 16 St. Mary's Parsonage, Manchester), at 7.—Dr. C. H. Lander: Smokeless Fuel and Oil.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Discussion on Modern Developments of Gas Production.

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

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. W. Tookey: Engineering Contracts.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—E. A. Davies: Ships' Life-Saving Appliances.

ROYAL AERONAUTICAL SOCIETY (Scottish Branch), at 8.—Major G. H. Scott: The New Empire View of Airships and the Practical Possibilities arising therefrom.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Daniel Hall: The Productivity of English Land.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool).—Annual Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St. Mary's Parsonage, Manchester).—Annual General Meeting

SATURDAY, APRIL 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. H. Ashworth: The Nervous System and some Reactions (II.): Of Marine Annelids and Earthworms.

IPSWICH AND DISTRICT NATURAL HISTORY SOCIETY (at Ipswich).—J. Reid Moir: The Antiquity of Man in Ipswich (Presidential Address).

PUBLIC LECTURE.

SATURDAY, MARCH 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Living Animals of the Sea-shore.