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## Intellectual Regimentation.

SIR MICHAEL SADLER has done a good service, "one stroke of faithful work," by envisaging again the question whether teachers should be Civil Servants. The title of this article is one of many happy phrases in his brilliant, if not altogether conclusive, address at the annual meeting of the Assistant Masters' Association. Our present measure of freedom from State control in education, he said, was the possibility of resisting, if the need arose, "intellectual regimentation." Against this important but contingent attribute of intellectual freedom, the primrose path of State control of education appears to lead to rare and refreshing fruit for teachers. One of the *sequelæ* of the Burnham salary scale with its regular increments has been that senior assistant masters and mistresses in secondary schools run considerable risk of being displaced by younger teachers entitled to lower salaries under the scale. It is stated indeed that teachers have been dismissed in this way purely on grounds of economy. In any event, there must be a tendency under existing conditions for the teaching profession to become immobile.

State control of education would offer to teachers security of tenure, fair if not generous salaries and pensions, an impartial system of promotion and transfer. It would secure greater uniformity in the work and organisation of our schools, a higher standard of scholarship and training in the teaching profession, and a stricter discipline. These results have been attained more or less completely in France and Germany, where the influence of the State on education is more "decisive and peremptory" than in Great Britain. English-speaking countries have usually preferred to leave the appointment of teachers in the hands of local boards, corporate bodies, or individual employers.

But with the Labour Party definitely committed to a policy of nationalisation on a large scale, the question of State control of education in Great Britain cannot be regarded as purely academic. Sir Michael Sadler, while expressing his personal preference for our present system, thought the trend during the last five years had been in the direction of State control. Mr. Fisher's Superannuation Act for teachers, for example, was closely modelled on the Civil Service pension system. Further, the finance of public education has in recent years become so chaotic that the magic wand of bureaucratic control may be invoked to produce some sort of order. We must not forget that, two generations ago, under somewhat similar conditions as regards the standard and efficiency of elementary education, Mr. Robert Lowe introduced the system of "payment by results"; a system which its author commended on the ground that the nation would be assured of value for its money. In the present distressing condition of the national finances, the president of the Board of Education may be searching for some empirical solution of our educational troubles which he could commend for the same reason.

If the straight issue be joined between intellectual freedom and bureaucratic control, we have no doubt that in the present temper of the public and of the teaching profession, the decision would be emphatically against bureaucratic control. In the recent educational conferences, the point of view of the teachers on this question was expressed without reservation or ambiguity. The fact is the war has produced a marked mistrust of "regimentation" in any form, mistrust of both its methods and its results. English people, in accord with their history and traditions, will show great caution in adopting any form of organisation which may tend to thwart the free growth and play of personality and the full exercise of political freedom. By ensuring the ninety-nine parts of education which is diligent and orderly routine, we must not stifle the hundredth part, which is art.

This, however, is not to say that the problem of the relation of the State to education does not exist. On the contrary, the question of State control is encountered not only in education but also in other professions such as medicine and the promotion of scientific research, and, more urgently perhaps, in the extensive field of industry. Any advance in dealing with the question in one aspect must affect others and orientate the national mind towards a general solution. We plead, therefore, that the best creative thought of our teachers, men of science, and statesmen should be dedicated to the question of defining the true function of the State in various departments of our national life.

Without attempting to explore the question in all its implications, we would suggest that if in any particular case State control or nationalisation is found to be the best solution of existing difficulties or the best policy for the future, its form should be adapted to special conditions. In teaching and scientific research particularly, spiritual values must be conserved, mechanical methods avoided, and the workers themselves as the real experts must be assured a fair share of direction and control. Some amount of "intellectual regimentation" may be necessary in the fight against ignorance and vice and in attacking complicated scientific problems. But from neither the teacher nor the scientific worker will the best results be obtained if their direction and control come from an authority which they may regard as external, ignorant, unsympathetic, and autocratic. In submitting these observations, we are in no sense attacking the policy of the Labour Party or any other political party. An eminent politician has suggested that we are all socialists nowadays. This is true in the sense that our work is directed in an increasing measure to the good of the community. The question of State control is one of method and machinery rather than of ideal, and should be studied in a cold scientific light, without personal or political prejudices or vituperation.

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## Formalism and Mysticism.

*Tractatus Logico-Philosophicus.* By Ludwig Wittgenstein. (International Library of Psychology, Philosophy and Scientific Method.) Pp. 189. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1922.) 10*s.* 6*d.* net.

READERS of Mr. Bertrand Russell's philosophical works know that one of his pupils before the outbreak of the war, an Austrian, Mr. Ludwig Wittgenstein, caused him to change his views in some important particulars. Curiosity can now be satisfied. The "Tractatus Logico-Philosophicus" which Mr. Ogden has included in his new library of philosophy is a remarkable and strikingly original work. It is published in German and English in parallel pages. It is difficult to appreciate the reason for this, seeing that the author is evidently familiar with our language and has himself carefully revised the proofs of the translation. Also we should have liked to have the Tractatus without Mr. Russell's Introduction, not, we hasten to add, on account of any fault or shortcoming in that introduction, which is highly appreciative and in part a defence of himself, in part explanatory of the author, but for the reason that good wine needs no bush and that Mr. Russell's bush has the unfortunate effect of dulling the palate instead of whetting the appetite. In his penultimate sentence Mr. Russell says: "To have constructed a theory of logic which is not at any point obviously wrong is to have achieved a work of extraordinary difficulty and importance." We agree, but how uninspiring when compared with Mr. Wittgenstein's own statement of aim: "What can be said at all can be said clearly, and whereof one cannot speak, thereof one must be silent."

In fact, when we come to the root of the matter there seems to be little in common between pupil and teacher. When we read Mr. Russell's works we feel indeed that what we can know of the universe is little enough in comparison with what we can never know, but yet he recognises no limit to the logical classification of its constituent entities. Indeed he seems to aim at an exhaustive inventory, at least of classes. Mr. Wittgenstein, on the other hand, makes us feel with Spinoza that our knowledge is limited to two modes of the existence of a being who himself exists in infinite modes.

The Tractatus consists of seven main propositions, six of which admit of expansion and aim at saying clearly what can be said. The seventh admits no expansion. It affirms the limit of what is expressible, the inexpressible, and it acquiesces in silence. In its form, the Tractatus recalls the Monadology of Leibniz; in its content, it approximates, as we have indicated, to Spinoza. Logic is the ladder by which we rise to a vantage-point from which we survey reality, but when we have risen we recognise that the logical propositions which have supported us are in themselves meaningless: we must throw them away in order to see the world rightly, and then, face to face with reality, we find it is inexpressible.

The six main propositions are the rungs in the ladder. (1) The world is everything that is the case. (2) What is the case, the fact, is the existence of atomic facts. (3) The logical picture of the facts is the thought. (4) The thought is the significant proposition. (5) Propositions are truth-functions of elementary propositions (an elementary proposition being a truth-function of itself). (6) The general form of truth-function is (omitting the symbols and substituting the interpretation) that every proposition is the result of successive applications of the operation of negating all the propositions making up any set of propositions, to the elementary propositions. The seeming obscurity of this last sentence may perhaps be removed by a quotation. "The propositions of logic demonstrate the logical properties of propositions, by combining them into propositions which say nothing. In a logical proposition propositions are brought into equilibrium with one another, and the state of the equilibrium then shows how these propositions must be logically constructed."

These six main propositions are not elaborated in the deductive or analytic manner, but it is shown that a number of propositions depend upon them in a way which proves that logic is a constructive process. It will be seen, then, that the Tractatus is not a book to be read cursorily; every proposition will only be understood if the reader succeeds in himself thinking the thought of it. Its appearance is a notable event in the philosophical world and will be received in many quarters as a challenge.

Probably the central point of interest is the meaning which Mr. Wittgenstein attaches to what he calls the atomic fact. Outwardly it appears to agree with what Mr. Russell describes generally as logical atomism, but when we get down to the atomic fact itself, it becomes as different from Mr. Russell's description of the constituent element as the modern scientific conception of the atom is different from the Democritean. For Mr. Wittgenstein the atomic fact is a system. "In the atomic fact objects hang one in another like the members of a chain." Further on he tells us we must not say, "the complex sign *aRb* says *a* stands in relation *R* to *b*"; what we must say is "*that a* stands in a certain relation to *b* says *that aRb*." If we accept this, what is left of the famous theory of relations? Also to Mr. Wittgenstein those well-known nonsense propositions which play so large a rôle in the Russellian logic are nonsense, that is, they are not propositions, they are nothing.

The interest of the Tractatus will doubtless culminate for most students in the mysticism with which it concludes. Pure formalism in logic must mean mysticism in philosophy. "Logic is not a theory but a reflexion of the world." It is transcendent. Logic is language. It is the clear expression of all that is expressible. But when we have said all that is sayable there remains unexpressed, inexpressible, the will, the life, the *that* we live as distinct from the *how* we live. "Of the will we cannot speak." "If good or bad willing changes the world, it can only change the limits of the world, not the facts." Philosophy when it follows the right method and says nothing but what can be said, says nothing which concerns philosophy. Such is the conclusion of this remarkable, thought-provoking book.

There is one serious omission of the editors which at times is embarrassing to the student. Writers are referred to whose special theories the reader is presumed to know, but there are no references to guide him should he wish to consult the originals.

H. WILDON CARR.

## Outlines of Astronomy.

*General Astronomy.* By H. Spencer Jones. Pp. viii + 392 + 24 plates. (London: E. Arnold and Co., 1922.) 21*s*. net.

TO deal in any adequate sense and in an elementary manner with the whole subject of astronomy requires both inclinations and aptitudes which are not altogether common. It is a field in which the greatest success may fairly be claimed for English and American writers. Thus in France, in spite of a genius for scientific romance which serves admirably in an allied and more restricted domain, the pen of Arago has found no conspicuous successor. Similarly in Germany the continued success of "Newcomb-Engelmann" is not merely a tribute to the original American masterpiece, but also betrays a native inability to create a serious rival. In one case we may suspect a natural impatience in tracing detail over a vast region, in the other a lack of that discriminating power which is needed in order to keep the detail in its due subordinate place. A nice sense of proportion and construction is as necessary as a sufficient technical equipment, and modern specialism is scarcely conducive to the combination of these qualities.

In his preface Mr. Jones alludes to the twin difficulties of inclusion and omission. But an author need not be obsessed by such problems in drawing the outlines of a science for the benefit of the uninstructed. His is the right to choose his own material. A critic may insist on orderly arrangement, coherence, and critical accuracy. He may go further and point out that what purports to be a complete picture falls far short of the intended aim, that essential features are lacking. But the author will do well to anticipate these two lines of criticism in a different spirit. The first is universal, and applies to all books as works of art or science. The second is truly pertinent, and yet may be disregarded by the author. For he must draw the picture as he himself sees it, and not as he imagines others will expect it to be drawn. Let it be incomplete or exaggerated, if that cannot be helped, but let it represent a personal view. In this way there is at least more to be gained than would otherwise be lost. It is only thus that a really fresh and graphic delineation becomes possible, and that is not altogether easy in a field where the predecessors have been many and some of them distinguished. Mr. Jones has successfully maintained his independence, and the result will be recognised as conveying a consistent, complete, and just representation of modern astronomy within the assigned limits of space and technical reasoning. A very simple algebraic or trigonometric formula is introduced occasionally, but the arguments, though generally effective, are elementary, and involve little or no formal mathematics. The book is written in a clear and simple style, and the illustrations have been chosen with judicious care.

The last three decades have witnessed a wonderful transformation in astronomy. To the undiscerning eye the progress of the science during the nineteenth century may well have appeared dull. It was then that the foundations were being laid for future advance, and this on two distinct lines. Steady adherence to established methods was laboriously accumulating the material on which notable generalisations and a more critical view of the whole subject could be founded, and at the same time more enterprising spirits were making trial of new methods which, owing to difficulties of technique, were not always immediately productive. It has so happened that the triumph over these difficulties, with the provision of new and powerful instrumental resources, has coincided with the critical discussion for which the stores of existing observations were ripe. The result of this confluence is that a text-book of general astronomy written in the nineteenth century, however excellent at the date of its appearance, could scarcely be brought up to date by any process short of re-writing the whole of it more or less completely.

It is, however, obvious that the foundations of astronomy have been so well and truly laid that the earlier chapters must follow a long familiar track. The landmarks are old, but even here there is some liberty of choice, and Mr. Jones's choice appears both fresh and judicious. A clear preliminary chapter on the celestial sphere shows that the author intends to be serious and not merely popular. It is not evident why the definitions of the ecliptic and celestial longitude and latitude are deferred to a later chapter. The two chapters which treat of the earth are excellent, the topics being well chosen and discussed at such length as to make them really instructive. The statement (p. 42) that twilight is least at the equinoxes is incorrect; in this country shortest twilight falls some three weeks nearer the winter solstice. In the chapter on the moon, which follows, a clear statement of the principal features of the lunar motion is very welcome.

The treatment of the sun naturally introduces the results of more modern work. It is curious that the word photosphere does not seem to occur, and the subtle problem connected therewith is entirely ignored. The subject of eclipses is explained very lucidly in a separate chapter. Here it may be noted that the index is capable of improvement. Thus the Einstein test by the deviation of stars in the field of the sun is described (p. 155), but omitted from the index, and the same thing happens with Janssen's and Lockyer's discovery (p. 130), that it was possible to observe prominences without an eclipse.

As one would expect from the author, the chapter on astronomical instruments is excellent, dealing with the more important modern types in a lucid manner. Astronomical observations are also explained briefly but clearly. A very attractive account of the planets and their systems is preceded by a simple explanation of the main features of planetary motion, and followed by a descriptive treatment of comets and meteors.

The concluding section of the book consists of three chapters dealing with the stars and the stellar system in the light of modern research. Possibly a fuller discussion of the whole of this fascinating subject would have been welcome, but restraint is necessary in a branch where research is progressing at a particularly rapid rate, and within the limits of space assigned it is difficult to see how a better choice of subject-matter could have been made. The subject of photometry receives that attention to which its importance entitles it. On the other hand, radial motions are passed over with little mention. The confusion of Betelgeuse (p. 285) with $\alpha$ Bootis is curious, and other slips will be noticed. The spectroscopic determination of the parallax of $\alpha$ Centauri (p. 330) is due to W. H. Wright (not to Campbell). An argument occurring in the section on short-period variables is quite unsound; it would be just as reasonable to assert that the earth-moon system cannot be binary on similar grounds. But in such matters allowance ought to be made for the need for brevity. The subject of these three final chapters might easily be expanded into a large volume.

It cannot be denied that the book is marred by a number of minor errors. They may be attributed to the want of the author's revision, owing to the recent eclipse expedition of which he was in charge. In passing a book through the press the most zealous and competent editor can scarcely replace the author himself. Certain corrections are called for in the interest of accuracy and for the instruction of the serious student, and will be easily introduced in a later edition. In the meantime, the general reader should find in the present work an interesting review of the methods and principal features of modern astronomy, from which he can gain an insight into its spirit and general trend.

H. C. P.

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## A Text-book of Metallography.

*An Introduction to the Study of Metallography and Macrography.* By Dr. L. Guillet and A. Portevin. Translated by L. Taverner. With an Introduction by Prof. H. C. H. Carpenter. Pp. xvi + 289 + Plates cxvii. (London: G. Bell and Sons, Ltd., 1922.) 30*s.* net.

THE handsome volume before us is the largest general text-book of metallography that has yet appeared in English, and the preface states that the authors have in preparation a still larger treatise, which is evidently intended to deal with the subject very fully. Their presentation is essentially French, and is worthy of the school founded by Osmond and Le Chatelier. In any historical account of the origins of metallography the name of Sorby is necessarily mentioned, but neither the authors nor Prof. Carpenter, who writes an introduction, quite do justice to his remarkable work. Sorby not only devised the method of preparing and examining micro-sections of metals, but he also described correctly and identified the principal constituents of several varieties of iron and steel, and recorded their structures in photographs which leave nothing to be desired in clearness and accuracy. These photographs appeared in 1887, or seven years before the classical paper of Osmond, in which the study was advanced many stages further. Sorby's experiments were actually made, at least with the lower powers, in 1864, but the lack of interest taken in them by manufacturers led him to put them aside until the work of Martens again directed attention to the use of the microscope in the study of metals.

The characteristic feature of this volume by Messrs. Guillet and Portevin is its wealth of illustrations, mostly excellent. The least satisfactory are those showing the process of recrystallisation in cold-worked metals, for which better material is now available. Taken as a whole, however, the plates reach a very high standard. The equilibrium diagram and other theoretical sections are treated briefly but clearly, and more stress is laid on practical applications than is usual in text-books. The physical properties of alloys are only cursorily reviewed, and the experimental determination of changes of volume might well have been described, in view of the fact that dilatometric results are used freely in the account of the special steels. The chapter on mechanical testing describes French machines, and needs to be supplemented for English readers. No fatigue test is included, and the list of etching reagents (awkwardly called "etchants") is rather meagre, and might well be enlarged. The concrete studies of groups of technical alloys are very useful, and bring together a large amount of information, but the section on alloy steels is out-of-date; it is based on the older papers of Guillet, and the important group of light alloys receives little attention.

The most novel feature of the work is the section devoted to macrography. This is actually older in date than microscopical metallography, having been employed by Widmanstätten in 1808 in the study of meteorites. It is not so well known as it should be that Sorby employed "nature-printing" to record the structure of converted bars in 1864, printing from an etched surface by means of printers' ink. This method was extensively used in this country during the war for examining shell and other forgings. The authors do not describe nature-printing, but give a good account of the etching of metallic surfaces for macro-photography, and of the interpretation of the results so obtained. This section is of great value.

The translation is clear and smooth. Proper names have suffered rather badly (Bénédick for Benedicks, Marten for Martens, Brani for Bruni, Carnilley for Carnelley, etc.) but other misprints do not appear to be numerous. As a comprehensive survey of a subject of growing importance, the book is likely to have a wide popularity.

C. H. D.

## Our Bookshelf.

*Gas Manufacture, Distribution and Use: Teachers' Notes for Lessons, with Blackboard Illustrations.* Second and revised edition. Pp. 148. (London: Compiled and Published by the British Commercial Gas Association, 30 Grosvenor Gardens, 1922.)

As may be gathered from the title, the primary purpose of this volume is to place at the disposal of teachers who wish to give lessons on the subject trustworthy information which may be of service to them. In addition, the introduction of a number of simple and clear diagrams is intended to lighten the task of illustrating lessons on the blackboard. The book will serve its purpose admirably. The information is of the right kind, and in the hands of a good teacher, who will naturally select what he wants for his own purpose, should be capable of rendering excellent service.

It would be a mistake, however, to suppose that the usefulness of the book would be confined to those who wish to use it for teaching purposes. As a matter of fact it brings together, and presents systematically, descriptions of gas plants, gas appliances of all kinds, and illustrations of their use such as it would be impossible to consult, so far as we know, in any single work. There is probably nobody in the gas industry, or preparing for it, who would not find this book useful at times, and for the journalist who in the absence of more thrilling themes may be called upon to deal with "the gas peril" it should provide a very desirable substratum of corrective knowledge.

Moreover, the householder who wishes to have a better understanding of the construction and method of operation of the gas appliances which he has installed, or is thinking of installing, will almost always be able to find something pertinent to the questions before him in one or other of the 121 lessons here set out, while in Appendix C, under the head "Gas by the Therm," he will find a clear explanation of this unit of heat as a basis of charge with a summary of the circumstances leading up to the Gas Regulation Act of 1920.

J. W. C.

*The Failure of Metals under Internal and Prolonged Stress: a General Discussion held on Wednesday, April 6, 1921, in the Hall of the Institution of Mechanical Engineers.* Edited by F. S. Spiers. Pp. iv+215. (London: Faraday Society, 1921.) 10*s*. 6*d*. net.

THE general discussion on the failure of metals, organised by the Faraday Society in conjunction with a number of technical institutions, was one of the most successful of the series. The volume containing the papers and discussions is likely to serve for some time to come as the standard source of information on season-cracking and similar defects in worked metals. The phenomenon is a puzzling one, and it was necessary first of all to collect the observations of many workers, whose experience touched the subject at different points, before any attempt at explanation could be made. The metallurgist and engineer, however wide his experience, will probably find much in the volume that is new to him. The very extensive records from Woolwich Arsenal are particularly valuable.

The theory of the origin of season-cracking is still imperfect. The hypothetical amorphous film between the crystal grains of metals is invoked by Dr. Rosenhain and others as the responsible material, but other workers have found the evidence unconvincing, and it is too early to say that any satisfactory explanation of the whole of the facts has been devised. Hardening cracks in steel present a rather different problem, but one so closely related to that of season-cracking as to justify their inclusion in the same volume. Fortunately, the results of recent work are not of academic interest merely, but experiments have shown that the cracking of cold-worked objects may be prevented entirely by annealing at a temperature so low as to cause no appreciable loss of hardness. This result has great theoretical as well as practical importance.

C. H. D.

*Die europäischen Bienen (Apidæ). Das Leben und Wirken unserer Blumenwespen.* Bearbeitet von Prof. Dr. H. Friese. 1 Lieferung. Pp. 112+7 Tafeln. (Berlin und Leipzig: W. de Gruyter und Co., 1922.) 10*s*.

THE name of Dr. H. Friese is well known to students of the Hymenoptera, and his published writings on bees render him competent for a work of this description. His aim is to give a general account of the life and habits of European bees within a compass of about 450 pages, of which 112 pp. are comprised in this first instalment. In some ways the work is scarcely abreast of the times, and it is a matter of surprise to find in the introduction the old Linnean classification of insects still adhered to, with the dragonflies included among the Orthoptera. Bees are regarded as constituting a single family, and the other major groups of Hymenoptera are relegated to a similar status. Furthermore, no outline of the classification of the Apidæ is presented to the reader, which is a distinct drawback. The section devoted to the general characters of bees might well have been longer—it is too brief and elementary to be of much value to the serious student. We note only the barest reference to the salivary glands, respiration system and other organs, although several pages are devoted to an account of the body-hairs, nearly fifty different kinds being illustrated. The author's main aim, however, is bionomics, and it is evident that the remainder of the book, when completed, will provide a trustworthy, well-illustrated dissertation on the habits and life-economy of the insects with which it deals. The seven coloured plates which accompany the present part are composed of original figures. Those which portray the various types of nest structure are among the most attractive illustrations of their kind which we have seen.

A. D. IMMS.

*Morbid Fears and Compulsions: their Psychology and Psychoanalytic Treatment.* By Dr. H. W. Frink. Reprinted from the American Edition. Pp. xxiv+344. (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1921.) 21*s*. net.

DR. FRINK's text-book deals with psycho-analytical treatment and the theories on which it is based. In the introduction, by the late Dr. James Putnam, there is a criticism of Freud's view that the duty of the psychotherapist ends with the undeception of the patient and the dissipation of his symptoms, without any consideration of the use he will make of his newly acquired freedom.

The first four chapters are devoted to a presentation of the theories underlying psycho-analysis, based on purely Freudian doctrines, but abundantly illustrated by the author's own observations and cases. After a description of sexual development, the unconscious and the censorship, the neuroses are considered in detail—the method of their production, their classification and individual psychology. A long description is given of a case of compulsion neurosis and its analysis, which is of considerable value in illustrating the preceding chapters on theory.

The book is evidently intended for, and will appeal most to, the student who has some acquaintance with psycho-analysis, and is desirous of extending his knowledge on the subject.

*Reinforced Concrete Simply Explained.* By Dr. Faber. (Oxford Technical Publications.) Pp. 77. (London: H. Frowde and Hodder and Stoughton, 1922.) 5*s.* net.

A VERY clear and simple account of the elementary principles of reinforced concrete design is given in Dr. Faber's book, and it will be found suitable for those who wish to have the knowledge required for the design of simple structures which will be safe, but not necessarily the last word in economy. The book covers the ground required for beams, slabs, and pillars. Both shearing and bending are considered in connexion with beams, and the effects of fixing the ends and of continuity are clearly explained. The design of pillars also includes a simple treatment of the bending moments communicated to the pillar by beams which are integral with it. There are very few blemishes, and these are of a minor character only, *e.g.* on p. 33, Fig. 7, the lower arrow for the dimension *d* is misplaced. On the whole the book is the soundest production of an elementary character which we have yet seen, and will be very useful to students of engineering who have to acquire a knowledge of reinforced concrete among other subjects in their course.

*Memoirs of the Geological Survey: England and Wales. The Geology of the London District.* (Being the Area included in the Four Sheets of the Special Map of London.) By H. B. Woodward. Second edition, revised, by C. E. N. Bromehead; with Notes on the Palæontology by C. P. Chatwin. Pp. vi+99. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1922.) 1*s.* 6*d.* net.

THIS new edition of the brief general geological guide to the London District, issued at a moderate price, will be of interest to thousands of citizens who spend their daylight leisure in rambles beyond London's fringe. The nature of the ground below the city is well brought out; but the four sheets of the one-inch map covered by the memoir also include pleasant fields where the outcrops of the strata may be traced. The description of the gravels shows how much may be learned from material excavated in the urban areas, when this is correlated with the terraced deposits of the Thames valley as a whole. The description and classification of stone implements is brought well up-to-date.

G. A. J. C.

*Lecture Demonstrations in Physical Chemistry.* By Dr. S. van Klooster. Pp. vi+196. (Easton, Pa.: The Chemical Publishing Co.; London: Williams and Norgate, 1919.)

DR. VAN KLOOSTER has brought together a number of experiments suitable for lecture demonstrations in physical chemistry. These experiments, to the number of 253, include, in addition to the more obvious experiments such as the determination of molecular weights, a series of thirty experiments on colloids and adsorption, some eighteen experiments on actino-chemistry, and conclude with a short series of experiments in which liquid air is used. When physical chemistry is taught to advanced students, lecture demonstrations are often regarded as superfluous; but with the growing importance of the subject the demand for suitable illustrations is likely to increase. The volume before us will, therefore, be welcomed by many teachers who will find it a considerable help in introducing experimental demonstrations into their lecture courses.

*Manual of British Botany: Containing the Flowering Plants and Ferns arranged according to the Natural Orders.* By C. C. Babington. Tenth edition, with amended Nomenclature and an Appendix. Edited by A. J. Wilmott. Pp. lvi+612. (London: Gurney and Jackson, 1922.) 16*s.* net.

IN this edition Mr. Wilmott has endeavoured to bring the names up-to-date; and on the vexed question of nomenclature has, so far as possible, cited the author who first gave to the name employed the connotation expressed in these pages. In the appendix have been inserted the more important revisions of genera (*e.g.* Moyle Rogers "Conspectus of the Rubi"), additional species, and, in places, important information connected with the main body of the work; the inclusion of all varieties now accepted—many of which were deliberately rejected by Babington—having proved impossible. For its size and weight ($7\frac{1}{2}$ oz.) the manual might be deemed expensive; but it has a value possessed by no other for the serious student of the British flora.

*Le Mouvement scientifique contemporain en France. No. 1. Les Sciences naturelles.* By Dr. G. Matisse. (Collection Payot. No. 10.) Pp. 160. (Paris: Payot et Cie., 1921.) 4 francs.

THOSE desirous of keeping touch with the recent work of French biologists, but unable to consult the original memoirs, will find here useful epitomes of the results and views of some of the more prominent workers. The first chapter is devoted to Lacaze-Duthiers and the Roscoff laboratory. The subsequent chapters contain summaries (i.) of the work of Yves Delage and Bataillon on heredity, artificial fertilisation, etc.; (ii.) of Houssay's experiments in dynamic morphology, in which those dealing with the shapes of fish are of especial interest; (iii.) of the results achieved by Cuénot, Bohn, and Réné Quinton in their several fields of research; and on the botanical side (iv.) of Chauveaud's work on plant development and transitory tissues; Molliard's investigations of the structural effects of artificial nutrients, and of parasitism; and Matruchot's cultivation of basidiomycete fungi from the spore to maturity.

## 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.*]

### On the New Element Hafnium.

THROUGH the courtesy of the editor of NATURE we have been able to see an advance proof of the letter of MM. Urbain and Dauvillier (NATURE, February 17, p. 218), and are glad to have the opportunity to add the following comment:

Our main reasons for believing that the element celtium, the detection of which was announced by Urbain in 1911, is altogether different from the element detected by us and named hafnium, are:

1. Celtium and hafnium show very great differences in their chemical properties. While we have found no difficulty in purifying hafnium preparations from contents of rare earths, the separation of celtium from the rare earths was found by Urbain to be so difficult, that although the detection was announced in 1911, only samples of small concentration have been obtained up to the present time.

2. It has not been possible by means of highly concentrated hafnium preparations to reproduce the characteristic optical spectrum ascribed by Urbain to celtium, and which, together with an investigation of the magnetic properties of his preparation, was the basis of the announcement of the discovery of this element. The result of a closer investigation of the optical spectrum of hafnium will soon be published.

3. The X-ray spectrum of a preparation containing a percentage of an element high enough to measure magnetic properties should show the characteristic X-ray lines of this element in great intensity, altogether different from the exceedingly faint lines found by Dauvillier. Quite apart from the possibility of accounting for these lines as due to a higher order spectrum of other elements, it seems to be very unlikely that these lines should be due to a contamination of Urbain's preparation by a trace of hafnium. Not only as stated in our first letter (NATURE, January 20, p. 79) they do not coincide within the limit of experimental error with our measurements of the wave-lengths of the hafnium X-ray lines $L_{\alpha_1}$ and $L_{\beta_2}$, but also the reason given by Dauvillier for not detecting the line $L_{\beta_1}$, which is stronger than $L_{\beta_2}$, can scarcely be maintained. In fact, our measurements for this line give a value which differs about 3 X-units from the Lu-line denoted by Dauvillier as $L_{\beta_2}'$, and with the dispersion used it should be easily separated from the latter line.

As stated in our letter in NATURE of February 10, p. 182, hafnium appears in large abundance in zirconium minerals, and we estimate the hafnium content of the earth's crust to be more than one part in 100,000. In the meantime we had the highly interesting information from Prof. V. Goldschmidt in Christiania, that in an investigation of zirconium minerals, in collaboration with Dr. Thomassen, he has discovered a mineral in which hafnium is a main metallic constituent. This has been verified by an X-ray investigation in this Institute of a sample kindly sent to us by Prof. Goldschmidt. On the other hand, an investigation of certain preparations extracted from a titanium mineral from New Zealand and kindly sent to us by Dr. Scott did not reveal any hafnium line. Taking the sensitiveness of the method into account, this mineral cannot contain appreciable amounts of hafnium.

The question discussed by MM. Urbain and Dauvillier which elements are to be ascribed in the family of rare earths, has hitherto been a matter of pure definition. The recent development of the theory of atomic structure, however, has given the question involved an entirely new aspect. The appearance of a group of elements in the 6th period in the periodic table exhibiting very similar chemical properties but quite different magnetic ones could be explained by Bohr on the basis of the fundamental principles of the quantum theory (for particulars cf. Bohr's Nobel lecture, shortly to appear in NATURE). For this atomic theory the properties of the elements in the 6th period of the periodic table have therefore become of great importance. The stimulus to our present investigations was provided by the great difficulty of reconciling this theory with the results announced six months ago by Dauvillier and Urbain. In fact, the existence of an element with atomic number 72 and the chemical properties ascribed to celtium cannot be reconciled with the theory. Our confidence in the theory, however, has been amply justified. For by following up the theoretical deductions we have been led to detect a new element, which is the proper analogue of zirconium and with atomic number 72, present in considerable abundance in the earth's crust. This confirmation of the theory was the deciding factor in our choice of the name hafnium for the new element.

D. COSTER.
G. HEVESY.

Copenhagen, February 9.

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### Hafnium and Titanium.

THE black iron sand from New Zealand examined by Dr. Scott in 1915 in which, as he informed the Chemical Society at its meeting on February 1, he found a substance which he is now inclined to regard as probably identical with an oxide of the new element recently discovered by Dr. Coster and Prof. Hevesy of Copenhagen, and named by them hafnium, was doubtless similar in character to the deposit observed to occur in the bed of a rivulet at Tregonwell Mill, near Menaccan, in the parish of St. Keverne, Cornwall, and also in a stream at Lenarth, in the same parish, and in which the Rev. William Gregor, the minister of that parish, who analysed the deposit in 1789, first detected the existence of the element now known as titanium.

The Cornish mineral, a titaniferous iron sand of variable composition, was known mineralogically as menaccanite, and the new element was consequently termed menachin. Similar deposits occur in other parts of the world, and, in fact, are widely distributed. Their characteristic constituents are known variously as ilmenite, iserine, thuenite, hystatite, washingtonite, crichtonite, etc.; the results of analyses of them by Mosander, Marignac and Kobell are to be found in Greg and Lettsom's "Mineralogy," and a list of localities in which they occur is given by Dana. Their composition is very variable, the amount of titanic acid, for example, ranging from 22·2 per cent. to 46·9 per cent. They are all essentially iron titanates, associated with variable amounts of oxides of iron, and, occasionally, of manganese and other substances.

The name titanium was given to the element by Klaproth as the result of his detection of it in rutile and ilmenite, and in ignorance, apparently, of Gregor's prior discovery, although this was announced in Crell's *Annalen* of 1791. Klaproth's experiments were confirmed by Vauquelin and Hecht in 1796. Klaproth subsequently examined menaccanite, and found that menachin and titanium were identical.

The atomic weight of titanium was made the subject of investigation by Rose in 1823, and again in 1829; by Mosander in 1830; by Dumas in the same year; by Pierre in 1847, and by Demoly in 1849. The methods employed were not identical, but they usually depended upon the analysis of the tetrachloride, which was held to be sufficiently purified by fractional distillation. The results were extremely discrepant, far more so than could be explained by ordinary analytical errors. The values for the atomic weight of titanium ranged from 47 to 56. The determinations have been discussed by Becker, and, independently, by Clarke in the "Smithsonian Collections," and also by Meyer and Seubert. Clarke contents himself with remarking that the atomic weight of titanium is "imperfectly determined," and Meyer and Seubert place *a* titanium in the list of those elements of which the value is uncertain to within several units.

Pierre's determinations made on the tetrachloride were long regarded as the most trustworthy, and his final value 50·25 was adopted in all atomic weight tables prior to 1885.

The position of titanium in the table drawn up by Mendeléeff, in accordance with the requirements of the Periodic Law, was discussed by him on the occasion of the publication of his famous memoir, when he pointed out that the "law" indicated that its accepted atomic weight, based mainly upon Pierre's work, was at least two units too high (see his "Principles of Chemistry," vol. ii. p. 26). A redetermination made upon the carefully purified tetrachloride and tetrabromide proved that Mendeléeff's prevision was correct (Thorpe, *Journ. Chem. Soc.*, 1885, 47, 108), and the value 48·1, then ascertained, was accepted by the International Committee, and finds its place in all recent atomic weight tables.

That there was an undiscovered element associated with titanium in its various naturally occurring compounds has long been surmised. It is almost impossible to escape the conviction that the extraordinarily discordant values for the atomic weight of titanium obtained by the several chemists above referred to are in all probability to be explained by the presence of an element of higher atomic weight in the material investigated by them. Mendeléeff, in the course of conversation with me, more than once expressed his conviction that a diligent search among naturally occurring titaniferous compounds, or among minerals belonging to the same group of elements as titanium, would be rewarded by the discovery of such an element.

T. E. THORPE.

Whinfield, Salcombe, South Devon.

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**Insulin.**

SIR WILLIAM BAYLISS's article in NATURE of February 10, p. 188, displays an attitude of friendly criticism towards the Medical Research Council's policy, in expressing their willingness to accept assignment of the insulin patent from the University of Toronto. The fact that an observer so sympathetic, and having so many opportunities of ascertaining the true nature of the position, should give expression to doubt and disquiet, may well arouse misgiving in a wider circle. There are several points concerning which he is clearly under a misapprehension.

(1) Sir William Bayliss, in stating that "there is a strong feeling here"—*i.e.* in this country—"against patenting products of value in the cure of disease," makes an assumption which seems scarcely justified by the facts. I think his statement is wider than his intention. It can hardly be maintained that such feeling is general, in face of the fact that practically every new remedy obtained by synthesis in the chemical laboratory is not only patented, but exploited for the profit of the discoverer or his employers. Sir William Bayliss is probably thinking only of remedies discovered in physiological or pathological laboratories, the patenting of which has, indeed, been discouraged by the facts that such remedies are usually invented by qualified members of the medical profession, with a wholly honourable tradition against secrecy and monopoly, and that their protection by sound patents is, in any case, difficult. It is, however, not logical that we should look askance at one chemist, who patents a process for extracting a hormone, even if he does it for personal gain, and regard with approval another, who makes a large fortune by patenting the synthesis of, say, a new hypnotic.

(2) It is, however, not necessary, in the instance under discussion, to consider the propriety of patenting remedies for gain. Sir William Bayliss's introduction, in this connexion, of the question of rewards for medical discoverers is really quite irrelevant. Whether the University of Toronto expects to make profit out of the patent is a question for its authorities to answer. I am quite certain, however, that, if profit is made, it will not go to the remuneration of the discoverers, but to make good the heavy expenditure in which the insulin investigation has involved the University, and to make provision for further research upon it. The Medical Research Council, I am confident, will make no profit at all from their action in accepting assignment, not even to replace the money they are spending to make this remedy available and to promote investigation of its properties.

(3) The question of profit being excluded, it is obvious that the Council's action could have no other aim than to assist the public in obtaining the remedy under the best possible conditions, and to prevent the dangers and difficulties which might arise if the preparation were left at the mercy of unrestricted commercial exploitation. Sir William Bayliss sees an easy way to secure these ends. "Would not," he asks, "the best way to effect these objects be to announce that the Medical Research Council were prepared to test and certify preparations sent to them?" He sees himself that this might involve "a large amount of work," and suggests large batches and the delegation of testing to firms having facilities. He may be assured that these possibilities have not been ignored; but it must also be said that he does not begin to see the real difficulties. It will suffice to mention one, which is easily overlooked from the arm-chair of the study, or even from the stool of the academic laboratory. The supply of raw material is not unlimited; it is by no means certain that it will prove adequate to the need of sufferers in this country, even if all of it is properly used. The ordinary methods of commerce would involve a vigorous competition for the material, with no guarantee against the purchase of a large part of it, or even the whole, at artificially exalted prices, by firms concerned only to take advantage of the popular excitement, by selling, at high prices, something which could be represented as "Insulin."

Does Sir William Bayliss seriously suppose that such a situation could be met by a friendly offer to test anything calling itself "Insulin," prepared by any one regarding himself as competent, or wishing to have his share in exploiting a public clamour? Given that the enterprise can be confined to firms possessing the necessary equipment of plant and scientific staff, and that they will agree not to raise the price of the raw material artificially by competition, or of the finished product by combination, there is everything to be said in favour of encouraging them to carry out experiments and improve the process. It is possible also to hand on, to firms accepting such conditions, all information, from any source, which can accelerate production and improve the product. This is, and always has been, the policy of the Medical Research Council. But such a policy has only been made possible, in the existing state of the law, by the Toronto application for patent and the Council's consent to accept assignment.

(4) The most surprising, and the most serious, misunderstanding of the position is revealed by Sir William Bayliss's statement, that "the necessity for any laboratory being unable to do this," *i.e.* to carry out research on insulin—"except by arrangement with the patentees does not seem desirable." I agree that it is not desirable; but the alleged inability is quite imaginary. No such permission is required, but many have sought and have been given help, and many more have received help without seeking. Sir William Bayliss will be familiar with the custom current among scientific workers, of maintaining a certain reticence with regard to work which is unfinished or results which are still in doubt, and even of asking others to keep clear of a certain problem for a time, to avoid duplication. I can state with confidence that, even in that restricted and legitimate sense, there has been no attempt on the part of the Council, or of those working for them, to keep any kind of secrecy or monopoly in this field, so far as pure research is concerned, uncomplicated by questions of personal gain.

In my own department, the whole of our knowledge of this subject has been put freely at the disposal of other pure research workers—not only what has come to us in connexion with the patent, but what has resulted from our own investigations. Sir William Bayliss acquits the Council of "any desire whatever to obstruct such research." I think he might safely allow himself to go a little further, and recognise that their policy in this matter, and its interpretation by those working for them, has resulted in a quite unusual freedom of assistance to research, with both information and material.

H. H. DALE.

The National Institute for Medical Research,
Hampstead, February 12.

### Multiple Resonance.

SIR RICHARD PAGET'S skilfully demonstrated lecture at University College on October 18, 1922, the substance of which is given in NATURE of January 6, is not less interesting as giving a very simple account of the nature and formation of speech sounds, than as showing how far-reaching and diverse are the applications of "multiple resonance" in acoustics.

Boys (NATURE, vol. 42, p. 604, 1890) made use of a special kind of double resonator in constructing a very sensitive form of "Rayleigh disc," and Rayleigh extended his theoretical consideration of double resonators given in his "Theory of Sound," vol. ii. p. 190, to show that "the condensation in the second resonator may be made to exceed to any extent that in the first, by making the second resonator small enough" (Rayleigh, *Phil. Mag.* xxxvi. 231-4, 1918).

Following some preliminary experiments by Prof. Callendar and Major Tucker in 1918, Capt. E. T. Paris employed the double resonator for the purpose of increasing the sensitivity of the hot-wire microphone originally devised by Major Tucker and also of extending the range (in pitch) of maximum sensitivity.

For a single resonator the response curve is a sharp peak, but with a proper design of double resonator the two peaks (characteristic of such resonators in general) may coalesce, so to speak, into what is practically one broad flat-topped peak. In the accompanying diagram (Fig. 1) the dotted line gives a typical response curve for a single resonator, and the full line is typical of the curve obtained when a resonator of suitable proportions is added, to form a double resonator.

Paris has shown how the form of the resonance curve can be varied with tuning of the component resonators, from equal response to each of the two natural tones, to the case of much stronger response to one than the other. The double resonator of Boys appears to have been of the latter kind. "A doubly-resonated microphone of the type described may be

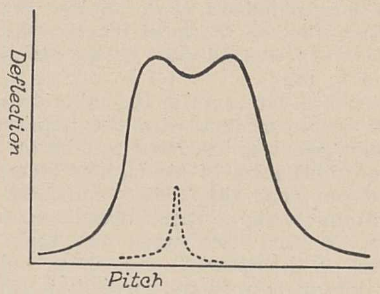


FIG. 1.

more than a hundred times as sensitive (to one of its resonant tones) as a suitably tuned singly resonated microphone with an aperture similar to that of the inner resonator" (E. T. Paris, Proc. Roy. Soc. A, vol. 101, 1922).

The present writer, independently, developed a form of *multiple* resonator to provide a recording system for the Gramophone Co., Ltd., Hayes, Middlesex, having a uniform response over a very wide range—namely four octaves. For so wide a range (129 to 2069 vibs./sec.) the source of sound was a series of stopped diapason, wooden organ pipes, giving fairly pure tones of uniform intensity as judged by the trained ear. The amplitude of vibration of the diaphragm—or of the point of the wax-cutting needle—was observed by means of exceedingly small mirror attachments, the best of which was similar to D. C. Miller's "phonodeik" (Miller, "Science of Musical Sounds," Macmillan). It was possible so to adjust the ten to twenty components of the multiple resonator that the response curve (plotted amplitudes against pitch) would conform very closely to a curve such as that determined by the theoretical constant intensity relation, $a^2 n^2 =$constant, without a serious loss of sensitivity.

A resonator of simple form with yielding walls is a double resonator. Rayleigh, on the suggestion of Clerk Maxwell, considered the case of a sphere with non-rigid walls (Phil. Trans., 1871, p. 87) and showed that it has two natural periods, being a system of two degrees of freedom, like an ordinary double resonator. Similarly, a rigid resonator of conical form with a diaphragm mounted at the narrow end is a double resonator, and so we get an explanation of the fact that the octave interval between the first and second partials for the conical resonator alone, is increased by as much as a tone if the natural frequency of an attached diaphragm falls between the frequencies of the partials.

Multiple resonance will perhaps account for the remarkable evenness of response and the characteristic quality of tone given by the resonating body of good violins. Helmholtz ("Sensations of Tone," 1885 edition, p. 87, Ellis translation) found two tones of greatest resonance on a violin by Bausch, one between 264 and 280, and the other between 440 and 466 vibs./sec., when he tested it by placing the ear against the back of the violin and playing a scale on the pianoforte. Ellis (*loc. cit.* footnote) gives details of elaborate tests made by sounding tuning-forks over the ∫ holes of a number of the best and oldest violins. There were at least two maxima in all cases, but the best specimens gave almost equal response to his forks from 240 to 560, and in the case of Dr. Huggins's Stradivari of 1708, described as one of the best Stradivari, "every fork was more or less reinforced; there was a subordinate maximum at 252; a better at 260-268 vib.; very slight maxima at 312, 348, 384, 412, 420, 428 (the last of which was the best, but was only a fair reinforcement), 472-480, but 520 was decidedly the best and 540 good. No one fork was reinforced to the extent it would have been on a resonator properly tuned to it, but no one note was deteriorated."

The peculiar shape of the body of a violin is such as to give double resonance even if the walls were rigid. Taking into account the vibrations of the wooden walls as well, we have a multiple resonator which will no doubt give an even response over a wide range in the best violin.

Just as Sir Richard Paget's double resonator modifies an artificial larynx to give vowel sounds, so the multiple resonator—the violin body—determines the valued quality of tone of the violin.

Multiple resonance gives promise of being a very fruitful field of research in acoustics.

P. ROTHWELL.

Signals Experimental Establishment,
Woolwich Common, S.E.18,
January 15.

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### Destruction of the Polarisation of Resonance Radiation by weak Magnetic Fields.

THE earlier studies of the resonance radiation of mercury vapour in exhausted quartz tubes by one of the present writers showed no traces of polarisation, even when the exciting light was polarised.

Recent experiments by Lord Rayleigh apparently indicated that polarisation existed in that part of the excited column at some little distance from the window at which the beam entered; in other words, when the excitation was produced by light from which the core of the 2536 line had been removed by absorption. This observation was not verified in experiments made by one of us last spring and published in a recent number of the *Philosophical Magazine*. The polarisation was found to be strong and of uniform percentage right up to the window at which the beam entered.

On commencing a further study of the phenomenon we found it impossible to produce as strong polarisation as was indicated by the earlier experiments, and after varying the conditions in every conceivable manner we finally found that the disturbing factor was the magnetic field of the earth, the polarisation rising to a very high value (90 per cent.) when the magnetic field of the earth was compensated by a large solenoid carrying a feeble current. In the absence of the solenoid the percentage of polarisation dropped to fifty or less.

This appears to be a new magneto-optic effect, and is manifested only when the magnetic field is parallel to the magnetic vector of the exciting light and perpendicular to the beam of exciting rays. A field of only five or six times the strength of the earth's field practically destroys the polarisation. Discrepancies found previous to the discovery of this effect were due to the fact that in some cases the apparatus faced north and south, and in others east and west. Lord Rayleigh's observation was doubtless due to the stray field of the electro-magnet which was used to flatten the discharge against the wall of his quartz lamp.

R. W. WOOD,
ALEXANDER ELLET.

Baltimore, Jan. 25.

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### Volcanic Activity in Iceland and Long Distance Transport of "Dust."

WITH reference to the communication on this subject made by Prof. Grenville Cole to NATURE, November 11, 1922 (vol. 110, p. 635), the following additional remarks may be of interest.

In the *Deutsche Fisherei Zeitung* for November 14, 1922, occurs a note which may be summarised as follows: A Geestemunde steam trawler, the *Tyr*, while returning from her last trip to Iceland, experienced a fall of ashy material on her deck. This occurred while at a distance of at least 400 sea miles from Iceland. It is stated that the material was doubtless from Hecla, and though no date of the occurrence is given, it is known that the vessel made Geestemunde on October 25. A communication from the British Consul at Thorshavn also deals with this matter, and reads as follows:

". . . beg to inform you that on October 6 this sandstorm was observed on these islands. The weather was fine that day, but clouded, and the sky had a red-grey colour, and I remember the feeling of getting fine sand in my eyes while being in a rowing boat that morning, and going home to lunch my wife showed me some fine dark grey sand lying in the windows, which had been open that morning.

"I may add that a telegram received from Iceland that day gave the news of volcanic eruption in Iceland."

For these two reports I am indebted to Mr. G. T. Atkinson, district inspector of fisheries, Eastern Area.

J. N. CARRUTHERS.

Ministry of Agriculture and Fisheries,
Fisheries Laboratory,
Lowestoft.

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### The Wegener Hypothesis and the Origin of the Oceans.

READERS of NATURE have been served with good reviews and discussions on the Wegener hypothesis, and it may therefore be of interest to point out that, so far as it relates to the origin of the Atlantic Ocean, this hypothesis was anticipated by previous writers, more especially by Osmond Fisher and W. H. Pickering. Fisher's views are well known to students of geodynamics, and Wegener himself refers to papers by W. H. Pickering and F. B. Taylor; but only by reading the accounts given by these authors can one realise how completely they forestalled Wegener, so far as the origin of the Atlantic by the westerly drift of the Americas is concerned.

It was to accommodate Sir George Darwin's views on the origin of the moon that Osmond Fisher suggested, first in NATURE (1882, vol. 25, p. 243) and afterwards in the second edition of his "Physics of the Earth's Crust," that the Pacific Ocean is a scar and depression on the earth's surface, left by the detachment of the moon. The following are Fisher's words (p. 380): "The hole would be filled up by the influx of the molten substratum from beneath and around. The remaining crust would separate into larger and smaller fragments, and partly float towards the cavity. Thus when the newly exposed surface of the molten substratum again solidified, a fresh crust, of greater density than before, would be formed out of the heavy substratum over the middle of the area, where the hollow had been made, and also in the channels between the fragments which had floated towards it; the Atlantic being the chief of these channels."

In his paper on "The Place of Origin of the Moon—The Volcanic Problem" (*Journ. Geol.*, 1907, vol. 15, p. 23) W. H. Pickering elaborates the view previously propounded by Osmond Fisher; and although he makes no acknowledgment, we may safely infer that, directly or indirectly, he owed the idea to Fisher. The following quotation shows how remarkably close Pickering got to the statement of the Wegener hypothesis: "A curious feature of the Atlantic Ocean is that the two sides have in places a strong similarity. . . . When the moon separated from the earth, three-fourths of the crust was carried away, and it is suggested that the remainder was torn in two to form the eastern and western continents. These floated on the liquid surface like two large ice-floes."

In his paper on the "Bearing of the Tertiary Mountain Belt on the Origin of the Earth's Plan" (Bull. Geol. Soc. America, 1910, vol. 21, p. 179) F. B. Taylor remarks: "Thus we may conclude, at least provisionally, that it was North America that moved away from Greenland, and not *vice versa*."

If the view that the American continent has drifted away from Europe and Africa during Mesozoic and Tertiary times comes to be established, which seems highly improbable, it will no doubt owe much to Wegener, and will be associated with his name in this special sense; but Osmond Fisher is clearly the author of the hypothesis of continental drift, so far as it applies to the problem of the origin of the Atlantic Ocean. The tectonic evidence provided by a study of the Atlantic floor, however, indicates that its submergence in large part during Tertiary times has been effected by the ordinary process of subsidence, and that, *pari passu* with this subsidence, considerable areas of Eurasia and Africa, which were previously submerged, have been raised above sea-level. Indeed, as Suess has pointed out, the evidence seems to show quite conclusively that, throughout the Mesozoic and Tertiary eras, a mediterranean ocean of the Atlantic type has in a large way dissected the continental masses and absorbed their drainage, although its orientation has changed.

These broad geotectonic considerations seem to be utterly at variance with the claim based by Wegener on the jig-saw relationship of the opposite sides of the Atlantic; and there can be little doubt that, to a large extent, they dispose also of the Fisher hypothesis of continental drift, so far as the origin of the Atlantic is concerned.

It should be remembered, however, that Fisher's views on continental drift were based on the hypothesis he entertained as to the condition of the earth's interior. There are profound differences between the Atlantic and Pacific Oceans. Astronomers tell us that the Fisher hypothesis as regards the Pacific is a very good one, and to this may be added the claim that, in large measure, it fits the facts known to us concerning the petrology and tectonics of the earth. While, therefore, declining to accept Fisher's hypothesis of continental drift to explain the origin of the Atlantic, we may accept provisionally his view that the Pacific owes its origin to the detachment of the moon, especially as some hypothesis seems to be necessary to explain the heterogeneity of the earth's crust.

T. CROOK.

### *Aster tripolium* on Salt Marshes.

I NOTICE in the article on Belgian botany in NATURE of January 20, p. 97, a statement which reminds me of some observations of mine at Dovercourt, near Harwich, in 1908. The article says that a fringe of the purple-rayed form of *Aster tripolium* occurs between the salt marshes, occupied by the yellow form, and the more fertile, less saline, soil. At Dovercourt there are fields overflowed by the sea at every high tide, but still showing signs of former cultivation. The specimens of Aster growing here were all fleshy and rayless. Separated from these fields by earthen dykes were other fields, which showed no signs of being flooded at any time. Here the Aster was always thin and wiry in the stalk, and bore a well-developed ray.

H. W. CHAPMAN.

Cawthorne, Jordans Village,
Beaconsfield, Bucks,
January 31.

### The Cause of Anticyclones.

WITH reference to Miss Catherine O. Stevens' letter (NATURE, February 3, p. 150) on this subject, it is clear that there could be no high-pressure areas unless there were low-pressure areas as well.

It is also quite clear that the pressure distribution at any moment depends upon the flow of the winds, the inertia of the air, and the rotation of the earth. But the atmosphere is a viscous substance, and the friction resulting from its viscosity would soon bring the whole mass to rest were there no continuous source of power to keep it moving.

It is generally agreed that the source of power which maintains the circulation of the atmosphere is difference of air density resulting from difference of temperature. The problems to be solved are—what is the exact distribution of temperature throughout the atmosphere? will the actual temperature distribution account for the winds? and how are these temperature differences maintained?

R. M. DEELEY.

Tintagel, Kew Gardens Road, Kew, Surrey,
February 2.

### The High Temperature of the Upper Atmosphere.

IN a letter in NATURE of February 10 Mr. Whipple suggests that a comparatively sudden increase in temperature of the air at a height of about 60 kilometres, such as observations of meteors render likely, would account for the well-known zones of audibility and silence. This seems to us a promising line of investigation, which might enable one to determine annual variations of temperature, if any. We had already examined the possibility of using meteor observations for this purpose, but they are as yet scarcely sufficiently accurate to enable one to determine the small differences involved. The same applies to the suggestion of Mr. Deeley in NATURE of January 20.

In the last paragraph of his letter Mr. Whipple suggests that the estimates which we made of the temperature on theoretical grounds require modification, as the atmosphere is exposed to the sun only during the day-time. We need scarcely point out that this fact had not escaped our attention and was allowed for in the coefficients of the formula actually used.

F. A. LINDEMANN.
GORDON M. B. DOBSON.

Clarendon Laboratory, Oxford,
February 12.

## The Bicentenary of Sir Christopher Wren.

By Eng.-Capt. EDGAR C. SMITH, O.B.E., R.N.

THOUGH during the celebration, next week, of the bicentenary of Sir Christopher Wren the main interest must needs centre around his great work as an architect, his position as one of the representative men of science of the seventeenth century should not be overlooked. Five years younger than Boyle, and ten years the senior of Newton, Wren had as his contemporaries Wilkins, Hooke, Goddard, Willis, Sydenham, Flamsteed, and Barrow. The year Wren was born Galileo was writing his famous "Dialogues," and in the subsequent developments which made England the scientific centre of the world Wren was one of the pioneers. While quite a youth Wren joined the group of philosophers who met at the lodgings of Wilkins or Boyle at Oxford, and at twenty-five he became Gresham professor of astronomy. Four years later he returned to Oxford as Savilian professor. The Royal Society owed much to him, and he was one of its earliest presidents. Perhaps not such an extraordinary boy as Young or Hamilton, his genius was recognised from the first. Barrow indeed, in 1662, referred to him "As one of whom it was doubtful whether he was most to be commended for the divine felicity of his genius or for the sweet humanity of his disposition—formerly as a boy a prodigy; now as a man a miracle, nay, even something superhuman."

Wren was born at East Knoyle, in Wiltshire, on October 20, 1632. His grandfather, Francis Wren, was a mercer in the city of London; his father, also Christopher Wren, was rector of East Knoyle and dean of Windsor. Another son of Francis was Matthew Wren, bishop of Hereford, Norwich, and Ely; a stiff-necked prelate who spent more years in the Tower than he need have done. Wren's mother died when he was young, but his father survived till 1658. At nine Wren was sent to Westminster school, then under the famous Busby. From Westminster, after an interval, probably due to the unsettled state of affairs—Oxford then having more soldiers than students—he passed to the University and was entered as a gentleman commoner of Wadham College, of which Wilkins was the warden. He graduated B.A. in 1651, M.A. in 1653, and that year became a fellow of All Souls, holding his fellowship until 1661, the year he was appointed Savilian professor.

Like most students of his day, Wren roamed over many fields of learning. With a talent for fine and accurate drawing he combined a manipulative skill which was the envy even of Hooke. These found employment in many ways. For Willis he made the elaborate drawings for a work on the anatomy of the brain. He was one of the first to inject liquids into the veins of animals. Writing to Petty in 1656 he says, "The most considerable experiment I have made of late is this;—I injected wine and ale into the mass of blood in a living dog, by a vein. . . . I am in further pursuit of the experiment, which I take to be of great concernment, and what will give great light to the theory and practise of physic."

Wren's two professorships cover a period of sixteen years—1657 to 1673. The Gresham and Savilian chairs were the first mathematical and astronomical professorships founded in England. One or the other had been held by Briggs, Bainbridge, Turner, Greaves, Gellibrand, and Gunter. Gresham College, London, was the old mansion of Sir Thomas Gresham, which stood on a site stretching between Bishopsgate Street and Old Broad Street. The lodgings of the professors of music and physic and the Reading Hall were close to Bishopsgate Street, but the quarters of the other professors were situated around a large quadrangle. An interesting sketch of the college is given in Weld's "History of the Royal Society." Wren's appointment was owing to Lawrence Rooke exchanging the chair of astronomy for that of geometry, the transfer being due "to a conveniency of the lodgings which opened behind the Reading Hall." Wren's lectures were read the same day as Rooke's and attended by the same auditors. He discoursed on telescopes, eclipses, the planet Saturn, and meteorology, and to this period belong his demonstrations concerning cycloids.

In February 1661 Wren resigned both his Gresham professorship and his fellowship of All Souls and returned to Oxford to succeed Seth Ward as Savilian astronomer. In this position he continued to investigate a wide range of subjects, suggesting self-registering weathercocks, thermometers, and rain-gauges; constructing telescopes for measuring small angles, and making experiments with pendulums. In 1668 he showed his experiments to illustrate the laws of motion by the collision of balls. Newton afterwards writing of the laws of motion said: "Dr. Christopher Wren, knight; John Wallis and Christian Huygens, who are beyond comparison the leading geometers of this age, arrived at the laws of the collision and mutual rebound of two bodies; but their truth was proved by Dr. Wren by experiments on suspended balls in the presence of the Royal Society."

It was while Wren still held the Gresham professorship that the Royal Society came into existence. The first official record was a memorandum of November 28, 1660. This gave the names of the persons who had "mett together at Gresham Colledge to heare Mr. Wren's lecture." After the lecture "they did, according to the usual manner, withdrawe for mutuall converse," and it was agreed upon that "this Company would continue their weekly meeting on Wednesday, at 3 of the clock in the tearme time, at Mr. Rooke's chamber at Gresham Colledge; in the vacation, at Mr. Ball's chamber in the Temple." Wilkins was chairman on this occasion. At the next meeting, December 5, Sir Robert Moray, the first elected president, brought word that the King approved of the Society and would be ready to give encouragement to it. The minutes also record that "Mr. Wren be desired to prepare against the next meeting for the Pendulum Experiment." On December 19 Mr. Wren and Dr. Petty were "desired to consider the philosophy of Shipping, and bring in their thoughts to the company about it."

The Royal Society was further indebted to Wren for drawing up the preamble to the charter of Incorporation in which Charles II. states his determination "to grant our Royal favour, patronage and all due encouragement to this illustrious assembly and so beneficial and laudable an enterprize." The charter was first read on August 13, 1662, and two years later Wren gave an address on the objects to which the Society should devote its energies. He exhorts the members "not to flag in the design since, in a few years, at the beginning, it will hardly come to any visible maturity. . . . The Royal Society should plant crabstocks for posterity to graft on." Lord Brouncker became the first president of the Society after its incorporation, Sir Joseph Williamson succeeded him in 1677, and Wren, who had been knighted in 1673, was elected president in 1680. Boyle had previously declined the honour through "a great tenderness in point of oaths." Wren held office till St. Andrew's Day, 1682.

So far, attention has been directed only to Wren's scientific activities. Soon after his return to Oxford, in 1661, he was invited by Charles II. to act as surveyor-general of His Majesty's works, and from this time dates his career as an architect, which ultimately raised him to the head of the profession. The first building designed by him was the chapel of Pembroke College, Cambridge, erected by his bishop-uncle as a thank-offering for his liberation from the Tower. His next building was the Sheldonian Theatre at Oxford. In 1665 he spent six months in Paris studying the Louvre and other buildings, returning home, as he said, "with nearly all France upon paper." In 1666 came the great fire of London, and with it Wren's opportunity. From September 2 to September 8 the flames swept across the city, and four days later Wren laid a plan for its rebuilding before the King. Immediately afterwards he was appointed "surveyor-general and principal architect for rebuilding the whole city; the cathedral Church of St. Paul; all the parochial churches . . . with other public structures." Wren was then but thirty-four, and in the remaining fifty-seven years of his life he not only designed and erected many important private and public buildings, but some fifty London churches, and also his great masterpiece, St. Paul's Cathedral. Several years were occupied in demolishing the ruins of old St. Paul's, and it was not until 1675, the year Wren built Greenwich Observatory, that the foundation stone of the new cathedral was laid. Thirty-five years later Wren's son put the topmost stone of the lantern into position.

Of the city of London as Wren knew it in his Gresham days but little remains. Wren, if he had had his own way, would have changed its very plan. It was his intention to cut two great arteries from east to west and another from north to south. At the intersections of these thoroughfares would have stood the new St. Paul's and the great public offices. He further designed that a noble quay should flank the Thames from the Tower to the Temple. For better or for worse his plans proved unacceptable, and so to-day it is yet possible to follow some of the footsteps of the old philosophers and to visit their memorials.

Though it escaped the fire, all trace of Gresham's mansion has long since disappeared. St. Helen's Church—sometimes called the Westminster Abbey of the City—where the inmates of Gresham College worshipped, still stands, and within its walls lie the remains of Hooke, Goddard and Gresham. Three of Wren's predecessors in the chair of astronomy, Gellibrand, Foster, and Gunter, were buried in St. Peter le Poer, which stood in Old Broad Street, while Rooke, "the greatest man in England for solid learning," was buried in St. Martin Outwich, from which the monuments were some fifty years ago removed to St. Helen's. Rooke died just before the Royal Society received its charter. Greaves, another Gresham and Savilian astronomer, was buried in St. Benets; John Collins, "the attorney-general of the mathematics," in St. James' Church, near Southwark Bridge, while John Wilkins, first secretary of the Royal Society, and from 1668 bishop of Chester, who died in 1672, was buried in St. Laurence Jewry. This was one of the churches rebuilt by Wren. Wilkins had been rector of the church, and on one occasion he invited Barrow to occupy the pulpit. Barrow preached so well that Richard Baxter declared he "could willingly have been his auditor all day long."

Wren himself lies in the crypt under the south aisle of the choir of St. Paul's. He died on February 25, 1723, and was buried on March 5. The well-known quotation from his epitaph: "Si monumentum requiris, circumspice," now to be seen over the north door of the cathedral, was first carved on the choir screen by Robert Mylne, the builder of the first Southwark Bridge and surveyor of St. Paul's, who lies close to Wren in the crypt.

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The grand committee formed by the Royal Institute of British Architects and other bodies interested, to celebrate the bicentenary of the death of Sir Christopher Wren, has arranged for a public commemoration service in St. Paul's Cathedral, on Monday, February 26, at 2.30 P.M., in the course of which an address will be delivered by the Very Rev. W. R. Inge, Dean of St. Paul's. The members of the grand committee, accompanied by the Lord Mayor and Sheriffs, will proceed afterwards to the crypt, where Mr. Paul Waterhouse, president of the Royal Institute of British Architects, and an attaché from the American Embassy in London, on behalf of the Architectural League of New York, will lay wreaths upon the tomb of Sir Christopher Wren. In the evening a Christopher Wren commemoration banquet will be given by the Royal Institute of British Architects at the Hotel Victoria, Northumberland Avenue, and commemorative addresses, dealing with the life and work of Wren, will be delivered.

In addition to these celebrations there will be exhibitions illustrating Wren's work, at the Galleries of the Royal Institute of British Architects, 9 Conduit Street, W.1, on February 26-March 3, and at the Museum, Public Record Office, Chancery Lane, W.C.2, both of which will be open free of charge to the public.

Another interesting proof from overseas of regard for the memory of the great London architect comes from the Architectural Institute of British Columbia, which has arranged to hold, in the largest Anglican church in Vancouver, a memorial service on exactly similar lines to the service which will be held in St. Paul's Cathedral on February 26.

## Absolute Measure and the C.G.S. Units.

By Sir GEORGE GREENHILL.

"WHAT is the matter with physics training for the engineer?" is a question asked to-day. The engineer will answer, "It is the C.G.S. source of arrogance and tyranny," following him even into the engineering laboratory, and his calculations in hydrostatics. He has no use for such minute units, as he works always to terrestrial gravitation measure of his world of existence, and C.G.S. is thrown aside as soon as the young engineer, gunner and navigator is liberated from the tyranny of the lecture and examination room, and he is free to talk and calculate in all the old units familiar to generations.

These C.G.S. units are described in Halsey's "Handbook for Draftsmen" as a "Monument of scientific zeal (misplaced) combined with ignorance of practical requirements." "The object of Weights and Measures is to weigh and measure, not merely to make calculations."

No wonder Prof. Hudson Beare maintained at the British Association at Hull the desirability of keeping the mathematics of the engineer distinct from the examination needs of the Science and Art, or even medical student in his research of a diploma, and that the teacher of engineers should preferably be an engineer himself. If he has to teach physics, it should be industrial physics, in their application on a large scale to constructional needs.

Mach pleaded age and infirmity for taking no hand in the translation of his work, and gave the translator a free hand. The opportunity was seized of making him sponsor of the C.G.S. system, and no other, by the ardent disciples of the Open Court. We find the same fervent advocacy of C.G.S. in our scientific schools over here, compelling even the engineering students to use their microscopic units to the exclusion of all others employed in his practical life.

A rival system, M.M.S. (millimetre — milligram — second), still more minute, was proposed in Germany, and is mentioned by Mach, but this was ironical. In France, Olivier, whose work was reviewed lately in NATURE, is pushing the M.T.S. system (metre—tonne—second) as better adapted for large scale work.

The M.K.S. (metre—kilogramme—second) system would suit most practical requirements, but this is rejected by the purist in units because it makes the density of water 1000, kg/m$^3$, instead of unity. But the advantage here is in keeping the air buoyancy in sight, as a correction of about 1·25 on the last figure of the absolute density, *in vacuo*, as it ought to be tabulated. Suppose it was required to weigh 1 lb. or 1 ton of hydrogen in the scales for an airship; describe your procedure.

Absolute measure was first introduced into dynamical teaching under Prof. Tait in Edinburgh, although Tait never carried his Glasgow colleague with him to a full extent. Gauss had initiated the idea previously as essential in magnetic measurement all over the world.

Tait told us the idea struck him in his struggle with the Definitions in Chapter II of his "Dynamics of a Particle"; and then it burst on him as a revelation of the way out of a theoretical difficulty always a puzzle to him.

The idea fructified, and to-day we find absolute measure universal in all theoretical physics, and the engineer is blamed for sticking to his old gravitation units for mechanics. The electrician, however, is compelled to work absolute in his cosmical electromagnetism, broadcasting his theoretical results, depending only indirectly on the gravitation of the earth.

In Tait's procedure a change was made in the unit of what was then called mass, changing it from a vague *sui generis* into the Imperial Standard Pound, and then $P=Mf$ implied a new unit of force, for which the name poundal was afterwards discovered, such that the heft of 1 lb. weight was $g$ of these units, poundals. The poundal was thus $1/g$ of the heft-weight of 1 lb., say 1/32, or half an ounce in round numbers. This unit was much too small for the engineer; he has refused to have anything to do with absolute measure, and jeers at the pedantry of calling the poundal a unit of weight, pointing to the precise language of the successive Acts of Parliament, from Nebuchadnezzar and earlier, down to our day.

WEIGHTS AND MEASURES ACT, 1878.

*Imperial Measures of Weight and Capacity.*

13. The weight *in vacuo* of the platinum weight mentioned in the first schedule of this Act and by this Act declared the imperial standard pound shall be the legal standard measure of weight and of measure having reference to weight and shall be called the imperial standard pound and shall be the only unit or standard measure of weight from which all weights and all measures having reference to weight shall be ascertained. [*N.B.*—No word mass occurs.]

Any person who sells by any denomination of weight or measure other than one of the imperial weights or measures or some multiple or part thereof, shall be liable to a fine not exceeding forty shillings for every such offence. Printer and publisher are liable for any act in contravention of this section.

So any one giving weight in poundals, in print or writing, would be liable to this fine. No mention is made in this Act of barometer or thermometer reading, required in the definition of the gallon, cubic measure; weight *in vacuo* covers all such ambiguity of its measure, inserted for the first time in the draft of this Act; the omission was a source of great trouble when the need arose for a new Standard Pound.

Not a word in the Act about the attraction of the earth on the pound weight. Nothing is said about the pressure on the bottom of the box containing the pound weight, and the influence of local $g$, however it may vary down a mine, or up in the air, or away into space from one end of the world to the other.

The pound weight does not alter, brought out of its vacuum into the atmosphere, or even if it was carried away into space to the other end of the universe; it always remains the lump of platinum defined in the Act. At least this was the current belief until quite recently, before a distinction was made between *Ruhmasse* and *Masse in Bewegung*.

If, however, the weight of a pound is to mean something quite distinct from the pound weight, as the force with which it is attracted by the earth, the confusion of language and measurement is intolerable.

It is not correct to say the word weight is always to be reserved, strictly speaking, for the subsidiary meaning of earth attraction, as the word was in use long before such distinction was made or understood, and is to be found in ordinary language and writing, *e.g.* in Shakespeare, the Bible, and other of our classics, in both senses, but usually in the meaning of the Act of Parliament.

The latest discoveries of atomic theory have forced a reconsideration of former definitions of fundamental units, considered unassailable on the Newtonian doctrine. Language again has failed to recognise these new distinctions. C.G.S. units are displaced in the relativity theory, where the unit of time is nearly 1000 years, instead of our terrestrial second, adopted to keep $g$ down to a reasonable figure, 981, or 32.

" Space-Time-Matter " of Hermann Weyl will give some idea of the latest lofty ideas of the universe, beyond the scope of these humble elementary remarks in defence of the old Newtonian mechanics—all the engineer has, so far, to guide him in the design of the steamship, locomotive, and flying machine. Here he is forced to adopt some immediate line of action, leaving the abstract theorist to pursue his speculations at leisure. The engineer must deliver the goods to time.

The *sui generis* mass $M=W/g$, Mach's terrestrial mass, implies unit mass of $g$, lb. ; Perry proposed for it the name " slug," about a 32 lb. shot. But slug in gunnery means any irregular piece of lead, cut off a church roof in civil war, and rammed down a fowling piece. It is curious to find *sui generis* mass in slugs still lurking in the engineers' table of moment of inertia of a body ; it has even been found by force of habit in a cross-section area for moment of stiffness of a beam.

There is too much of the mere algebraical literal calculus in the presentation of dynamical theorems. Quantities receive a label, M, W, $g$, $v$, $s$, $t$, as in mere algebra, and this letter label is stuck on the quantity for identification, without sufficient explanation of the measurements required to translate the label into the description of an actual body, or its behaviour in motion and associated measurement.

But the writer of the usual text-book is obliged to keep in mind the needs of his class in preparing to meet the examiner, or is on the road to be an examiner himself in his turn, and his book adopted. So the round goes on, and a curious jargon has arisen, cultivated by the schoolmaster and despised by the engineer.

Darboux surprised our company once by retailing the well-known story of the French Minister of Education, pulling out his watch and boasting how at that moment the same lesson was in progress in all the schools in France. I was so bold as to cut in—" Mais, il y a une suite." " Quelle suite ? " " Le ministre a continué,—du même traité, de moi."

The Hospitalier notation is a ready escape from confusion when the derived unit appears, involving two or more of the three fundamental units. Then a velocity in feet or centimetres per second is indicated by $v$, ft./sec. or cm./sec., and an alteration of velocity per second by ft./sec.$^2$ or cm./sec.$^2$; thus $g=32\cdot2$, ft./sec.$^2$, or 9·81, m./sec.$^2$ So, too, for density, in lb./ft.$^3$, gm./cm.$^3$, kg/m.$^3$, t./m.$^3$. A moment of inertia, Wk$^2$, would be in lb./ft.$^2$, and so on. But the adoption of this Hospitalier system is still very slow, although accepted by a resolution of the Paris Electrical Congress, 1880, and again at Frankfurt, 1891.

Although absolute measure of force is insisted on in all C.G.S. records, there is no accurate measurement of force except first in the gravitation unit of the gravity field, as with the Current Weigher-Balance ; and after the experiment is complete, the factor $g$ is to be supplied, but often forgotten.

Rayleigh appears to be writing feelingly, quoted in *Engineering*, July 4, 1919 : " When a problem depends essentially on gravity, $g$ makes no appearance. But when gravity does not enter at all, $g$ obtrudes itself conspicuously, and requires to be kept carefully in its proper place " (as in electro-magnetic and elastic measurement).

All matter is transparent to gravity : there is no escape from it on the surface of the earth. In the work of the engineer to combat the powers of Nature, gravity is the force he is up against, and the strength of it provides him with the unit the engineer will never discard, as capable of immediate exact measurement. He will never abandon his gravitation units for such minute substitutes in the C.G.S. system, useful only for passing an examination, or for microscopic physical measurement.

Weighing and measuring must be carried out in a gravity field, and not *in vacuo* ; the experimenter must be allowed to breathe in a warm room during a long careful measurement. The factor $g$ is inserted after the work is over, for calculation and record in absolute measure, and the C.G.S. system was invented to make calculations and tabulate them, not to weigh and measure, as Halsey pointed out.

The metric system is a legacy of the French Revolution, when all ancient tradition was swept away and the world to be started going afresh. Time and angle were to be decimalised with French logic. The quadrant was divided into 100 grades, each of 100 centesimal minutes ; and a minute on the meridian was made into the kilometre—the unit of distance. But sexagesimal clocks, watches, and chronometers were not to be thrown into the sea for such a theoretical fad as centesimal time ; and the ridiculous official names assigned to the days of a decimal week excited derision. Any attempt was bound to fail to bring music into line with the metric system, by a decimalisation of the octave.

Elsewhere the metric system has taken a firm hold in the civilised world, as a means of cosmopolitan commercial intercourse, and must be accepted. But the sailor will not surrender his cosmopolitan sexagesimal measure, of time and angle, inherited from the Chaldæan astronomer, and he continues to graduate the quadrant into ninety degrees, and the degree into sixty minutes, and he takes the sexagesimal minute of latitude on the meridian as his unit of length, and calls it a mile, geographical (G), nautical (N), sea (S), or Italian, in the old books.

The sailor then starts a decimal subdivision of the mile, dividing it into 10 cable, and the cable into 100 fathom. Geodetical measurement makes this fathom a little more than 6 ft.,—6·08, say 6 ft. and 1 inch over. Longitude he measures on his chronometer, giving sexagesimal time of 24 hours (h.) in the day, an hour of 60 minutes (m.); and a minute of 60 seconds (s.); four seconds of longitude = one minute of longitude at the equator, or a mile, an easy range of eyesight. The schoolmaster cuts the fathom down to 6 ft. exactly, and would sweep it away as a useless load on the schoolboy's memory, although universal in sounding, as in

"Full fathom five thy father lies."

The schoolmaster has his eye, too, on the suppression of all the ancient measures of agriculture,—furlong, rod, pole, perch, rood, chain, ell, palm, hand. But the chain as the length of the pitch at cricket is too sacred to be assailed. And what is the height in C.G.S. centimetres of a horse *x* hands high? He is obliged to cling to the mile, the statute, land, military mile, of 8 furlongs, 80 chains, or 1760 yards.

It is unfortunate the sailor carried the world mile on to his own unit, perhaps under a mistaken idea that the two miles were undistinguishable. Newton was arrested in his speculation on gravity by falling into this error. The land soldier mile is the one entitled to its name as the length of 1000 paces (*passus*, not *gradus*), *millia passum*, M.P. on the Roman milestone, covered in marching along the road, making 5·28 ft. the double pace of the Roman soldier; this is cut down to 5 ft. in our modern drill book, and less still in the metric equivalent of the French soldier.

It is strange to read to-day in the "Admiralty Manual of Navigation," 1914, page 1, the earth is described as an oblate spheroid, greatest and least *diameter* 3963, 3950 miles (military, soldier, statute). In navigation the surface of the ocean is always treated as a perfect sphere, and of girth 360 × 60 = 21600 sea miles (S), making the *radius* of the sphere 3438 S miles, the length of the radian along a meridian. Besides the solecism of mentioning the military land mile as a measure in navigation, the real dimensions of the earth are double as stated in the Manual. Can we wonder then at an Admiral sending himself and his flagship to the bottom by a confusion between radius and diameter?

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## The Royal Society.

### MUNIFICENT GIFT FROM SIR ALFRED YARROW.

THE generous gift from Sir Alfred Yarrow, announced in the subjoined letter from him to the president of the Royal Society, and gratefully accepted by the Society, is a most welcome acknowledgment from a great leader of industry of the practical service of scientific investigation. Sir Alfred, who was elected a fellow of the Society last year, has always taken an active interest in the progress of science and has promoted its application to industry in many ways—directly in his own works and indirectly by gifts to educational and scientific institutions. His faith in science as the maker of the modern world is unbounded, and the words in which he gives expression to it should afford scientific workers both pride and encouragement. We are at the beginning of a new era of human history, and it is to the close association of science and industry, in the spirit of Sir Alfred Yarrow's letter, that we must look for strength to meet the difficulties before us. The Royal Society, and the scientific workers it represents, may be trusted to continue to extend the boundaries of natural knowledge, and if statesmen and industrialists have the same progressive aims we can look with confidence to whatever the future may bring.

I would ask you to be so kind as to bring before the Council, at an early opportunity, the following proposals:

I have, for many years, held the view that the prosperity of this country has been greatly hampered in the past for the want of better promotion to scientific investigation and its application to practical affairs.

I am convinced that the future prosperity of this country will be largely dependent upon the encouragement of original scientific research. The birth of new industries, and the development of existing ones, are due largely to the growth of science, thus securing employment and the welfare of the whole community being advanced.

It is doubtful whether even yet it has been realised how completely this country would have been at the mercy of our antagonists in the late war, had it not been for the research work done by our scientific men before the war and during its course.

I desire to mark my sense of the value of research to the community by offering, as a gift to the Royal Society, 100,000*l.* to be used as capital or income for the purposes of the Society, as the Council may think fit, because I recognise conditions alter so materially from time to time that, in order to secure the greatest possible benefit from such a fund, it must be administered with unfettered discretion by the best people from time to time available.

Care must, of course, be taken that a gift from the fund shall in no case lessen any Government grant.

In accordance with your practice you would, I assume, appoint a Committee to administer the fund, and would also frame rules for the guidance of the Committee, while reserving the right to alter such rules from time to time; and I would suggest that they be reconsidered by the Council every tenth year so as to meet modern needs.

I should prefer that the money be used to aid scientific workers by adequate payment, and by the supply of apparatus or other facilities, rather than to erect costly buildings, because large sums of money are sometimes spent on buildings without adequate endowment, and the investigators are embarrassed by financial anxieties.

Although I thus give a general expression of my wishes, I do not intend, by so doing, to create any Trust or legal obligation for their fulfilment.

In conclusion, I should like to record my firm conviction that a patriotic citizen cannot give money, or leave it at his death, to better advantage than towards the development of science, upon which the industrial success of the country so largely depends.

A. F. YARROW.

## Obituary.

### Prof. W. K. von Röntgen.

It is given to few men of science to make a contribution to knowledge which compels world-wide interest from its first announcement. The late Prof. Röntgen's discovery of the X-rays in 1895 was not only of the first importance, but also enjoyed the distinction of finding an immediate and immense field of application in surgery and medicine. Presently they were destined to play also a prominent part in the extraordinary developments in atomic and molecular physics which have characterised the last twenty years—developments which make it safe to assert that at no period in its history has physical science been more effective and wide-reaching in its fundamental activities. Röntgen was happily spared to be a witness of all this, and although his contributions to X-ray research ceased some years ago, his satisfaction at the growth of the subject can have been in no way diminished.

Wilhelm Konrad von Röntgen was born at Lennep in the Rhineland on March 27, 1845. Although a German by birth, he was sent to school in Holland, and later he took his doctor's degree in Switzerland at Zurich in 1869. Then he was appointed assistant to Kundt at Würzburg in Bavaria, and afterwards at Strasbourg, where he carried out a well-known piece of work on the ratio of the specific heats of gases. He became a privat-dozent of the latter University in 1874. A brief period followed as professor of mathematics and physics at the Agricultural Academy at Hohenheim, after which he returned to Strasbourg in 1876 as extra-ordinary professor of physics. In 1879 he became professor of physics and director of the Physical Institute at Giessen; and six years later followed his appointment to the chair at Würzburg. It was here he made his famous discovery. Afterwards he was appointed to the chair of experimental physics and director of the Physical Institute at Munich; he resigned these appointments in 1919. Röntgen died at Munich on February 10, 1923, at the ripe age of seventy-eight years. He received the Nobel Prize for physics in 1901, and with Prof. Lenard the Rumford medal of the Royal Society in 1896.

While Röntgen's researches extended over a fair range of physics, their importance is completely overshadowed by his discovery of the X-rays, the credit for which is in no way lessened, but rather is enhanced by the curious belatedness of the event. Crookes, during his memorable investigations (1879–85), constructed a discharge tube with a concave cathode and a platinum target to display the heating effects of focussed cathode rays. Thus all the essential features of a modern gas X-ray tube were there, and X-rays must have been generated in abundance, but, although much of value *within* the tube was noted and recorded, the X-rays remained unnoticed.

Later Lenard, in 1894, demonstrated conclusively that cathode rays could pass through a thin window of aluminium, and were able to excite phosphorescence a few millimetres away in air. This was a correct observation, despite the fact that we now know that part of the phosphorescence was due to X-rays excited by the aluminium. About this time the inexplicable fogging of unopened packets of photographic plates in the neighbourhood of excited Crookes tubes was engaging the attention of more than one English physicist, but not until the autumn of the following year was the major discovery made by Röntgen, the manner of it being somewhat accidental. It so happened that in a search for invisible light rays he had enclosed a discharge tube in light-proof paper, and, to his surprise, noticed that, when the tube was excited, a barium platinocyanide screen lying on a table a few metres distant shone out brightly. If obstacles were interposed between the tube and the screen they cast shadows, and very quickly a unique and fascinating feature was revealed—the new or "X"-rays could penetrate many substances quite opaque to light. The degree of penetration depended on the density; for example, bone was more absorbent than flesh. When Röntgen communicated his results to the Physico-Medical Society of Würzburg in November 1895, the immense significance of his discovery received universal appreciation. A translation of his paper appeared in the issue of NATURE for January 23, 1896 (vol. 53, p. 274).

An army of workers sprang up and a torrential output of observations and speculation followed, as a glance at the scientific journals of those days will verify. The Röntgen Society came into being in London in 1897, largely at the instance of the late Silvanus Thompson, and similar societies were inaugurated later in other countries. Röntgen himself contributed three memoirs to the subject during these years, but later returned to his earlier interests in physics. He had, with others, established the fact of the ionising properties of the X-rays.

Much controversy and a wealth of speculation followed as to the nature of the rays. But experiment gradually whittled down the various theories, and no question now arises that the X-rays are light rays with wave-lengths which place them next to, and beyond, the ultra-violet. It was their minuteness of wave-length that defeated all the earlier attempts to sort out the rays, and this uncertainty continued until Nature herself was found to have fashioned suitable diffraction gratings in the form of crystals, the regular atomic spacings in which were of the right order of magnitude. We can now claim a knowledge of the existence of more than thirteen octaves of X-rays. Of these, three octaves or so are used by the radiologist, these having wave-lengths of the order of $10^{-8}$ cm.

We can only refer briefly to the enormous application of the X-rays in medicine. It is probable that no more potent weapon has been put into the hands of the medical man. The late war brought this home in unexampled fashion, and while human endeavour reached its pinnacle in almost every phase of life, it is difficult to overestimate the services which Röntgen's discovery rendered to humanity. An extensive industry in X-ray equipment has sprung up in this country and abroad.

The new knowledge was not without its menace, as many of the pioneers discovered to their cost. Prolonged and frequent exposure was found to produce a disastrous effect on human tissue. But the conditions of danger and the means of avoiding them were gradually ascertained, and recently, thanks to the recent work of the X-ray and Radium Protection Committee, under the chairmanship of Sir Humphry Rolleston, president of the Royal College of Physicians, the necessary precautions have been widely circulated. In the light of a fuller knowledge the destructive effect of the rays has been turned to account by taking advantage of their selective action when applied to superficial and deep-seated growths in the tissue.

The X-rays have also found extensive industrial application to detect flaws and impurities, and in many other directions.

As already mentioned, the X-rays have proved of the greatest importance in recent developments of fundamental physics. We owe to them Moseley's arrangement of the elements in the order of their atomic numbers, a quantity determined by the atomic nucleus. The wonderful results of Sir William Bragg and his son on crystalline structure rest wholly on X-ray measurements. Much of the work which under Sir J. J. Thomson and Sir Ernest Rutherford has made the Cavendish Laboratory world-famous has dealt with X-ray and kindred phenomena.

At the close of Röntgen's life, we may well pause to survey the goodly harvest that science has reaped from the event with which his name will be for ever associated. Hard on the heels of his discovery came that of the electron by J. J. Thomson and of radioactivity by Becquerel. The new chapter of physics which was thus unfolded has already had the most profound effect on everyday life. G. W. C. K.

## Mr. Bernard Bosanquet.

Mr. Bernard Bosanquet, who died on February 8, after a short illness at his home at Hampstead, to which he had moved a few months ago, has occupied for more than a generation a foremost place in English intellectual life. For the last ten years his health has required him to refuse public engagements, but he continued to be as assiduous in literary productions as during any period of his active life. He was at work till the end, and we are told that he left an uncompleted book on his desk, of which, however, three chapters are finished. The intended title was "What is Mind?" He was an ardent philosopher, who cared little for the brilliance of a speculation and nothing whatever for originality or ownership of ideas, but sought the truth concerning human life and the meaning of experience with an earnestness which seemed like the devotion of a religious mission.

Born in 1848, Mr. Bosanquet was educated at Harrow and at Balliol College, Oxford, and after graduating spent ten years at Oxford as fellow and tutor of University College. In 1881 he came to London and threw himself ardently into the work of the Charity Organisation Society and the Ethical Society, and also lectured on ancient and modern philosophy for the University Extension centres in London.

His "Logic, or Morphology of Knowledge" is a classic. It was published in 1888, and carried out with systematic thoroughness the new principle of an inner activity of thought which had already found expression in Mr. F. H. Bradley's polemic against the formalism and associationism of the empirical school. The next large work was "A History of Æsthetic" in 1892. In 1912–1913 were published the two volumes of Gifford Lectures, the first on "The Principle of Individuality and Value," the second on "The Value and Destiny of the Individual." It was in these lectures that he worked out his philosophical theory of the meaning of life. "This universe," he said, borrowing a phrase from Keats, "is the vale of soul-making." These volumes constitute one of the profoundest works of pure philosophy of the modern period.

Mr. Bosanquet was a man of great personal charm. Dialectic, in the Socratic meaning, was the joy of life to him, but he was always sympathetic to the opposer, genuinely eager to understand his point of view, and always anxious to appreciate its value. Yet no one was firmer or more tenacious in argument. He never expounded any theory or defended any position unless his whole heart was in it, and unless he was convinced of its truth.

Mr. Bosanquet kept himself fully abreast of all the intellectual movements of his time. He was thoroughly acquainted with the philosophical thought of Germany, and he was deeply interested in the new movement in Italian philosophy, the idealisms of Croce and Gentile, though dissenting from them on essential points. His knowledge of Italian was thorough, and only a few months ago he contributed an article in Italian to Prof. Gentile's *Giornale critico*. He was not attracted by the modern French philosophy, which he could never come to regard as other than superficial. The reason for this, no doubt, was that the approach to philosophy through the problems of science, the fundamental questions of mathematics, physics and physiology, which is especially distinctive of French philosophy, seemed to him less important and less compelling than the ethical approach.

Besides the important works mentioned, Mr. Bosanquet wrote numerous smaller books, many of striking originality and value; of these we may mention "The Philosophical Theory of the State" and two quite recent books, "The Meeting of Extremes in Contemporary Philosophy," 1921, and "Implication and Linear Inference," 1920.

For five years, 1903–1908, Mr. Bosanquet was professor of moral philosophy at St. Andrews. He was an original fellow of the British Academy, and was president of the Aristotelian Society from 1894 to 1898. He received the honorary degree of LL.D. from the University of Glasgow, and of D.C.L. from the University of Durham.

Mr Bosanquet married, in 1895, Miss Helen Dendy, a sister of Prof. Arthur Dendy, of King's College, London. Mrs. Bosanquet served on the Royal Commission of Inquiry into the Poor Law. She is the translator of Sigwart's "Logic" and the author of several books on social and economical questions.

## Dr. A. H. Fison.

The staff of Guy's had subscribed money for a wireless installation to illustrate Dr. Alfred Henry Fison's lectures, and for the use of the hospital in other ways. On February 1, when on the roof by himself, attaching an aerial, Dr. Fison fell through a skylight to the floor below. Three days later he died without regaining consciousness.

Dr. Fison's life-story is that of a teacher whose enjoyment in knowing was so vivid that no delight could equal that of passing his knowledge on. In his earlier life he had for twenty years lectured for the Oxford University Extension Delegacy; and this is a school in which the spirit of enthusiasm for knowledge is engendered. If an extension lecturer be not in complete sympathy with his audience, if he has not the instinct for detecting want of harmony between his mind and theirs, his lectures are a failure; his thought-waves must be of the length for which his auditors' receivers are tuned.

From 1912 until his death Dr. Fison was Secretary to the Gilchrist Trust. Each year in the spring he visited various parts of Britain to inspire enthusiasm and to organise local arrangements; in the autumn and winter to deliver lectures. His efforts to fill successfully the gaps caused by death in the Gilchrist staff discovered to him how very rare are the men who have the gift which he possessed of securing in their first few sentences the complete confidence of their audiences and retaining their strained attention for eighty or ninety minutes—halls crammed with people of all sorts and conditions, from the clergy, doctors, and schoolmasters of the town to miners and mill-hands—sending them away with the feeling that the evening which had closed a long day's work had altered their views of the world and had, at the same time, entertained them hugely.

In 1906 Dr. Fison was appointed lecturer in physics to Guy's Hospital, and somewhat later to the London Hospital also. Although his teaching work was elementary, he held that no teacher can be efficient who does not follow the most recent developments of his subject. He was a sound scholar—in the sense in which the expression is used by students of the humanities who are disposed to arrogate it to themselves. The very large gathering of students at the memorial service in the Chapel of Guy's was a measure of his success. Shortly before the accident brought his activities to a sudden close he talked to the writer of these notes of his plans for an early retirement and the devotion of his remaining days to investigations for which his duties as a teacher had left him but scanty leisure, and the publication of his reflections—his bent was ever towards philosophy—upon various aspects presented by the problems of physical science. His best-known contributions are "Recent Advances in Astronomy" (1898) and "A Textbook of Practical Physics" (1911, rewritten 1922).

### MR. RAWDON LEVETT.

THE death at Colwyn Bay on February 1 of Mr. Rawdon Levett, at seventy-eight years of age, will be regretted by none more than by the members of the Mathematical Association, of which, under its old name of the Association for the Improvement of Geometrical Teaching, he was one of the original founders. From his pen, in NATURE, of December 29, 1870, p. 169, first came the suggestion that such an Association should be formed, and the first conference was held at University College, London, on January 17, 1871. Levett possessed much more than the driving power and organising capacity which made him so successful a secretary in the first twelve years of the Association. Unlike most of his contemporaries he had familiarised himself with the continental text-books and with the methodology of his subject as taught in France, Germany, and Italy. The ideas of non-Euclidean geometry found in him an apt exponent to any who cared in those days to listen to him, and in the revolution that was to come in the fields of geometry and analysis he played for a time a prominent part. His "Elements of Trigonometry," which he brought out in collaboration with Dr. Davison in 1892, shows how much he had been influenced by De Morgan, by Cauchy and the continental school, and by Chrystal—and in that case the influence had been reciprocal.

The name of Canon J. M. Wilson has stood for half a century with that of Rawdon Levett on the list of officers or of vice-presidents of their Association. Both were at St. John's; Wilson was Senior in 1859; Levett was 11th Wrangler in 1865 (Rayleigh's year). Both were schoolmasters, Wilson in those days at Rugby, and Levett at King Edward's School, Birmingham. Both have retained their interest in the work of the Association, though ill-health had for many years past prevented Levett from taking any active part in its later history. The interests of neither were restricted to the sphere in which their academic honours were won.

Levett was a man of wide reading and general culture. By many his name was probably seen for the first time on the dedicatory page of "John Inglesant"—"I dedicate this volume to you that I may have an opportunity of calling myself your friend." The spiritual kinship that knit together men like Levett and Shorthouse indicates but one of the intellectual influences that brought to the Birmingham schoolmaster intimate relations with a wide circle of men who appreciated to the full his noble character, rare judgment, and fine literary instinct. Birmingham was the poorer by his loss when the shadow of the White Scourge fell upon him in 1903, and he retired to his Welsh home at Colwyn Bay. Now he is gone, and the only founders left are Canon Wilson, Mr. A. A. Bourne, Sir Thomas Muir, the Rev. E. F. M. MacCarthy (secretary for seven years), and the Rev. W. H. Laverty. W. J. G.

### PROF. GASTON BONNIER.

WE regret to announce the recent death at Paris of Prof. Gaston Bonnier, professor of botany at the Sorbonne, member of the Institute (Académie des Sciences), of the Academy of Agriculture and the Council of the University of Paris, Officier de la Légion d'Honneur, foreign member of the Linnæan Society of London, and member of many other scientific bodies.

Prof. Bonnier was the president of the Société Botanique de France, and editor of the *Revue générale de Botanique*, founded by him in 1889. Among his numerous botanical publications that have become classic may be particularly mentioned his "Cours de botanique," "Géographie botanique et la botanique descriptive," "Flore complète de la France," "Nouvelle Flore des environs de Paris," and "Flore du nord de la France et de la Belgique." His published research on the correlation of function, form and structure of plant organs is as remarkable for its simplicity and clearness of style as for its scientific value. His journalistic contributions to *Le Temps* were appreciated by all its readers.

Prof. Bonnier played a most important part in the reform and extension of the teaching of the natural sciences in France. To his students and research workers, including men and women of many nationalities, he was friend, guide and master.

The French president, the University of Paris, and many scientific bodies were represented at the obsequies, which took place with military honours.

## Current Topics and Events.

ON February 14, Mr. Fisher presented to the House of Commons the usual petition from the Trustees of the British Museum praying for further support. Though this is merely a form arising out of the peculiar mode of government of the museum, we may be permitted on this occasion to emphasise the desirability of doing nothing that should hinder the performance of this trust "for the general benefit of learning and useful knowledge." The British Museum, a term which includes the Natural History Departments, is not one of those Government establishments that swelled its ranks and its expenses under stress of war, nor has it shown a reluctance to reduce them in the difficult times of peace. On the contrary, it has only just brought its scientific staff back to the pre-war level, and it has conscientiously reduced its estimates as required by the Geddes Commission. Its scientific publication is almost, if not entirely, suspended. This is a state of affairs we may lament, but must endure. What we are not prepared to suffer without protest is any further demand for reduction. There are rumours of such a demand, amounting to several thousands of pounds. This could only result in a diminution of the valuable work accomplished by this great establishment, work already most seriously hampered by the inadequate size of the staff. To choke one of the great founts of "learning and useful knowledge" can never be an economical proceeding, and any attempt to do so will meet with the united protest of all scientific workers.

THE Home Secretary has appointed a committee to inquire into the desirability of extending the Workmen's Compensation (Silicosis) Act of 1918, which provides compensation for men injured by silica in specified industries. The association of miner's phthisis (fibrosis of the lungs with superadded tuberculosis) with the inhalation of hard dust, as in quartz mining or knife grinding, has long been known, and its recognition has led to the introduction of appropriate preventive measures. Collis pointed out that the danger of a dust was in proportion to its content of free silica, and Mavrogordato found that coal dust was actually an antidote when mixed with rock dust, which by itself was highly injurious. Later experiments by Gye and Kettle have shown that the action of silica is chemical rather than mechanical, and that colloidal silica is distinctly poisonous. Chronic silica poisoning in rabbits causes degenerative changes in the liver and kidneys, and, though the applicability of these results to the occurrence of similar lesions in men is at present quite an open question, it is evident that the harmful effects of this common substance may prove to be much more widespread than is at present supposed.

THE New York correspondent of the *Times*, in the issue of February 13, refers to some successful experiments upon the dissipation of clouds by the Army Air Service of the United States at Dayton, Ohio, under the direction of Prof. Bancroft of Cornell University and Mr. Francis Warren. The process consists in scattering electrified sand with the propeller of an aeroplane moving 500 ft. above the tops of clouds. The sand is said to be charged to 10,000 volts, and the result is referred to in the headline of the note as "rain-making." The coalescence of the cloud particles in consequence of the diminution of surface-tension is suggested as the proximate cause of the disappearance of the clouds, which are stated to have varied from several thousand feet to several miles in length and breadth, and in thickness from 500 ft. to 1500 ft. The general conclusion of the correspondent is that fogs "need be no more and, given only clouds, rain can be had wherever it is wanted." An important question is, of course, how much? "The time required to precipitate the moisture . . . rarely exceeded ten minutes," and in the case of very thin clouds the moisture evaporated before reaching the ground. Further particulars will be awaited with interest. In the meantime the announcement brings once more into prominence the need for special laboratories for the practical physics of the atmosphere, for which a good deal of work has long been waiting. The coalescence of water-drops, the correlative pulverisation of water and their relation to electrification, are not by any means fully explored. The energy-relations are very complicated. It is known, for example, that a bucketful of water tossed out of an aeroplane would be pulverised into an electrified cloud by its own gravitational energy. To get it back again into a continuous mass of water at the ground by the use of electrified sand will be a very interesting completion of the cycle when we understand it.

A TELEGRAM recently received at the Linnean Society from Tiflis announced that an eminent foreign member of the Society, Prof. Serge Gabrilovitch Navashin, of the Botanic Garden, Tiflis, Georgia, was to celebrate on February 18 his fortieth year of scientific work and the twenty-fifth anniversary of his announcement of double fertilisation in plants. This message recalls the new era in the study of the embryogeny of the flowering plants which followed

Treub's discovery of chalazogamy in Casuarina in 1891. Two years later Navashin reported a similar unusual course of the pollen-tube in the birch, and his own work and that of others supplied new instances. In 1898 Navashin announced at the meeting of the Russian Society of Naturalists his discovery, in species of Lilium and Fritillaria, of what at once became known as "double fertilisation"—the fact that, of the two male nuclei which enter the embryo-sac, one fuses with the egg-cell, the joint product being the embryo, while the other fuses with the two polar nuclei of the embryo-sac, either before or after their union, the product of this fusion being the endosperm, which supplies a store of nourishment in the seed for the embryo. The discovery was rapidly confirmed and extended by Navashin and others, and the occurrence was shown to be frequent if not general in the flowering plants. It gave a new interest to the discussion as to the true nature of endosperm, and, incidentally, provided an explanation of "xenia," or the occurrence outside the embryo of characters derived from the male parent. Notable contributions to this discussion were made by Strasburger, Miss Sargent, and others, but the problem still awaits a satisfactory solution.

THE Right Hon. T. R. Ferens, High Steward of Hull, has consented to accept the office of president of the thirty-fourth congress of the Royal Sanitary Institute, to be held at Hull on July 30–August 4.

SIR CHARLES PARSONS, honorary member of the Institution of Electrical Engineers, has been awarded the Faraday medal of the Institution. The medal is awarded for "notable scientific or industrial achievement in Electrical Engineering, or for conspicuous service rendered to the advancement of electrical science."

IN the *Observer* for February 18 it is recorded that "A Lahore telegram says that a meteorite, which was clearly seen in January in most of northern India, was traced at Quetta, where it buried itself. The remains show that at the time of impact it must have weighed six tons."

IT has now been announced that the donor of 5000*l.* to the Rowett Animal Nutrition Research Institute at Aberdeen is Mr. Walter Reid of Aberdeen. Other recent contributions include one of 500*l.* from the Highland Agricultural Society of Scotland.

WE learn from the *Scientific Monthly* that Dr. Robert A. Millikan, of the California Institute of Technology, Pasadena, has been awarded the 1922 Edison medal of the American Institute of Electrical Engineers for "meritorious experimental achievement in electrical science."

THE committee for the jubilee of Prof. Kamerlingh Onnes on November 11 last, which issued the memorial volume of the Physical Laboratory at Leyden, 1904–1922, announces that a limited number of copies of the volume is still available; copies may be obtained at the price of ten florins on application to the treasurer of the committee, Dr. H. R. Woltjer, Natuurkundig Laboratorium, Leyden, Holland.

ON Tuesday, February 27, at 3 o'clock, Sir Arthur E. Shipley will deliver the first of two lectures at the Royal Institution on life and its rhythms, and on Thursday, March 1, Mr. Theodore Stevens will begin a course of two lectures on water power of the Empire. The Friday evening discourse on March 2 will be delivered by Dr. G. C. Simpson on the water in the atmosphere, and on March 9 by Dr. C. W. Saleeby on sunlight and disease.

BY arrangement with the grand committee of the Royal Institute of British Architects in charge of the bicentenary celebrations of Sir Christopher Wren, Messrs. Hodder and Stoughton will issue on February 26 a memorial volume, dealing with various aspects of Sir Christopher Wren's life and work, under the general editorship of Mr. Rudolf Dircks, librarian of the Royal Institute of British Architects. The volume is being published at five guineas and upwards, and all the profits from its sale will be handed over to the St. Paul's Cathedral Preservation Fund.

AN exhibit of special interest at the present time will be found in Museum No. I. at Kew Gardens, in Case 128 on the ground floor. It consists of a collection of funeral wreaths, garlands, flowers, leaves, fruits, seeds, etc., in excellent preservation from ancient Egyptian tombs, including those of Aahmes I. and Rameses II., kings of Egypt of dates respectively 1700 B.C. and 11–1200 B.C. The flowers chiefly used are those of *Nymphæa cærulea, Acacia arabica*, var. *nilotica*, together with leaves of *Mimusops Schimperi* and *Salix Safsaf*. It may be noted that the various flowers, seeds, etc., are identical with those of the same species found growing at the present day.

AT the annual general meeting of the Society of Public Analysts held on February 7, the following officers and council were elected for the ensuing year:—*President*: P. A. Ellis Richards. *Past-Presidents*: Leonard Archbutt, A. Chaston Chapman, Bernard Dyer, Otto Hehner, S. Rideal, A. Smetham, E. W. Voelcker, and J. Augustus Voelcker. *Vice-Presidents*: F. W. F. Arnaud, F. H. Carr, and G. W. Monier-Williams. *Hon. Treasurer*: Edward Hinks. *Hon. Secretary*: E. Richards Bolton. *Assistant Hon. Secretary*: R. G. Pelly. *Other Members of Council*: H. Ballantyne, S. F. Burford, S. Elliott, B. S. Evans, E. M. Hawkins, Harri Heap, H. F. E. Hulton, Andrew More, A. E. Parkes, W. R. Schoeller, G. R. Thompson, and J. F. Tocher.

THE following officers and other members of Council of the Royal Meteorological Society were elected at the annual general meeting on January 17:—*President*: Dr. C. Chree. *Vice-Presidents*: Mr. R. H. Hooker, Dr. A. Crichton Mitchell, Dr. G. C. Simpson, Dr. G. T. Walker. *Treasurer*: Mr. W. Vaux Graham. *Secretaries*: Mr. J. S. Dines, Mr. L. F. Richardson, Mr. G. Thomson. *Foreign Secretary*: Mr. R. G. K. Lempfert. *Councillors*: Mr. C. E. P. Brooks, Dr. John Brownlee, Mr. David Brunt, Capt. C. J. P. Cave, Mr. J. E. Clark, Mr. R. Corless, Mr. F. Druce, Col. H. G. Lyons, Mr. H. Mellish, Sir Napier Shaw, and Mr. F. J. W. Whipple. *Assistant Secretary*: Mr. A. Hampton Brown, 49 Cromwell Road, South Kensington, S.W.7.

The Journal of the Camera Club, which first appeared in 1886 and was issued at regular intervals for twenty years, was one of the foremost of publications connected with photography. The authorities of the Club feel that the time is now ripe to begin a new series. It has been decided to issue the Journal quarterly, and that it shall contain summaries of lectures given before the Club as well as articles on photographic subjects. The first number has just been published, and contains among its many items technical articles by Dr. Alexander Scott, Mr. Chapman Jones, and others. The whole number is interesting, even to non-members of the Club, to whom its price is 6*d*.

The Ministry of Agriculture is able to announce, as the result of conferences held at Washington in May and October last, that bulbs of Chionodoxa, Galanthus, Scilla, *Fritillaria imperialis*, *F. Meleagris*, Muscari, Ixia and Eranthis, have been added to the list of bulbs permitted unlimited entry into the United States, the permission holding good for a period of three years from January 1 last. The activities of the phytopathological service of the various countries at the ports continue to increase; bulbs now reach this country from Holland guaranteed by the inspection services of the Netherland Government. British potatoes may receive certificate of immunity after trial at the official station of the Ministry of Agriculture and Fisheries at Ormskirk, and the British phytopathological services receive increasing demands for inspection service before export. In the present state of our knowledge of plant pathology the requirements of these services raise many problems requiring further research; thus it is very difficult to say in the case of transplanted stocks, whether a swollen structure at the base is a somewhat excessive callus or a form of crown gall. Such questions seem to indicate the advisability of leisurely inspection at the nursery before despatch rather than examination at the port just before shipping. This plan is largely adopted, and recalls to mind the advantages and disadvantages of the Central Passport or Permit Offices which dealt with civilian travellers during the war.

The eighth Bulletin of the Non-Ferrous Metals Research Association contains much valuable material. Good progress is being made with the systematic researches undertaken on behalf of the Association, and an extensive investigation is now planned, dealing with the subject of die-casting alloys. The scale of this investigation, which is of interest to the electrical as well as to the engineering industries, will depend on the amount of support received from firms making use of die-casting in some form. It is proposed to undertake work in three sections, dealing respectively with aluminium alloys, brass and bronze alloys, and alloys of low melting-point, the laboratories selected being the National Physical Laboratory, the Research Department of Woolwich, and the University of Sheffield. A new feature of the Bulletin is an article by Prof. Courtman on recrystallisation, with a bibliography of 73 items. Such summaries of published work are likely to prove valuable to members. Abstracts of important papers are also included, but in view of the extensive abstracting of the Institute of Metals it is intended to confine this part of the work to a small number of papers of special technical importance. The Association has adopted a very liberal policy in regard to publication.

*Modern Wireless* is a new magazine which promises to play an important part in popularising the art of radio communication, and guiding the development of methods of broadcasting. The first number, which was published in February, begins an interesting series of articles by Sir Oliver Lodge describing the method of transmission of wireless waves. There is also an important article by P. R. Coursey describing methods of receiving radio signals from electric lighting wires. It is not generally known that in many cases an aerial is an unnecessary adjunct to a broadcast receiving set. All that is necessary is to connect the set through a plug and a small condenser to any electric light fitting indoors. If a gas pipe or a water pipe is available we can use it for the earth, but in many cases, as Mr. Coursey points out, even this is not necessary. All that is required is to have access to the electric lighting wires whether the supply be direct or alternating. As an aerial is objectionable for several reasons, this method will help to popularise broadcasting, but it will make it difficult for the Post Office to enforce the purchase of a broadcasting license. There are many other interesting articles in this number. We congratulate the editor, Mr. J. Scott-Taggart, who is a well-known radio expert, on his success in making this issue interesting and easily understood, and yet maintaining high technical accuracy.

The recent issue of the index parts of *Science Abstracts* completes Volume 25 of each of the sections —Physics and Electrical Engineering—for 1922. While the Electrical Engineering volume has nearly the same number of pages, 650, as last year, the Physics volume has increased by 90 pages, and now has nearly 1000 pages. The number of abstracts has increased by about 50 in the former and about 460 in the latter section, and there is a slight reduction in the average length, 0.486 page, of an abstract in the former and a considerable reduction, from 0.398 to 0.364 page, in the latter section. Ten years ago the figure was 0.317 page, and it is extremely doubtful whether the intrinsic value of scientific papers has increased in the interval to a sufficient extent to justify the increased length of the average abstract. Whatever opinion may be held on this question, there can be no doubt that *Science Abstracts* fulfils with conspicuous success its task of placing before its readers a short account of the advances made during the year in the subjects with which it deals, and that as a result it should receive every support from electrical engineers and physicists.

## Research Items.

Mental and Physical Characters in Race Study.—In the February issue of *Discovery*, Prof. H. J. Fleure discusses the influence of racial on mental characters. This region is, as he remarks, still uncharted by science, and the discussion is difficult because the material still remains to be collected. But racial peculiarities are strangely persistent, as, for example, in Wales, where the predominant type is in all probability due to descent, with modification, from the early Neolithic inhabitants, though it has been modified by emigration. At any rate, he rightly protests against the too common habit of treating mental characters, be it of French, Germans, or Britons, in the mass. "In each national group are many racial mosaics, and similar groups of characters occur in all. There are differences of social expression and lack of expression connected with social and historical facts, and these are apt to vary from century to century." But behind all these there are correlations of physical characters with psychical characters which at present we are unable to correlate scientifically.

The Future of Architecture.—In a recent issue of the *Sociological Review* (vol. xv. No. 1), Mr. S. C. Ramsey discusses the regional and vocational influences of architecture. The finest and most consistent architecture the world has ever seen was, he says, that of the ancient Greek quarryman. We can scarcely follow the writer in supporting the position that the sailor has been "the energiser and inspirer" of our buildings, nor in the assertion that "Victorian civilisation was essentially a miner's civilisation, the improvisation of the mining camp, and Victorian building was mainly of the camp or settlement variety, temporary and muddled, without real tradition, permanence, or ordered beauty." He sees hope in the houses erected under the Ministry of Health, where "mounting prices and the need for rigid economy have lopped off the extraneous and hideous features beloved of the Speculative Builder." He looks forward to the time when the person who expresses his individual pride in the building of a luxurious private house will not exactly be shunned, "but looked on a little critically," and "energy will be lavished on public buildings for the enjoyment and benefit of the community as a whole." It may be some time before this stage is reached, but meanwhile the writer's view of the position cannot safely be ignored.

Crime and Poisoning.—Lt.-Col. J. A. Black, Chemical Examiner for the Punjab, has issued a report on the work of his department (Lahore: *Civil and Military Gazette* Press, 1921). The greater part of the report deals with matters involving the investigation of crime and especially of poisoning. Instead of expert witnesses being examined and cross-examined in a trial for poisoning as in England, the evidence of the Chemical Examiner is taken in Indian Courts, frequently in the form of a written statement. His report, therefore, contains a categorical account of the results of his analysis without indulging in probabilities or opinions, and leaving deductions, unless these are obvious, to the interpretation of the civil surgeon, whose duty it is to guide the Court. The Court does not appear to be otherwise guided in respect of matters purely chemical. The volume of work in connexion with cases of poisoning is considerable in the East, where homicidal poisoning is very prevalent, and suicidal poisoning, often from motives which appear perfectly inadequate to the Western mind, is very common. The difficulties are increased by the fact that cases of serious illness, and even of death, frequently occur without the attendance of qualified medical men, and the replies made by the police on the prescribed forms are frequently of little value. Col. Black enlivens his report by the narration of several picturesque cases which have come under his notice. The task is rendered somewhat easier by reason of the fact that the poisons available are mostly well-known, and on account of ignorance of the fatal dose, a large excess is usually administered, so helping to simplify the work of the chemist. For some of the poisons, when no chemical test is available, the microscopic appearance of the plant used is frequently quite diagnostic. Simple physiological tests are frequently made, and facilities have been afforded by setting up in Calcutta a laboratory for applying serological tests for the whole of India. Col. Black is of the opinion that no very subtle form of poisoning exists in India.

Chaparral Scrub in California.—The broad sclerophyll vegetation of California forms the subject of a communication by W. S. Cooper (Carn. Inst. Wash. Pub., No. 319) in which the ecological relationships of these types of vegetation are treated in some detail. The author is able to justify and develop the point of view of Schimper, that these types of vegetation, like the Mediterranean "maqui," develop in regions of winter rains and long dry summers. Thus the annual cycle of the "chaparral" scrub in California includes a summer period of four months in which the soil contains practically no available water, while the winter rains coincide with low temperatures. The growing period is thus limited chiefly to short periods in spring and autumn. Two main types of vegetation are compared in detail, the broad sclerophyll forest and the "chaparral," and it is shown that the habitat of the latter differs mainly in its more extreme water relations. Anatomical details of the plants in relation to habitat are well treated, a curious feature being the presence of mycorhiza in the roots of the dominant chaparral species, although the soils only average 0·1-0·3 per cent. of humus.

Mites and Rotifers from Spitsbergen.—The Journal of the Quekett Microscopical Club, November 1922, contains an account by Mr. Julian Huxley of the Oxford University Expedition to Spitsbergen in 1921, followed by two reports on the collections of mites and rotifers. The aim of this expedition was primarily the study of Arctic life from an ecological standpoint rather than the search for new species, and the results promise to be of great general interest, especially from a biological point of view. Many new forms have, however, been discovered in addition to numerous new records for Spitsbergen, and as the work proceeds the number will be considerably increased. In the report on the mites, Mr. Soar describes and figures a species of Hydracarina, *Sperchon linearis* Sig Thor, taken in large numbers at Bear Island, hitherto known only from the high mountain districts of Norway and Sweden. He suggests that its appearance in Spitsbergen may be due to the agency of birds; the ova of the mites, which are deposited on stones, being probably conveyed there on the feet of birds. Mr. Bryce in his report makes similar suggestions for the occurrence of the rotifers—the agency of birds or transport by winds. He gives a valuable summary and revision of all the Rotifera found up to the present in Spitsbergen. The total number of species is now 81, of which 70 are actually more or less common in Great Britain. Twenty-eight species were taken by the expedition, of which ten are new records, one being also new to science, but even this species shows no striking variation from already known European varieties. A list is given of mosses identified by Mr. H. N. Dixon, with their localities and details of the rotifers and tardigrades they harboured. The new species of rotifer and a new parasite are described and figured.

FUMAROLES IN ALASKA.—A volcanic eruption on a great scale in June 1912 smothered in half a foot of ashes the town of Kodiak in southern Alaska. This was traced to the Katmai volcano about 100 miles to the west in the long Aleutian chain of volcanoes. In 1915 the U.S. National Geographic Society sent a preliminary expedition to examine the region. The next year a larger expedition discovered to the west of Mount Katmai the remarkable valley of the Ten Thousand Smokes which was explored in 1917, 1918, and especially 1919. These explorations were conducted by Dr. R. F. Griggs, who describes them in "The Valley of Ten Thousand Smokes" (National Geographic Society, Washington). The valley, which has an area of about 30 to 40 square miles, is floored with Jurassic sandstones and shales overlain in places by volcanic rocks. Lines of fumaroles skirt the sides and cross the valley to the number of 10,000 or more. The fumaroles generally have a temperature of 200° C. to 300° C., but some records of over 500° C. are given. Analyses of the gases showed steam to be the principal constituent, but appreciable quantities of hydrofluoric acid were present. From earlier accounts of the district it is clear that these volcanic manifestations in the valley date from the eruption of Katmai in 1912. The text is admirably illustrated by photographs, maps, and coloured plates, and gives a full account of the valley and the work of the expeditions. It is written in a popular vein but embodies a great deal of scientific interest. The study of the vegetation in relation to the ash deposits is of particular value. The valley with Mount Katmai and the surrounding country, to the extent of 1700 square miles, has been declared by the United States Government a "National Monument" reserved from settlement or exploitation.

BACTERIA AND TRAVERTINE.—An interesting case of the promotion of rapid deposition of travertine by bacterial action has been described at some length by Mr. John Parry in a lecture given before the Diamond Fields Mining Institute at Kimberley, S. Africa (Report in *Chemical News*, vol. 125, pp. 225, 241, and 257, 1922). The organisms, which are compared in their action with Drew's marine *Bacillus calcis*, occur in water streaming down the shafts of Kimberley mines, and they produce deposits of fibrous calcium carbonate in iron pipes and crusts on planks and tunnel-floors. These deposits have a lustrous black surface, which is attributed to organic matter derived from decaying timber in the mines. Evaporation clearly plays no part in the accumulation.

THE UPPER AIR IN INDIA.—A presidential address by Mr. J. H. Field to the section of physics and mathematics of the eighth Indian Science Congress on "The upper air: objects and methods of research in India," is printed in the Proceedings of the Asiatic Society of Bengal, vol. xvii., 1921, No. 4. The subject of the address was chosen as the science of meteorology has during recent years attracted to its side physicists and mathematicians of eminence who are rapidly evolving order out of chaos. In contrast to the temperature changes experienced at the ground by day and night during summer and winter, it was pointed out that at the height of half a kilometre (1640 ft.) India enjoys an equable temperature throughout the twenty-four hours. Similarly with wind, both in direction and force, great changes very commonly occur within the lowest layer. Passing upwards through a range of many kilometres, the temperature, which has been falling more or less steadily to very low values, shows a sharp halt in its rate of fall, or the "lapse-rate" suddenly becomes zero. This startling change occurs in India at a height of about 10 kilometres; near the equator it lies at about 17 kilometres, and from the equator it falls continuously with increasing latitude toward the poles, where it seems to lie at a height of about 7 kilometres. Reference is made to observations of the upper air carried out in India by means of free-flying balloons and the theodolite and by means of balloons and kites carrying self-recording meteorological instruments; many clever devices have been introduced to adapt the observations to Indian climate. The solution of rainfall problems in India is alluded to as a matter of life and death, controlling as it does the dread spectre of famine. It is the business of the Indian meteorologist to forecast with all possible speed the rains both in the monsoon and in the cold weather.

THE GREEN RAY.—Instructor Lieut.-Commr. F. W. Shurlock, R.N., of H.M.S. *Royal Sovereign*, sends the following notes describing observations of the green ray: At Vigo, on January 21 and 22, the sun set behind an island. On January 21 one tip of the disappearing segment showed the green tint, while the other was indistinct, probably owing to irregular refraction. On January 23 the disc was red and changed to magenta. At sea, off Oporto on January 24, the two tips were green. The green portion broke up into irregular patches with colours resembling those of soap films. Just after sunset a row of irregular yellow patches appeared over the place where the sun's rim was last seen. At sea, off Cape St. Vincent on January 25, the sky being clear and the sun a golden yellow, a typical example was observed. The green colour started from the tips and flooded the exposed part of the disc. After sunset, a small diffuse patch of pale green appeared immediately above the place where the sun set and faded almost at once. The whole effect lasted about three seconds and was seen by a group of trustworthy observers. It is interesting to note that with a telescope ($\times 30$) the green afterglow was distinctly seen; with binoculars ($\times 6$) it was faintly seen; while unaided observers failed to detect it.

AN IMPROVED HYGROSCOPE.—Messrs. Negretti and Zambra have devised an improved hygroscope which indicates at a glance the percentage of moisture in the air. The hair hygrometer was originally constructed by Saussure, who used a hair to indicate changes of moisture, the hair elongating when moist and contracting when dry. Considerable improvements have been made by Messrs. Negretti and Zambra, and twelve or more hairs form the basis of the new instrument; human hair is specially selected and scientifically treated. The hairs are anchored by their lower ends and the upper ends are connected to a link which operates on a lever attached to the pointer spindle. The dial is graduated from 10 to 100 in percentage relative humidity. Readjustment of the instrument, if required, is quite simple. On the lower part of the dial is a scale to ascertain the dew-point if required. It is claimed that the instrument will be of especial value in many industrial processes, and various types are manufactured depending on the requisite conditions. A large type of the same instrument combined with a dew-point hygrometer has also been devised.

## Comparative Embryology of Plants.[1]

It is generally acknowledged that land-living plants have sprung from some algal source: that the land was invaded and that the invaders show form and structure adapted to sub-aerial life. If this be true, land-plants should still show features indicating their origin, and such characters should be expected to appear in their embryology. The higher algal structure is generally referable to the filament or row of cells with a free apex, and a base attached to the substratum. The individual commonly springs from such a source, amplified in various ways to form the adult. It is found that the comparative embryology of land-plants up to the seed plants themselves also suggest a filamentous origin. The apex is defined by the very first segmentation of the zygote: the base in bryophytes is the base of the sporogonium: in leafy plants it is the suspensor, recognised by Lang as a vestigial organ. He held that its presence is a last indication of the filamentous structure, a juvenile stage rapidly passed over in them, and often suppressed. The body thus visualised between apex and base may be called the primitive spindle.

Two distinct types of its orientation exist. In the first, the apex is directed to the neck of the archegonium (exoscopic). That is the characteristic of all bryophytes, and of Equisetum, Isoetes, and Tmesipteris. In the other, the apex is directed away from the neck (endoscopic), and it is found in lycopods, some primitive ferns, and in all seed-plants. An intermediate position is seen in certain ferns, including all the later types. In fact, with some exceptions, the distinction follows the major lines of affinity in the vegetable kingdom: therefore it is probably of high morphological importance. The interest will centre round the exceptions: and their explanation is probably to be found in the varying orientation of the archegonium.

The end of all higher embryology is the establishment of a leafy plant with its shoot pointed upwards. Where the archegonium points downwards, endoscopic orientation will lead directly to this result, but if the archegonium be inclined or inverted, the spindle will have to be inconveniently curved to secure that end. Many lycopods, selaginellas, and some ferns show awkward curvatures of the embryo to carry it out. But some of them have no suspensor: in these the awkward curves are absent. It is suggested that the inconvenience has been removed by abortion of the vestigial suspensor, which tied their ancestors down to the endoscopic orientation so inconvenient where the archegonium points obliquely, or actually upwards. The horsetails, Isoetes, and the leptosporangiate ferns would all be derivative in this respect. Having no suspensors, their initial polarity could be freely determined so that the apex would point from the first in the convenient direction.

Upon the spindle thus defined, whether complete or abbreviated by abortion, straight or curved, the appendages are attached. The leaves are possibly in phyletic origin, the results of distal dichotomy of the apex. But in fact they are attached laterally, and together with the axis they constitute the terminal bud. The first root is always of lateral origin in pteridophytes, and phyletically it is an accessory organ, absent in fact in the most primitive types. It is only in seed-plants that it appears to continue the axis downwards. Lastly, the "foot," which is so inconstant in its development, is clearly accessory also, in fact a sucker formed laterally where it is required. So the primitive spindle, defined by the apex of the shoot and with the tip of the suspensor as its base, appears to be a real and constant feature in the embryos of plants. But as it is liable to be abbreviated by the abortion of its base, and complicated at the apex and also lower down by the formation of lateral appendages of various sorts, it is often effectively disguised. Nevertheless, an adequate morphological and biological comparison of plants suggests that all their embryos are referable in origin to a filamentous source, such as is prefigured in the algæ.

[1] Abstract of the presidential address to the Royal Society of Edinburgh, delivered by Prof. F. O. Bower, F.R.S., on October 23, entitled "The Primitive Spindle as a Fundamental Feature in the Embryology of Plants" (Proc. Roy. Soc. Edin., vol. xliii. part i. p. 1).

## Exploitation of South African Fisheries.[1]

By Prof. J. STANLEY GARDINER, F.R.S.

THE Union of South Africa has consistently endeavoured to pursue a far-sighted policy in reference to the exploitation of its seas. A survey with the S.S. *Pieter Faure* was made twenty years ago and resulted in the starting of a trawler industry, while a series of volumes were published dealing with the fauna of the grounds. In 1920 the Union hired a whaler, the *Pickle*, 102 feet long, 20 feet beam, and 11½ feet draught, equipped the vessel with trawls, warps, and sounding gear, and sent it to explore the fishing area, Dr. Gilchrist being the scientific adviser. The ship was commissioned for 20 months. It was singularly unsuited in many respects for trawling in commercial fashion, being of too shallow draught and not of the right build, only hauling an otter trawl of 40 feet head rope, whereas a trawler of its size could employ one of 120 feet with resulting catch at least six times as great. Notwithstanding these drawbacks excellent work was done, 543 stations having been investigated, generally by 1-hour trawls, distance traversed 4 miles. While the hauls are thus closely comparable, they are difficult to collate with commercial fishing. They deal entirely with unexplored grounds; we should have liked a few on the known grounds, already frequented by steam trawlers, for comparison.

Commercial trawling is now carried on down to 300 fathoms, and the total area within these depths off South Africa is about 120,000 square miles. The grounds may be divided into three areas—the eastern off the shores from Kosi River to Port Elizabeth, 625 miles; the southern from the latter to the Cape, 360 miles; and the western from the Cape to Cunina River, 1080 miles. The eastern is mostly a 10-mile belt, sloping off steeply from 60 fathoms; this is the region of the Agulhas Current, which causes in most places a roughness unsuited to trawling. The southern is that of the Agulhas Bank, a name given to the southern broad point of the continental slopes, its edge 150 miles from the shore. The western has a broad slope, not bounded by any marked steep, about 60 miles across, half within the 100-fathom line; it is on the whole smooth and regular ground, and lying on the colder side of the Cape—average difference 10° F.—should prove good trawling ground with fish of similar quality to those of our own shores.

The two most important deeper water fish proved to be the stockfish, or Cape hake, and Macrurus,

[1] Union of South Africa: Fisheries and Marine Biological Survey. Reports Nos. 1 and 2 for the years 1920 and 1921. By Dr. J. D. F. Gilchrist.

or Cape whiting, both of which have their centres of intensity at 150 fathoms, or even deeper. There is also the kingklip (in appearance like a ling), the dogfish, various soles and other flatfish, but the variety of economically valuable trawl fish so far obtained is not great. New fishing areas were discovered off Durban and off the Umvoti River, but neither of these are of sufficient size for steam trawlers. However, crayfish up to 12 inches occurred in immense numbers, a commercial trawler subsequently, in a haul of 1½ hours, taking more than 10,000. The results of the investigation indicate an abundance of life on all this eastern ground, and it must carry its due proportion of fish. Many small areas suitable for trawling appear likely to be disclosed by further survey, but it is not an area for steam trawlers, though, like the west coast of France, it should develop in time a considerable population of "longshore" men.

Turning to the south and west the reports give indications here of the possible development of an immense fishery. The *Pickle* demonstrated to the local trawlers the potentialities of deep-sea fishing, and new areas were found within a few hours' steaming of Cape Town. The most northerly trawlings were off Luderitz Bay, and it would seem probable that there is good ground right down to Cape Town; we should also expect similar ground further north as far as Union territory extends. Before such ground can be exploited commercially it must be surveyed, so that trawlers may avoid rough patches. To know the depth and nature of the bottom is not enough, and trawling tests are essential. Doubtless the fish migrate at different seasons, so that the latter tests will have to be undertaken at least twice over. It is an expensive business, of course—the running expenses of a trawler would be about 1000*l*. per month—but the encouragement of food production is a vital necessity to all States, while fish-meal is a bye-product of high value. In any event it is clear that South Africa has to the south and west an area more than capable of supplying all the fish that can at present be consumed; the western grounds alone may well prove as rich as those to the south of Ireland of about the same area, which in 1910 produced 1·35 million cwts.

With these potentialities in mind it is extraordinary to find that the fishery vessel is to be given up. In substitution a survey vessel, *Crozier*, is to be used at intervals for fisheries work. To employ a twin-screw vessel with a complement of 80 hands for such work is wretched economy, work which can be better done with a trawler and a crew of 14. The phase of using such Admiralty vessels for fishery work is one which nearly every country of Western Europe has passed through and abandoned; surely South Africa would be well advised to learn by their experiences. In any event we trust that the series of special reports on the fauna obtained by the *Pickle*, commenced in report 2, will be proceeded with; they are of high scientific value.

## The Teaching of Elementary Geometry.[1]

THE Assistant Masters' Association recently appointed a committee to consider the teaching of elementary geometry; the report of this committee, backed by the authority of the Executive Committee of the Association itself, that of the Assistant Mistresses' Association, and that of the Educational Institute of Scotland, has now been published. The outstanding fact, and one of no little importance, is that the committee was appointed to produce an agreed sequence of propositions and has not done so. The terms of reference were:

(*a*) To examine the case for an agreed sequence;

(*b*) To suggest the best means of attaining the general adoption of the sequence agreed upon.

The most definite conclusions are:

VII. The committee does not feel that it is either desirable or possible at present to stereotype a sequence; and

I. No formal proofs should be required of Euclid I. 13, 14, 15, 4, 8, 26, 27, 28, 29. . . . The teaching of formal geometry should be based upon the quasi-axiomatic acceptance of these results.

The committee is unquestionably right in its belief "that the main difficulties due to variety of sequence will be removed if the first of its recommendations [*i.e.* I. just quoted] is generally accepted," and possibly the most valuable feature of the report is the extended currency it will give to this principle.

For the rest, the committee is concerned not so much with principles as with giving what help it can to the "very large number of teachers who do not claim to be experts in geometry" and who need "guidance amid the welter of sequences and methods . . . published during the last twenty years." From this modest and reasonable point of view little fault will be found with the detailed recommendations, though, as is freely admitted, there is room for difference of opinion on many points. A teacher who followed their scheme exactly would come to no harm.

The committee follows in the main the "Cambridge Schedule," with some expansions (which some will not think improvements) apparently designed to show exactly how it intends the propositions to be dealt with. For example, the section on areas begins with the rule for measuring the area of a rectangle and the section is more detailed than in the Schedule, clearly indicating a treatment different from Euclid's. It is pointed out at the end of Section VI. that Pythagoras's proposition and Euclid III. 35, 36 should be dealt with by the use of similarity as well as by Euclid's method. The report contains a needed warning (Recommendation IV.) against the slovenly use of the "method of limits" in dealing with tangency; and another (Recommendation V.) against ignoring the existence of incommensurables; "at the proper stage," the committee says, "the attention of the pupil should be called to the fact that the proofs given do not cover all cases."

A very important feature of the report is that certain propositions are marked with an asterisk, indicating that formal proofs of them should not be required in examinations. Some are marked also with a (†), indicating that no formal proof should be attempted in the class-room.

On this point the practice of Examining Bodies differs; most of them asterisk propositions, but some more, some less. It would undoubtedly be of great assistance to the schools if uniformity could be reached, and for this purpose the selection made by the committee might well be taken as the standard.

Altogether, the committee may be congratulated on its work; it has not set up obstacles to further progress, as with its terms of reference it easily might have done; on the other hand, the report will probably reach many teachers who need help and will give them much of the assistance they need.

[1] The Teaching of Elementary Geometry: Being the Report of a Special Committee appointed by the Incorporated Association of Assistant Masters in Secondary Schools. Pp. 15. (London: Oxford University Press, 1923.) 1s. net.

## Photograph of a Bright Meteor.

CONSIDERING the great frequency of the appearance of bright meteors which flash across the night sky, it is astonishing how few photographs of them have been obtained. The actual photographing of a meteor is really quite a simple matter, but the whole success of the operation depends on whether the camera is pointed to the position in the sky where a meteor happens to pass.

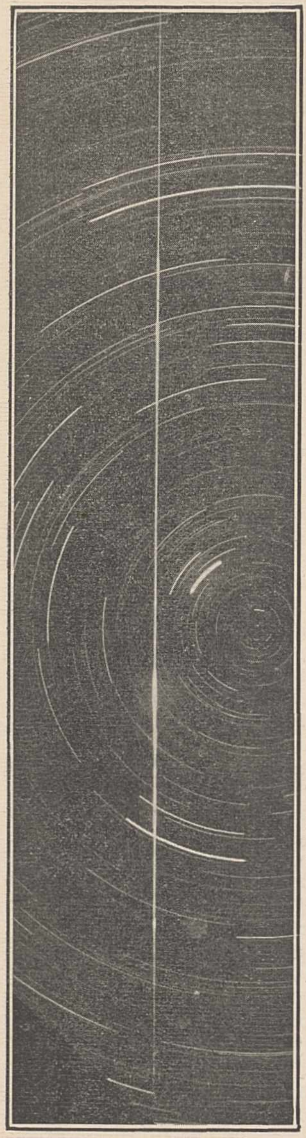

FIG. 1.—Photograph of a Taurid fire-ball.

While any camera will serve the purpose, a suitable instrument is one having a large aperture and short focal length. In a communication to the Royal Astronomical Society (Monthly Notices, vol. 83, p. 92) Dr. W. J. S. Lockyer describes a very interesting photograph which he has secured, and also the instrument used. The lens is an old portrait doublet having an aperture of five and a quarter inches and a focal length of twenty-eight inches; quite a suitable lens. This lens is mounted in a home-made box camera which carries a plate $8\frac{1}{2} \times 6\frac{1}{2}$ in. The field of the lens covers about 16 degrees.

For the purpose of photographing meteor trails, the camera is fixed firmly on a stand and pointed directly at the pole star. This direction is chosen because the stars make their trails completely on the photographic plate, these trails being portions of small circles. By comparing such trails with a star atlas all the stars can be easily identified and the position of the meteor trail accurately deduced. It is Dr. Lockyer's usual practice, when working at night with the 9-inch prismatic camera of the Norman Lockyer Observatory, always to expose as long as possible one plate in this meteor camera, which is erected just outside the dome.

During the night of November 16 last, the plate (Marion's "Record," H.D. 500) was exposed from $8^h\ 58^m$ to $11^h\ 12^m$ G.M.T. In the course of development the first images to appear were the trail of the pole star and a long streak across the plate which was the trail of a bright meteor. A reproduction of a portion of this plate (reduced by one-quarter) is shown in Fig. 1. The photograph shows practically the complete length of the meteor trail.

Considering the slowness of the movement of the image of the pole star (the short brightest trail near the pole) due to the earth's rotation, and the relatively great speed of the meteor—probably in any portion of its trail only a very small fraction of a second—the brilliancy of the latter must have been very great, judging by the great density of the trail.

The most striking feature of the meteor's trail is the great differences in intensity along its path. In some portions it is so bright that it has produced halation on the photographic plate (unbacked) as strong, if not stronger, than the pole star itself. These intensity differences are due most probably to the unequal volatilisation of the material forming the meteor.

It is interesting to note that the meteor trail, when traced on a celestial globe, passes close to a star named $\kappa$ Tauri, the radiant point, for that date, of slow-moving bright meteors, as determined by Mr. W. F. Denning. Evidently the meteor here photographed was a Taurid fire-ball and the brilliancy of its image was due to its comparatively slow motion.

## An Australasian Biological Collecting Expedition.

THE native animals and plants of Australia are of exceptional interest, and many of them are likely to disappear, or at least to become rare, as the result of the extension of the settled areas of the country—a process which has already been in operation for many years. The Trustees of the British Museum, recognising the importance of securing an adequate representation of this remarkable fauna and flora while there is yet time, have made arrangements for a collecting expedition, which started from London a few days ago. Mr. G. H. Wilkins, to whom the leadership has been entrusted, has special qualifications for carrying out his task with success. He is Australian by birth, and he has a good knowledge of the country, where he has many friends from whom he may expect to receive valuable assistance. He has travelled extensively in various parts of the world, and he has already acted as naturalist to several important expeditions. He spent four years, 1913–1917, on the coast of Alaska and in the Beaufort Sea, as a member of the Stefánsson Canadian Arctic Expedition. In 1920 he visited Graham Land with the Cope Expedition, and in 1921–22 he was with the Shackleton-Rowett Expedition, in the *Quest*, visiting South Georgia and the Antarctic Quadrant from Enderby Land to Coats Land. On the return journey valuable collections were made at Gough Island.

Mr. Wilkins expects to be able to obtain assistance, partly voluntary, in Australia, and thus to be provided with a scientific staff among whom the various branches of the work will be distributed. A special effort will be made to obtain good series of mammals, birds, insects, and other members of the land fauna, and to spare some time for the collection of plants. He will collect first in Queensland, at one or two selected stations, going south when the rainy season commences, revisiting Queensland in 1924, and reaching the Cape York Peninsula in one or both years.

A preliminary survey, on a smaller scale, by a collector employed by the Godman Exploration Fund Trustees, has shown that the representation of Australian mammals in the national collection is by no means so complete as it should be; and there is good reason to believe that the projected expedition will add considerably to existing knowledge. This preliminary work has been rendered possible by a generous gift made by Dame Alice Godman and her daughters, in memory of the late Mr. F. du Cane Godman, a trustee of the British Museum. The fund thus created will enable the Museum to do much useful work of a similar character, and its utility would be greatly increased if it were to be augmented by the contributions of other benefactors. It is not sufficiently realised that the work of the Museum is hampered in many directions by the want of funds which would perhaps be supplied from private sources if its needs were more generally known.

## University and Educational Intelligence.

Aberdeen.—Mr. W. W. M'Clelland, additional lecturer on education, has been appointed principal lecturer on education in the Edinburgh Training Centre.

The statutory meeting of the council of the Association of University Teachers of Scotland was held in Aberdeen on Saturday, February 10. Prof. F. O. Bower was appointed chairman of the council for the ensuing year, and Dr. W. W. Taylor, honorary secretary.

Bristol.—The following appointments have been made at the Agricultural and Horticultural Station at Long Ashton: Mr. H. Briton-Jones, as lecturer in mycology; Mr. Edward Ballard, as adviser in plant pathology, and Mr. H. P. Hutchinson, as organiser of research in willow growing.

Arrangements are being made for holding a summer school on August 3-17. Prof. Lloyd Morgan will again be president of the school, and Mr. W. W. Jervis will act as director of studies.

Geography will, in future, be included as a subject for the final part of the curriculum for the degree of B.Sc.

Cambridge.—Mr. G. E. Briggs, St. John's College, has been re-appointed demonstrator in plant physiology.

A further report of the Syndicate appointed to draft Ordinances to carry out the new statute for the admission of women to degrees has just been issued. In one very important point the report has now been modified; the women students are to be given the right to admission to University instruction effectively on the same terms as members of the University. It looks as though one chapter in this long-standing controversy is drawing to a close.

Revised regulations for the medical examination have been submitted to the Senate for approval. The transference of organic chemistry from the First M.B. examination to the Second M.B. examination will facilitate the process by which the First M.B. examination is passing from the University to the schools.

Edinburgh.—The University Court has accepted with much gratitude a gift by Mr. James A. Hood, of Midfield, Lasswade, of the sum of 15,000*l*. to endow a chair of mining. It is proposed that the chair should be established by the University and the Heriot-Watt College in co-operation.

The following appointments have been made: in the faculty of science, Dr. Malcolm Wilson to be reader in mycology and bacteriology, and Dr. H. Robinson reader in experimental physics; in the faculty of arts, Dr. G. A. Carse to be reader in natural philosophy.

The Cameron prize in the faculty of medicine, which is given annually in recognition of some important and valuable addition to practical therapeutics, has been awarded for 1923 to Prof. J. J. R. Macleod, of the University of Toronto.

London.—A course of three free public lectures on "Recent Work on Inborn Errors of Metabolism" will be given by Sir Archibald E. Garrod, in the Robert Barnes Hall of the Royal Society of Medicine, at 5.30, on Wednesdays, February 28, March 7 and 14.

Oxford.—On February 13, Congregation had before it a proposal to establish a new final school in science and philosophy. The scheme was introduced by Prof. C. J. Webb and Mr. H. B. Hartley, and supported by Profs. H. H. Joachim and J. L. Myers. It was opposed by the Warden of Wadham and Mr. H. W. B. Joseph, and thrown out on a division by 66 to 38. Many will regret that an opportunity for bringing scientific and philosophical studies into closer relation has thus been lost. The arguments of the opposition that carried most weight were probably those that were concerned with matters of practical difficulty rather than of principle.

The reports of the Delegates for Forestry and of the Committee for Rural Economy were presented to Convocation on February 20. The former report gives the number of students at the beginning of the year as 76. Lectures were delivered on silviculture, general and tropical, forest management, mensuration, protection, policy, valuation, utilisation, botany, entomology, surveying, and engineering, by Prof. Troup, Sir William Schlich, and others. Parties of students were taken for practical instruction to France, Austria, and various stations in England. Full use was made of the practical training ground of Bagley Wood. The first of the Oxford Forestry Memoirs was issued during the year.

The Committee for Rural Economy reports the number of students of agriculture as 134. Lectures have been given by Prof. Somerville and others. The University farm has been largely used for practical demonstrations, and other farms have been visited and important papers have been published. A special study of farm management has been conducted under the auspices of the Institute for Research in Agricultural Economics. A research on soils is in progress by Mr. G. R. Clarke.

Both of these departments show evidence of great activity and efficiency. They have come to take an important part in the present life of the University.

An engineering scholarship, of the annual value of 70*l*., tenable for three years, provided by the South Wales Institute of Engineers, is being offered for competition by the University College of South Wales and Monmouthshire. Further information, and the form of application, may be obtained from the Registrar, University College, Cardiff. Applications must be received by, at latest, March 19.

The annual general meeting of the Association of Technical Institutions will be held at the Carpenters' Hall, Throgmorton Avenue, London, E.C., on Friday and Saturday, March 2 and 3. At the opening meeting the president, the Right Hon. Walter Runciman, will introduce the president-elect, Sir Alfred Herbert, who will deliver his presidential address. The following papers will be read on the Friday afternoon and Saturday morning: "Modern Systems of Apprenticeship and Training of Young Workmen with reference to Technical Education," Mr. W. Calderwood; "The Guilds of London and Technical Education," Mr. C. C. Hawkins; "The British Colour Industry—its Dependence on the Place of Research in the Scheme of Higher Education," Dr. H. H. Hodgson; "The Dyeing Industry, Research Work and Technical Education," Dr. Levinstein.

## Societies and Academies.

LONDON.

Royal Society, February 15.—E. R. Speyer: Researches upon the Larch Chermes (*Cnaphalodes strobilobius*, Kalt.), and their bearing upon the evolution of the Chermesinæ in general. Alternation of form is the normal course of biological development in all Chermesinæ, but it breaks down in *Cnaphalopes strobilobius*, Kalt. The Progrediens type of all Chermesinæ is potentially a winged form, and is not a true dimorphism of the Sistens type. The Sexuales are different morphologically from all other generations and are probably a new production in evolution. Species which are purely parthenogenetic have ceased to develop from an evolutionary point of view, and show the probable course of evolution in the various genera. Migration from one species of conifer to another is responsible for a duplication in the series of form-alternating, parthenogenetic generations; the series upon one conifer has become morphologically different from that on the other through the action of Natural Selection in two different environments. In existing species with two host-plants, that portion of the cycle which now takes place upon the definitive host-plant has arisen through a stimulus given by a recent return to sexuality, this accounting for the linking up of the two cycles and a duplication of the series of parthenogenetic generations.—G. V. Anrep: The irradiation of conditioned reflexes. Experiments were performed with tactile conditioned reflexes, the parotid gland being taken as the effector organ. The tactile reflexes established on one side of the animal irradiate without a measurable decrement into the other side of the animal. The conditioned inhibition is in broad limits a cruder form of inhibition than the differential inhibition. The irradiation of the conditioned inhibition follows in the main the rules established for the irradiation of the differential inhibition and that of the reflex itself. The short trace reflexes take an intermediate position between the simultaneous and the long trace reflexes.—M. Dixon and H. E. Tunnicliffe: The oxidation of reduced glutathione and other sulphydryl compounds. The reduction of methylene blue by the sulphydryl compounds, reduced glutathione, cystein, and thioglycollic acid, is an autocatalytic reaction. The active agent producing this catalysis is the disulphide form R.S.S.R. The disulphide compounds also catalyse the oxidation of the sulphydryl compounds by atmospheric oxygen. The form of the reaction curves is not autocatalytic. The reaction velocity in the cases of glutathione and cystein shows a sharp optimum at a $p$H of 7·4. Thioglycollic acid does not show this. The bearing of these results on the conception of the function of glutathione and related compounds in tissue oxidation processes is discussed.—J. C. Bramwell, R. J. S. McDowall, and B. A. McSwiney: The variation of arterial elasticity with blood pressure in man. A method is described by which the extensibility of an artery in living man may be measured at all internal pressures up to the diastolic pressure. As in the case of an isolated artery, the extensibility decreases as the internal pressure is increased.—L. J. Harris: On the existence of an unidentified sulphur grouping in the protein molecule. Pt. I.—On the denaturation of proteins. Pt. II.—On the estimation of cystine in certain proteins. The conditions under which the grouping reactive to nitroprusside is liberated from ovalbumin and other proteins, and of its survival in the proteose, peptone, and polypeptide molecule, were examined. The nitroprusside reaction, attributed by Arnold to cystein, may be due to the presence of a grouping of the thiopeptide type. Gravimetric estimation of cystine in proteins by a new method indicates that whereas in serum albumen the cystine accounts for 89 per cent. of the total sulphur content, in ovalbumin 86 per cent. of the sulphur still remains to be accounted for.—N. B. Laughton: Reflex contractions of the cruralis muscle in the decerebrate and spinal frog. In the decerebrate frog there was a prolonged tonic after-effect in the contraction of the cruralis muscle on reflex stimulation of the ipsilateral sciatic nerve. No such tonic effect was observed in the cruralis muscle of the spinal preparation. A shorter latent period and a more rapid increment of height were marked in the spinal preparations. During spinal shock the height of the reflex contraction in the spinal frog is not maximal. In half the experiments the height of the myogram was greater in the decerebrate than in the spinal preparations.

British Mycological Society, January 20.—H. Wormald: Crown gall on nursery stock. Résumé of crown gall investigations and account of crown gall on apple stock in this country.—Miss W. Ridler: The fungus present in *Lunularia cruciata*. The fungus is not constant in occurrence, but when it occurs, it is definitely localised. There is no evidence that the fungus has any effect on the production of sexual reproductive organs or gemmæ or on the size of the plants. The association is regarded as harmless parasitism on the part of the fungus.—A. S. Horne: The systematic characters of closely allied strains of Fusarium were described. Spore shape, dimensions, and septations have proved exceedingly variable and of less relative value in classification than occurrence of sclerotia, chlamydospores, colouring principles, relation to active hydrogen, etc. "Sectoring" often occurs in culture and has resulted in increase in the number of strains from 6 to about 14.—W. Brown: Experiments on growth rate and cultural factors of the same species of Fusarium. The amount of "staling" varied in different strains. Practically any cultural characteristic can be developed in any one strain by choosing suitably the composition of the various constituents of a synthetic medium.—J. Ramsbottom: Berkeley and Broome: An account of the way in which these two mycologists became interested in the study of fungi and associated together, as shown by their correspondence in the British Museum (Natural History).

Geological Society, February 7.—Prof. A. C. Seward, president, in the chair.—G. Vibert Douglas: Geological results of the Shackleton-Rowett (*Quest*) expedition. The more detailed work commenced in South Georgia, which lies 900 miles east of Cape Horn and is 100 miles long by 20 miles in width. It is an upland dissected by glacial action. The glaciers in general show signs of withdrawal. The island consists of sedimentary rocks and, at the south-eastern end, igneous rocks. The sediments may represent two periods of deposition, divided by an unconformity. The rocks all show signs of metamorphism, and the strike of the folds and lamellæ of the phyllites indicate that the pressure came either from the south-south-west or from the north-north-east. Elephant Island is situated in the Powell group of the South Shetlands and is an ice-covered plateau rising to 1200-1500 feet above sea-level. The Tristan da Cunha Group, 1500 miles west of the Cape of Good Hope, are of volcanic origin. Gough Island, more than 200 miles south of the Tristan da Cunha Group, is 8 miles long by 3 miles in width. It is a monoclinal block, with dip-slopes to the west and escarpments to the east. The lavas forming these features are basaltic, and intrusive into these lavas is a trachytic stock. Following this intrusion the basalts were cut by a series of doleritic dykes. In general, it is similar to Ascension and St. Helena Islands.

DUBLIN.

Royal Dublin Society, January 23.—Prof. J. A. Scott in the chair.—J. Joly: Isostasy and continental drift.—H. H. Dixon and N. G. Ball: The structure of the vascular supply to the storage organs of some seedlings. According to the view that the tracheæ convey material only in an upward direction, and are not functional in the downward transport of organic substance in the plant, the organs connecting the stores of organic substances with embryos would either contain no tracheal (woody) strands, or would possess only vestigial traces of this tissue. In the seedlings of *Lodoicea sechellarum*, *Phœnix canariensis*, *P. dactylifera*, *P. silvestris*, and of *Vicia faba*, the petiole of the cotyledon transports the stored organic material to the growing embryo, and in the bundles the tracheal or woody strand is normally developed, and in some cases, at least, the tracheæ are differentiated earlier than the sieve-tubes. Hence the structure of these seedlings is in agreement with the view that the wood transmits organic materials.

PARIS.

Academy of Sciences, January 29.—M. Albin Haller in the chair.—Georges J. Rémoundos: The iteration of multiform functions.—A. Angelesco: A class of polynomials and an extension of Taylor's and Laurent's series.—E. Gau: The study of invariants relating to the characteristics of partial differential equations of the second order with two independent variables.—Birger Meidell: The probability of errors.—Paul Piketty: Cold hardening by drawing. The method of M. Seigle for increasing the strength of metal bars by extension up to the elastic limit was utilised by the author in 1911 for reducing the weight of steel in reinforced concrete construction.—Jean Chazy: The expression of Einstein's law in Cartesian co-ordinates.—MM. Huguenard, Magnan, and A. Planiol: A compensated hot wire anemometer. The most convenient way of mounting a hot wire anemometer is to measure the fall of potential over a resistance placed in the circuit containing the hot wire. The curve showing the gas velocity as a function of the potential differences is nearly parabolic, and as a consequence accurate measurements can be made only over a narrow field. If the shunt be replaced by a fine platinum wire of variable resistance, the conditions can be arranged to give a linear relation between the potential differences and the gas velocity.—Rodolphe Soreau: The laws of variation of the characteristics of standard air with altitude. A new formula is deduced for the pressure as a function of the altitude in which the temperature of the air is eliminated. The pressures calculated from the equation agree well with the experimental results, the latter being computed from 89 observations with balloons at heights ranging up to 20,000 metres.—L. Décombe: The theory of gravitation.—M. de Broglie and J. Cabrera: The gamma rays of the radium and thorium family studied by their photo-electric effect. The apparatus described in an earlier communication has been applied to determine the wave lengths of the gamma rays of the mesothorium group.—A. Portevin and P. Chevenard: The dilatometric study of the alloys of aluminium with magnesium and silicon. The coefficients of expansion of the alloys were obtained by a differential method against a standard of pure aluminium.—Mlle. G. Marchal: The dissociation of silver sulphate. The dissociation was studied over the temperature range 820° C.-1220° C., and the partial pressures of oxygen, sulphur dioxide, and sulphur trioxide calculated for 28 temperatures between these limits.—Paul Mondain-Monval: The law of solution. Sodium nitrate obeys the solubility law of Le Chatelier very closely.—Edouard and Remy Urbain: The atmolysis of a gaseous mixture containing several constituents. Application to the mixture utilised in the sulphuric acid industry by the contact method.—F. Loewinson-Lessing: A relation between the atomic numbers and atomic weights of the chemical elements. Starting with helium, for the first twenty elements the atomic weight is equal (within one unit) to the sum of the atomic number of the element and of that immediately succeeding it.—L. J. Simon and G. Chavanne: A new method of preparation of monochloracetic acid. The preparation is based on the hydration of trichlorethylene by sulphuric acid (90-93 per cent.) at a temperature of 170° C. The yield is more than 90 pei cent. of the theoretical.—M. Tiffeneau and Mlle. J. Lévy: Pinacolic and semi-pinacolic transpositions. Comparison of the aptitude to migration of various radicals. In these transpositions the migrating tendency of the ethyl and benzyl groups is much more marked than with the methyl radical. No satisfactory explanation for this can be given.—A. Briquet: The invasion of the sea on the coast of Berck and the teachings of recent geology. The encroachments seriously threaten the Haut-Banc light and the City of Paris Hospital. The causes and possible engineering remedies are discussed.—F. Raspal: Temperature measurements in trial borings 1700 metres deep near Molières (Gard). At 1674 metres depth the temperature was 82°·5 C. A rise of 1° C. per 24·3 metres was found as an average over the range 300 metres to 1674 metres.—Pierre Bonnet: The existence of the upper Silurian and lower Devonian in southern Transcaucasia.—G. Pontier: The presence of *Elephas planifrons* in the red crag (English Upper Pliocene). An account of a detailed examination of a molar of *E. planifrons* found north of Felixstowe in 1922.—J. Thoulet: Relation between the depth of the line of appearance of mud and the depth of the waves.—Ph. Wehrlé and R. Cordebas: The notion of phase in the study of the undulatory perturbation of pressure.—Marcel Mirande: Special elaborating organites (sterinoplasts) of the epidermis in the scales of the bulb of the white lily.—Robert Stumper: New researches on the venom of ants. Determinations of the percentages of formic acid from three species of ants (*Cataglyphis bicolor*, *Camponotus æthiops*, and *Camponotus maculatus*). Formic acid was proved to be the only free volatile acid present.—E. Aubel: The microbial metabolism of lactic and pyruvic acids.—René Legendre and Maurice Nicloux: A mask designed for administering oxygen in artificial respiration. After poisoning by carbon monoxide or other gases, the efficiency of the usual methods of artificial respiration is much increased if oxygen is simultaneously administered. The mask described resembles those used in administering anæsthetics, and leaves the eyes uncovered. It is furnished with two valves and is of small capacity. Schafer's method of artificial respiration is recommended.—Georges Mouriquand and Paul Michel: The experimental conditions of the action of cod liver oil. Its osteodystrophic power in the presence of an insufficient food regime.

## Official Publications Received.

Ministerio da Agricultura, Industria e Commercio. Annuario publicado pelo Observatorio Nacional do Rio de Janeiro, para o anno de 1923. (Anno 39.) Pp. xiv+462. (Rio de Janeiro: Imprensa Nacional.)

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico: anno de 1911. Pp. v+94. Boletim Meteorologico: anno de 1917. Pp. 147. Boletim Meteorologico: anno de 1918. Pp. v+139. (Rio de Janeiro.)

The Carnegie Trust for the Universities of Scotland. Twenty-first Annual Report (for the Year 1921-22) submitted by the Executive Committee to the Trustees on 14th February 1923. Pp. iv+81. (Edinburgh.)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1922. (Publication 2709.) Pp. iii+125. (Washington: Government Printing Office.)

Věstník Královské České Společnosti Nauk. Třída Matematicko-Přírodovědecká. Ročník 1920. (Mémoires de la Société Royale des Sciences de Bohême. Classe des Sciences. Année 1920.) Pp. iv+17+20+21+11+20+6+43+93. (Prague: F. Řivnáč.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1921. Pp. iv+44. (Trinidad.) 6*d.*

## Diary of Societies.

*SATURDAY*, February 24.

Royal Institution of Great Britain, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (2).

British Psychological Society (at Bedford College), at 3.—Prof. T. H. Pear: An Examination of some Current Beliefs concerning Muscular Skill.—Miss M. MacFarlane: The Use of Mental Tests in American Schools and Clinics.

*MONDAY*, February 26.

Victoria Institute, at 4.30.—Dr. A. T. Schofield: The Voices behind Spiritism.

Institute of Actuaries, at 5.—P. H. McCormack: Damaged Lives and Options.

Fellowship of Medicine (at Royal Society of Medicine), at 5.30.—C. Rowntree: Cancer of the Breast.

Institution of Mechanical Engineers (London Graduates' Section), at 7.—Prof. E. G. Coker: Photo-Elastimetric Researches on Mechanical Engineering Problems.

Royal Society of Medicine (Odontology Section), at 8.—Adjourned Discussion on: Dental Sepsis as an Œtiological Factor in Disease of other Organs.

Royal Geographical Society (at Æolian Hall), at 8.30.—Lt.-Col. T. T. Behrens: The Brenner Pass Boundary and Italy's New Province.

*TUESDAY*, February 27.

Royal Institution of Great Britain, at 3.—Sir Arthur E. Shipley: Life and its Rhythms: (1) Life and its Attributes.

British Science Guild (at Mansion House), at 3.30.—Sir Ronald Ross, Rt. Hon. Sir Joseph Cook, and others: The Importance of promoting Efficiency and Economy in Industry, Commerce and all Imperial Affairs by the Progressive Use of Science and Scientific Method.

Royal College of Physicians of London, at 5.—Dr. W. G. Savage: Canned Foods in Relation to Health (2).

Institute of Marine Engineers, Inc., at 6.30.—Eng.-Comdr. R. Beeman: Auxiliary Machinery.

Royal Photographic Society of Great Britain, at 7.—R. Chislett: Bird Life in the North Isles of Shetland.

Circle of Scientific, Technical, and Trade Journalists (at Institute of Journalists).—J. L. Greaves: Paper: Some developments in its Manufacture.—Discussion on the Requirements of Art, Trade, Technical and other Journals.

*WEDNESDAY*, February 28.

Geological Society of London, at 5.30.—S. H. Warren: The Late Glacial Stage of the Lea Valley (Third Report). With a Report on the Arctic Flora by Mrs. Eleanor Mary Reid and Miss Marjorie Elizabeth Jane Chandler.—S. H. Warren, with Appendices by Dr. C. W. Andrews, Mrs. E. M. Reid, and Miss M. E. J. Chandler, A. S. Kennard, B. B. Woodward, and M. A. C. Hinton: The *Elephas-antiquus* Bed of Clacton-on-Sea (Essex), and its Flora and Fauna.

Royal Microscopical Society (Industrial Applications of the Microscope Section), at 7.—Demonstrations and Exhibits.—C. Baker: The R.M.S. Microscope (New Model).—C. Beck: Mercury Globules under Polarised Light, with Special Reference to Dr. Owen's Communication read at the last Meeting.—A. Gallenkamp and Co., Ltd.: The Gallenkamp Electrometric Titration Apparatus, an "End Point" Indicator for all Acid, Alkali and Oxidation Titrations.—Adam Hilger, Ltd.: Interference Accessory for testing the Stands and Fine Adjustments of the Microscopes—Vertical Illuminator for the Microscopical Examination of Opaque Objects.—Ogilvy and Co.: Silverman Illuminator for Opaque Objects and Standard Illuminator, both showing Similar Specimens for Comparison of Image—W. Watson and Sons, Ltd.: A Petrological Binocular Microscope for Glass Examination, illustrated by Lantern Slides.—H. J. Denham: Some Mounting Media for Microscopic Objects, especially for Cotton and other Hairs and Fibres, and for general Microscopical Work.—T. Terrell, junr.: The Use of the Microscope in the Gas Mantle Industry.

Royal Society of Arts, at 8.—Prof. W. E. S. Turner: Heat Resisting Glasses.

British Psychological Society (Medical Section) (at Medical Society of London), at 8.30.—Dr. J. A. Hadfield: Some Observations and Criticisms of Psychotherapeutic Methods.

Royal Society of Medicine (Social Evening), at 9.—Sir William Hale-White: Pasteur in Relation to Medicine.—Prof. T. M. Lowry: Pasteur in Relation to Chemistry.—Dr. G. Monod: Pasteur as an Artist.

*THURSDAY*, March 1.

Royal Institution of Great Britain, at 3.—T. Stevens: Water Power of the Empire (1).

Institute of Chemistry at 4.30.—Annual General Meeting.

Royal Society, at 4.30.—A. Mallock: The Effect of Temperature on some of the Properties of Steel.—Prof. C. H. Lees: Inductively Coupled Low Resistance Circuits.—Lord Rayleigh: Studies of Iridescent Colour, and the Structure producing it. I. The Colours of Potassium Chlorate Crystals. II. Mother of Pearl. III. The Colours of Labrador Felspar. —Dr. L. V. King: The Complex Anisotropic Molecule in Relation to the Dispersion and Scattering of Light.

Royal College of Surgeons of London, at 5.—Dr. W. G. Savage: Canned Foods in relation to Health (3).

Linnean Society of London, at 5.

Royal Aeronautical Society (at Royal Society of Arts), at 5.30.—Major F. M. Green: Helicopters.

Child-Study Society (at Royal Sanitary Institute), at 6.—Prof. L. Hill: The Sun and Open-Air School.

Institute of Electrical Engineers, at 6.—Report presented on behalf of the British Electrical Research Association by S. W. Melsom and E. Fawssett on Permissible Loading of British Standard Paper-insulated Electric Cables.

Chemical Society, at 8.—N. V. Sidgwick: Co-ordination Compounds and the Bohr Atom.—W. H. Gray: Silver Salvarsan.—Prof. H. B. Dixon: On the Propagation of the Explosion-wave through Gaseous Mixtures.

Royal Society of Medicine (Obstetrics and Gynæcology Section), at 8.—S. Forsdike: The Treatment of Hæmorrhage at the Menopause by Radium, with a report upon 45 cases.

Camera Club, at 8.15.—G. B. Clifton: My Method of making Bromoil Prints.

*FRIDAY*, March 2.

Association of Technical Institutions (Annual General Meeting) (at Carpenters' Hall), at 11 and 2.—Sir Alfred Herbert: Presidential Address.

Empire Forestry Association (at Guildhall), at 3.—Annual Meeting.

Royal Society of Medicine (Laryngology Section), at 4.45.—Dr. J. Horne: Tumours in the Inter-Arytenoid Space of the Larynx.

Philological Society (at University College), at 5.30.—C. T. Onions: Dictionary Evening.

Junior Institution of Engineers, at 7.30.—C. Saxton: Glass-forming Machines.

British Medical Association (Marylebone Division), (at Medical Society of London), at 8.—Dean Inge: Religion and Medical Sociology.

Royal Society of Medicine (Anæsthetics), at 8.30.—Dr. W. G. M'Cardie: General Anæsthesia in ordinary Dental Surgery (to be followed by a discussion).

Royal Institution of Great Britain, at 9.—Dr. G. C. Simpson: The Water in the Atmosphere.

*SATURDAY*, March 3.

Association of Technical Institutions (Annual General Meeting) (at Carpenters' Hall), at 11 and 2.

Royal Institution of Great Britain, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (3).

### PUBLIC LECTURES.

*SATURDAY*, February 24.

Horniman Museum (Forest Hill), at 3.30.—S. H. Warren: The Interplay of Land and Sea.

*TUESDAY*, February 27.

London School of Economics, at 5.—Sir Josiah Stamp: Statistics, before, during, and after the War: Income and Wages.

*WEDNESDAY*, February 28.

London School of Economics, at 5.—Prof. Graham Wallas: The Competition of the Sexes for Employment (Stansfeld Lecture).

King's College, at 5.30.—Principal L. P. Jacks: The Limitations of Natural Science.

Royal Society of Medicine, at 5.30.—Sir Archibald E. Garrod: Recent Work on Inborn Errors of Metabolism. (Succeeding Lectures on March 7 and 14.)

*THURSDAY*, March 1.

Royal Institute of British Architects, at 5.—Sir Ryland Adkins: Architecture and the Countryside (a Layman's Question).

University College, at 5.30.—Prof. A. E. Richardson: The Public Buildings of Sir Christopher Wren.

*FRIDAY*, March 2.

King's College, at 5.30.—C. E. M. Joad: The Case for Pluralism (1). (Succeeding Lectures on March 9 and 16.)

*SATURDAY*, March 3.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murray: Legends of the Gods of Ancient Egypt.