NATURE

SATURDAY, APRIL 12, 1924.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

NO. 2841, VOL. 113]

Cambridge and Overseas Universities.

IT is not without significance that at a time when the University of Cambridge is suffering from overcrowding, several important steps should have been taken to facilitate the admission of the best students of other universities. The recent establishment of the research degrees of Ph.D., M.Sc., and M.Litt. has attracted a rapidly growing number of first-class graduates from the universities of the British Empire and promises the development of very important schools of post-graduate research. Research schools are no new thing in Cambridge, but a general development of research by young graduates in all branches of study is now taking place, and will succeed so far as Cambridge can find the right men to direct it and can adapt an elastic machinery to meet its requirements.

New developments bring fresh dangers. One difficulty has arisen already to which the University has replied by altering its rules as to affiliated students. These students may take degrees on two years' residence instead of three, and may, under certain conditions, proceed direct to Part II. of a Tripos examination without passing the more elementary Part I. Hitherto for these affiliated students it has been an essential part of their qualification that they should have passed in English, Latin (or Greek), one other language, and mathematics in one of the examinations leading to their previous degree. This has induced students not quite ready for research but well qualified to take the course for Part II. of a Cambridge Tripos, to plunge prematurely into the course for a research degree where the restrictions as to the nature of a student's earlier examinations are not in force. The new scheme adopted by Cambridge removes these restrictions for graduates with first-class honours of certain approved universities, who have attended classes at such a university for a period of not less than three years. Restrictions as to English, Latin (or Greek), one other language, and mathematics remain for the second-class honours graduate, and the privilege is removed from the third-class honours and the pass graduates. This is all in accordance with the general stiffening up of the conditions of admission, which is taking place throughout the University and naturally accompanies increased pressure on its accommodation. Greater elasticity in the conditions of admission of the best men is, however, wisely combined with the general raising of the standard for the admission of the weaker candidates.

That these new regulations are appreciated in Overseas universities, we have evidence in an article by Prof. H. S. Carslaw in the *Sydney Morning Herald* (January 22, 1924), from which we may quote a few passages :

"The truth is that Oxford and Cambridge have become much more than formerly graduate schools of the other universities at home. . . . J. J. Thomson and Eddington were graduates of Manchester, and Larmor of Belfast, Rutherford of New Zealand, and Elliot Smith of Sydney had each graduated before entering Cambridge. If the graduate of another university proceeds to Oxford or Cambridge at about 20 or 21, enters upon the shortened course for final honours, and throws himself into the life of his college, he is as welcome there and will gain as much from his residence there as any other member of the University. . . . It is because I am sure Oxford and Cambridge—and indeed any seat of learning where great men gather—can help us that I urge as strongly as I can the need for development here of such intercourse and interchange."

Prof. Carslaw's whole article is summed up in the last sentence quoted above. It is a frank and generous recognition of the value of graduate study at Oxford and Cambridge from one who entered Cambridge as a graduate of Glasgow and has since widened his university experience by years of distinguished service at the University of Sydney. He slightly overstates the privileges carried by affiliation, and it may not be amiss to state them here briefly. These privileges are (1) exemption from the University Previous Examination; (2) the allowance of up to one year's residence out of the three years required by the University; (3) on approval by the proper University Board of Studies, exemption from one part of a Tripos which has normally to be passed before entering another part of a Tripos.

A first list of universities recommended for approval for affiliation has been published. It includes all the universities of Great Britain and Ireland and certain University Colleges, the students of which prepare for degrees of the University of London. The list of universities of the British Empire is nearly complete, and it is to be presumed that certain universities of Canada and South Africa omitted from the present list will figure in an extension promised for a later date. American universities are well represented, though there are some obvious omissions. For American universities, the test of honours is not generally applicable; instead of graduating with first- or second-class honours, a student must graduate in the first sixth of his class (showing exceptional ability in some subject) or must graduate in the first half of his class respectively. Continental universities are for the moment represented solely by the Universities of Basle and Berne, a curious selection for which no explanation is offered.

Taken as a whole, the new regulations for affiliation may be taken as symptomatic of a desire to facilitate closer relations between Cambridge and other universities, and of the recognition of the need to keep high the standard of admission of students for the research degrees of the University.

Mendelism in Evolution.

The Mechanism of Mendelian Heredity. By Prof. T. H. Morgan, A. H. Sturtevant, Prof. H. J. Muller, and C. B. Bridges. Revised edition. Pp. xiv+357. (New York: Henry Holt and Co.; London: Constable and Co., Ltd., 1923.) 25*s*.

A GOOD deal of water has flowed under the bridges since the first appearance of this work by Morgan and his three best-known pupils, and we think that the second edition will be generally welcomed. Morgan's "Physical Basis of Heredity," published in 1919, was of more restricted scope, dealing chiefly with the chromosomes as such, whereas the present volume is concerned primarily with genetical problems. It is not necessary to detail the scope and standard of the book, since these are already well known. Suffice it to say that it has been thoroughly revised and brought up-to-date, and that two new chapters, on inheritance in unicellular organisms and on the Œnothera problem, have also been added.

A few minor criticisms may perhaps be made. P. 93: Winge has, as a matter of fact, made it probable that in fish at least there does exist a single sex-factor; and in any event a number of cases are known in which crossing-over takes place in both sexes in the autosomes, and one (Lebistes) in the X-Y pair as well. P. 276: Onslow's work on the pigments of rodents should have been mentioned, in which the factor for dominant white was shown to produce an inhibiting substance during development. P. 298: Unless we suppose that mutation occurs mainly at reduction or fertilisation, the criticism levelled at Jollos's work does not hold; and in any case statistical treatment of results obtained with and without special treatment would settle the point at issue. P. 306: The omission of the cytological results of Dobell and Jameson (Proc. Roy. Soc. 89, and *Q.J.M.S.* 64), which showed clearly that in certain Sporozoa reduction followed immediately after conjugation, is curious. The omission of the beautiful work of Blakeslee on chromosome mutations in Datura is also to be regretted. Apart from such details, however, the book remains one of the most lucid presentations of genetical theory.

The appearance of this new edition from the very fountain-head of neo-Mendelism may, however, serve as a useful peg on which to hang a few corrections of current misconceptions. If two pegs (of opposite sign!) are necessary, perhaps the letter from Mr. Tate Regan in NATURE of January 12 may be taken as the second.

Mr. Regan threw his glove into the Mendelian ring—or perhaps it would be better to say that he borrowed one from Prof. Johannsen for the purpose. If the

reviewer reads him aright, he approves of the idea, expressed as a mere suggestion by Johannsen, that "the whole of Mendelism [is] perhaps nothing but an establishment of very many chromosomical irregularities, disturbances or diseases. . . ."

This is a widespread point of view, nor does it lack considerable evidence in its support. In Drosophila, the only organism studied for the origin of mutations on a large scale, not only are many mutants definitely abnormal, but even the great majority of those which are not "pathological" have a slightly reduced viability.

Let us remember, however, that there are several quite separate problems involved. There are (1) the atomistic or factorial conception of the germ-plasm; (2) the origin of those variations which have been of importance in evolutionary change; (3) the mode of inheritance of this latter type of variation; (4) the possible difference between different species or groups as to the readiness with which they vary, and the mode by which this variation is being effected.

The first three problems are often jumbled together, through lack of clear thinking, into one omnibus problem—and this by Mendelians and anti-Mendelians alike. Let us consider them in order.

(1) This, it is safe to say, has been put on an impregnable basis, more particularly by the discovery of the Morgan school, that each mutant factor not only segregates according to Mendel's laws, but also is situated in one chromosome, and has its own perfectly definite *place* in this chromosome with relation to other factors. When it is urged that, if all mutant factors are abnormalities, we are told nothing about any factorial composition of the *normal* germ-plasm, a very important point is forgotten. Each *mutant factor* implies a *normal allelomorph*. What is more, we can in a number of cases be certain of what is probable in all—namely, that the normal factor exerts the same type of effect as the mutant. The certainty comes from cases of multiple allelomorphism. When, for example, we find that not merely one but two, three, or even ten mutations may take place in the same factor ("sameness" shown by each mutation occupying the identical locus in a particular chromosome), and that these various mutations all affect the same organ, we can be certain that the normal allelomorph also affects this same organ. Such examples as the white-eosin-red series of sex-linked mutations of Drosophila should serve to convince the most sceptical.

(2) Origin of variations in evolution. This is the problem which is most in dispute. A few mutations of Drosophila have been found which are equally viable with the wild type. But they are difficult of detection and analysis because they are of very small extent—in other words, because they resemble the type of variation chiefly postulated by Darwin as effective in evolution! It is, however, possible (problem 4) that different species differ in the readiness with which they vary. In any case it is certain that they do differ very much indeed in the number of Mendelising variations which they present in Nature. The species of Drosophila show singularly little genetic variation in Nature; in this respect they are very different from a population of maize or the species of Rubus, which contain many genetic (and Mendelian) types, *not*, however, necessarily differing in viability.

(3) But the question of the origin of mutations which show Mendelian inheritance is formally quite distinct from that of the *evolutionary value of factors already in existence*, which, however, show this same mode of inheritance. It is here that confusion is commonest.

Let us take a few clear cases chosen at random, and see whether their normality can well be attacked. (*a*) In heterostyled plants—an adaptation dear to the heart of Darwin—the two conditions differ by a single Mendelian factor (Bateson and Gregory, 1905, Proc. Roy. Soc., B, 76). As both are necessary for the continuance of the race, neither can well be considered abnormal. (*b*) In the equally remarkable animal adaptation seen in butterflies with polymorphic mimetic females, the differences between the forms depend on a few segregating factors (Punnett, "Mimicry in Butterflies," Cambridge, 1915). (*c*) The Nordic's blue eye (more accurately, the factor for pigment on both sides of the iris is dominant to that for pigment on the inner side only; see Punnett's "Mendelism" or other standard works) behaves as a Mendelian recessive to the dark eye. Will Mr. Regan maintain (even though, if the reviewer's memory is correct, he is himself dark-eyed) that the Nordic's eye-colour is in any sense pathological, due to a "disease of the chromosomes"? (*d*) Baur (*Zts. Abst. Vererb.* 3, 1910) made a cross between two species of snapdragon which not only gave fertile F 1, but also showed segregation in F 2. Difference in about twenty independent Mendelian factors must have constituted the difference between the two species. Similarly in animals, Detlefsen (Carnegie Publ. 205, 1914) was able to show that in two guinea-pig species, the genes for agouti banding of the hair were not identical, but formed an allelomorphic pair, which showed Mendelian segregation in back-crosses between the F 1 and one of the parent species. (*e*) Apart from the segregation of sex-determiners, which in many cases is probably a matter of whole chromosomes, or at least several linked factors, instead of single factors, Winge (*Journ. Genet.*, 13, 1923) has just made it probable that in the fish Lebistes there is a single Mendelian factor for maleness at a definite locus in the Y-chromosome,

and for femaleness in the corresponding locus in the X. Which—if either—of the two sexes in fish would Mr. Regan consider a disease? (*f*) Numerous examples of variation in Nature being due to Mendelian factors are known in Lepidoptera—of intermingled variations in one locality (Pictet, Acta Soc. Helv. Sc. Nat., 1922, etc.), of differences between geographical races (Pictet, *loc. cit.*), and of new varieties which have replaced the old, such as the melanic varieties of various moths (Garrett and Harrison, 1923, NATURE, 112, 240; Bateson, "Problems of Genetics," New Haven, 1913, ch. vi.).

Now it is not *necessary* that these should have originated in the same way as the mutations seen in Drosophila. Harrison's observations on moths make it probable that sometimes "adaptive mutations" due to external agencies may take place in Metazoa as we know them to in Protozoa (Jollos, 1921, *Arch. Protistenk.* 43). But once there, they segregate—*i.e.* are Mendelian; and Morgan's work on Drosophila makes it reasonably certain that if they do so they are chromosomal units. That is, even if for the sake of argument we suppose that the Drosophila type of mutation is pathological, the Drosophila type of inheritance is not. Characters of obvious evolutionary significance behave in a Mendelian way equally with those which are pathological. The problem would then be the origin of the Mendelising factors of evolutionary importance.

Although several points still remain obscure, yet, apart from this problem of the precise method of origin of variations, the body of facts gathered in the last twenty years, concerning segregation, linkage, multiple factors, multiple allelomorphs, and modifiers, not only gives the hypothetical germ-plasm a definite body and home, but is almost precisely what was required to provide a tangible working mechanism for the bulk of Darwin's own ideas; and it is a matter of constant surprise why many who profess themselves Darwinian of the Darwinians should not only not avail themselves of the new tool, but also evince positive hostility to it. The new principles are, indeed, the only tool we at present possess which is capable of putting evolutionary theories to experimental test. Yet, with a few honourable exceptions, most taxonomists and "evolutionists" prefer to stick to speculative methods—speculative because incapable of being tested either by experiment or by calculation—and make no attempt to use the new principles in experimental attack—or, for that matter, even in interpretation.

But the world—"eppur si muove"; and this admirably condensed book from Morgan's laboratory is well adapted to help biologists to appreciate both the amount and the direction of recent movement in this particular field. J. S. HUXLEY.

Fluid Motion in Theory and Practice.

The Mechanical Properties of Fluids: a Collective Work. By Dr. C. V. Drysdale, Dr. Allan Ferguson, Dr. A. E. M. Geddes, Dr. A. H. Gibson, Eng. Vice-Adm. Sir George Goodwin, F. R. W. Hunt, Dr. Horace Lamb, A. G. M. Michell, G. I. Taylor. (Applied Physics Series.) Pp. xv+362. (London: Blackie and Son, Ltd., 1923.) 20*s.* net.

IN the introduction to this work, which is apparently the first of a series to be devoted to applied science, Vice-Admiral Sir George Goodwin, the late Engineer-in-Chief of the Navy, acknowledging that in the present day engineering requires a great deal of help from branches of science with which it has not hitherto been closely associated, insists that engineering practice to be worthy of the name must keep abreast of and in touch with all the developments and discoveries in these fields. What Sir George has in mind is doubtless something more than the inculcation of the principle of keeping, by engineering firms of repute, of a staff of physicists on the premises, sufficiently domesticated to deal with the particular scientific problems which arise, the adoption of which by the fighting services is one of the most remarkable effects of the War. He is evidently of opinion that the engineer should himself be familiar with the fundamental principles by means of which the solution of the various problems which confront him must be attempted.

The wisdom of this conclusion will be evident from the consideration that ignorance of the possibilities and the limitations of scientific methods will, as past experience has shown, place in an unfortunate position the engineer who, in virtue of being in an executive capacity, has to make a decision and assume full responsibility for his action.

The present work, we are informed, is intended for the large body of engineers who have to deal with fluids in their everyday work either in industry or in preparations for war, and for the reason that information on the fundamentals of the subject of fluid phenomena is more difficult or inconvenient to obtain than in the case of solids. This, it may be remarked, is not altogether the fault of writers on this subject. Forty years ago, in a lecture to the Royal Institution, Osborne Reynolds remarked that "it has long been a matter of general regret with those interested in natural philosophy that, in spite of the most strenuous efforts, the theory of fluid motion fits very ill with the actual behaviour of fluids." It is to this discrepancy between theory and practice, which the lecturer himself did so much to diminish, that we must ascribe the defect of which Sir George Goodwin complains.

At any rate, the issue of the present volume should go far to remedy these defects; for here we have a volume which in effect comprises eight monographs by well-known teachers and investigators in the field of fluid phenomena.

As might be expected from a glance at the list of contributors, the manner in which the subject-matter is presented is admirable and almost beyond criticism, and—a possibility which one imagines has been fully realised by the writers—it may be expected that the work will be used as a text-book on fluid motion in our engineering colleges, for which purpose it may be thoroughly recommended. Its main objective, however, as we have seen, is the engineer in practice, and in this connexion some remarks on the choice of the subject-matter may not be unprofitable in view of an early demand for a second edition.

Although dealing with the mechanical properties of fluids, the book would have lacked completeness without a section on the mathematical theory of fluid motion, and the editor is to be congratulated on having persuaded Prof. Horace Lamb to undertake this task. Of this section it is enough to say that the admirable manner in which, in the space of 45 pages, the hydrodynamical theory of streamline, vortex, and wave motion is presented, with all the clearness for which the writer is famous, will add to the many thousands of Prof. Lamb's engineering children who rise up and call him blessed.

The section on the mathematical theory of fluid motion is preceded by an article by Dr. Ferguson, apparently of an introductory character, dealing with certain "general properties" of fluids such as density, compressibility, surface tension, viscosity, osmotic pressure, etc., each of which from its inclusion in the subject-matter may be assumed to have some claim to be regarded as a "mechanical" rather than a physical property. It will be generally accepted, we suppose, that a "mechanical" property of a fluid must depend on its action in bulk, and that a "physical" property is one which depends on the arrangement and properties of the molecules composing it. According to this criterion, we should agree that density is a mechanical property since it is a function of the external pressure, but should regard compressibility and viscosity as essentially physical properties. The distinction is, of course, unimportant, but illustrates the difficulty in the choice of the properties of fluids to be discussed in an article of this kind, and in the rejection of others, such as vapour tension, which are equally important to the engineer.

The third section deals with viscosity and lubrication, and is written by Mr. A. G. M. Michell, whose name is well known to marine engineers in connexion with the Michell thrust block, which has achieved such deserved success in modern marine practice. The theory of film lubrication both for plane and cylindrical surfaces is treated very fully, as would be expected from one of the pioneers in the subject, and modern types of bearings on his principle are described. The devotion of a third of this section to the well-worn subjects of viscosity and viscometry seems, however, scarcely justifiable, as this has involved, apparently, the omission of all reference to the important subject of boundary lubrication, and the work in this field of W. B. Hardy, Deeley, and others.

The fourth and fifth chapters, written by Prof. Gibson, are devoted to streamline and turbulent motion, and hydrodynamical resistance. In the former the characteristics of the different types of motion as determined by the shapes and dimensions of the bounding surfaces and the speed and viscosity of the fluids are fully discussed and methods of measuring the rates of flow are described. This chapter also contains a certain amount of matter which seems to have strayed from the succeeding chapter—for example, the general law of resistance to flow of fluids in parallel channels, and the treatment, by the principle of dimensional homogeneity, of the transmission of heat between solid surfaces and fluids flowing over them. As these are only particular cases of hydrodynamical resistance and the general principle adopted for its study, which are treated in the fifth chapter, it is a little difficult to account for their position. The combination and rearrangement of these two chapters would, we think, add considerably to their value and also avoid a certain amount of repetition.

As would be expected from a specialist in this subject, the problems of the resistance experienced by bodies completely or partially submerged in fluids, which are so important to the aircraft or ship designer, are very completely dealt with; but one feels that in a work of this description some attempt should have been made to give the engineer an outline, at any rate, of a theory of eddy motion. If Prof. G. I. Taylor, who we suppose is the greatest authority on eddy motion, could have been induced to undertake this task, in addition to his existing contribution, the value of the book would have been greatly enhanced.

Chap. vi., also by Prof. Gibson, deals with the effect of the elasticity of fluids and their boundary surfaces on the pressure distribution. This chapter also contains a useful section on the theory of the wave transmission of power, which has recently become of considerable practical importance.

In Chap. vii., by Prof. G. I. Taylor, is given the theory of the soap film method devised by himself and Dr. Griffiths for the solution of problems in stress

distribution which are too complex to be dealt with by the ordinary equations of equilibrium of an elastic solid. The value to the engineer of this method is illustrated by the treatment of such problems as the reduction in strength of shafts due to the presence of keyways in them, and the strength of angles and rolled joists under torsion.

Chap. viii., by Dr. Geddes, on wind structure, is a valuable compilation of the results of recent research on the distribution of velocity and pressure in winds. The theory of the gradient winds is given, together with much information of value to the aviator on the variation of velocity and temperature of the air with altitude. The corresponding problem of the horizontal variation of velocity in winds, which is of fundamental importance in the selection of a wind-pressure factor in the design of large structures, does not receive attention, possibly on account of the lack of experimental data.

Chap. ix., by Dr. Drysdale, is devoted to the principles and practice of sound ranging and acoustic signalling under water. This is a branch of engineering which owes its development entirely to the War, but must now of necessity play an important part in the training of the marine engineer. Various types of sound transmitting devices are described, but unfortunately no indication is given of the accuracy with which they will operate.

The importance of the principle as an aid to navigation will be realised from the description which is given of the methods of acoustic echoes applied to determination of depth sounding and detection of proximity of wrecks, rocks, and icebergs.

The last chapter, by Mr. F. R. W. Hunt, deals with the resistance offered by the air to the motion of projectiles, a knowledge of which is fundamental in the study of external ballistics. The methods of determining this resistance by firing trials, in which either the times of the projectile passing a number of equidistant points along the trajectory are recorded (Bashforth chronograph), or by measuring the velocity at two points a known distance apart (Hutton), are described; and a brief reference is made to the alternative method, developed since the War, of suspending a scale model of the projectile in a current of air moving at the appropriate speed and measuring, by direct weighing, the forces and couples exerted by the air stream on it. As the author points out, this method was originated in France and has since been taken up vigorously in America, but in neither case, we believe, have experiments been carried out at speeds greater than the velocity of sound. On the other hand, considerations of national modesty or of secrecy need not, we think, have forbidden reference to the fact that at the National Physical Laboratory, Teddington, the determination of the drag of model projectiles up to speeds exceeding twice the velocity of sound is a matter of routine.

There is one further matter in this section which calls for comment. It is commonly assumed that, for speeds exceeding the velocity of sound, the scale effect in head resistance is negligible, and the results of recent experiments at the National Physical Laboratory with scale models one-thirtieth full size, when compared with the results of firing trials, support this view. In Fig. 5 are given curves derived from the results of Krupps' experiments of 1912 which indicate scale effects which, in certain circumstances, can only be described as colossal. For example, at a speed 40 per cent. above the velocity of sound, an increase in linear scale of only 3 to 1, or an increase in the density of the air in the same ratio, would apparently diminish the head resistance to one-third of its original value.

One cannot say that this is incredible for the reason that the range of this particular speed-scale value is beyond that hitherto attained in high-speed wind channels, but it is certainly astonishing. One can scarcely suppose, for example, that this interpretation of the experiments commended itself to the designers of the German long-range gun which shelled Paris during the War.

It could scarcely be expected that, in a collective work by eight authors, overlapping would be eliminated, but there are a few examples which might be avoided in a second edition. Thus, the distribution of velocity in a fluid flowing in laminar motion through a parallel pipe is worked out in full on p. 34 and also on p. 104. The principle of dimensional homogeneity is demonstrated on p. 29 and also on p. 188, and a general discussion of viscosity is given on p. 28 and also on p. 98.

As will be apparent from the foregoing remarks, the book is one which, although of interest to all classes of engineers, is essentially addressed to the engineer of the fighting services, by whom we are sure it will be deservedly appreciated. T. E. STANTON.

The Foundations of Science.

Logic. By Dr. W. E. Johnson. Part 3: The Logical Foundations of Science. Pp. xxxvi+192. (Cambridge: At the University Press, 1924.) 12*s.* 6*d.* net.

THE primary necessity for logic, as Dr. W. E. Johnson conceives that science, whether it be formal or applied, is to be able to invent for its categories absolutely precise descriptive terms with unambiguous meanings, so that thought shall be rigidly

fixed in its expression before it sets to work. For logic, in his view, has meticulous work to do in its analysis and criticism of thought. In the two parts of the work previously issued, logic has been treated as a purely formal science; in Part III. it is applied. In it Dr. Johnson deals with the foundations of science, and therefore with the points at which logic passes into metaphysics and comes into relation with philosophy generally, with ontology particularly.

A century and a half ago Kant could speak of logic as the type of a perfect science which, since Aristotle, had not had to advance or retrace a single step. To-day it would be impossible to single out any science in which fundamental disagreements as to principle are more profound. We have only to compare this latest production of the school of thought we associate with the University of Cambridge, with the Italian, Benedetto Croce's, conception of logic as the science of the pure concept, to see the world of difference. So far as definitions are concerned, indeed, either might subscribe the words of the other, but when it comes to meanings we find ourselves in totally different universes of discourse. On what does this difference depend? Certainly not on any ambiguity as to what is meant by thought. No one can be ignorant of the meaning of the term thought, or if he be, or if he profess to be, there exists no possible means by which he can be informed. It is altogether different when we try to define the other of thought. Here philosophers are worlds apart. According to Dr. Johnson, there is a fundamental distinction between the psychical and the physical, and both are real in the same unequivocal sense. He confesses that the distinction may not be philosophically tenable, but the principles of science, he tells us, are impossible unless it be postulated. According to Croce, on the other hand, logic depends on a distinction within thought itself, and it presupposes not an alien existence but a prior mental science, æsthetic. For Croce, there is no existence the reality of which does not consist in its ideality. Dr. Johnson's logical method is mathematical in the abstract meaning, according to which mathematics is a formal ordering of a presented material.

The author's whole philosophical attitude depends, he tells us, on a fundamental distinction between two types of acts. The analysis of S is P yields him an act of separation which applies to the S and an act of discrimination which applies to the P. This gives him the relation of substantive and adjective. Substantives are existents necessarily distinct; adjectives are determinates opposed but belonging to the same determinable.

More interesting, however, is the fate which is to overtake our old familiar philosophical concepts, substance and cause. Substance is to disappear finally. Although he does not say so, we cannot but suspect that Dr. Johnson has been impressed by Prof. Whitehead's concept of Nature as an "ether of events." In any case, Dr. Johnson has decided that the concept of substance shall be born again and re-christened the "continuant," and Kant's first category of relation is to be changed from *substantia et accidens* to "continuant and occurrent." Cause is allowed to retain its name (notwithstanding that some of Dr. Johnson's colleagues have loudly protested that science has no need of it and have called for its suppression), but it is to submit to a new distinction according to whether it is conceived as transeunt or as immanent. All this new nomenclature, of which it is true Part III. is comparatively sparing, is well enough if philosophers are willing to accept it, but it leaves out of account the curious psychological fact that we can only unlearn our language and learn a new one with practically insuperable difficulty.

There is one term, however, which Dr. Johnson frequently uses and nowhere defines, and, though it is common enough, a definition is most certainly called for — the term "scientist." He generally opposes it to "philosopher," and in more than one passage he opposes it also to "logician." Since he classes himself with philosophers and is certainly a logician, does he intend to denominate those who are engaged in actual scientific research, and does he imply that by the nature of their work they are hostile to philosophy and indifferent to logic? It is difficult to think so, but perhaps if he chances to see this notice he will make his meaning clear when he publishes Part IV. The reverse of the implication, namely, that philosophers and logicians are hostile to science, would certainly be resented.

This, however, is only a minor point; the major point of interest in this volume is the discussion of causality and Dr. Johnson's claim to have reformed the Kantian answer to Hume and presented a real logical foundation of physical science. There is just one point, indeed, on which he is likely to be challenged, and that not only by philosophers but by physicists and mathematicians as well. He takes as the typical illustration of a physical "continuant" a moving particle with a constant mass. But for modern physics, is not mass a function of velocity and therefore the concept of a particle with a constant mass a self-contradiction? If its velocity is zero, it has no mass; at the velocity of light its mass is infinite. In philosophy, is not a particle with unchanging mass a re-affirmation of the concept of material substance which Dr. Johnson in defining his "continuant" claims to discard?

H. WILDON CARR.

The Nucleic Acids.

Die Biochemie in Einzeldarstellungen. Herausgegeben von Aristides Kanitz. Nr. V: Chemie und Physiologie der Nukleinstoffe nebst Einführung in die Chemie der Purinkörper. Von Prof. Dr. R. Feulgen. Mit einem Sonderkapitel, die Pathologie der Purinstoffwechsels von Frieda Feulgen-Brauns. Pp. xii+432. (Berlin: Gebrüder Borntraeger, 1923.) 18*s*.

THIS volume, dealing with the chemistry and physiology of the nucleic acids, forms the fifth volume of the series of monographs published under the title "Die Biochemie in Einzeldarstellungen." Prof. Feulgen is himself well known as a worker in this field; not only has he now given us an exhaustive compilation of the literature, but he has succeeded also in producing a readable and interesting account of the development and present position of the subject.

The nucleic acids form a group of substances of exceptional interest to both physiologist and chemist; in these bodies a carbohydrate group is associated with a phosphoric acid group and also with a purin or pyrimidin base. Such a complex forms the simplest kind of nucleic acid, and this unit may again be associated with other similar units and built up into a still more complicated structure in which as many as four such units are combined.

It is noteworthy that research on these substances has led to the isolation of one of the hitherto unknown stereoisomeric pentoses. Levene succeeded in identifying the pentose which is split off from inosic acid (the nucleic acid of muscle) as d-ribose, and showed that the same pentose was also present in guanosylic acid.

In dealing with complex compounds such as the nucleic acids, the question of their classification presents considerable difficulties, which, however, diminish as our knowledge of their constitution increases. The term "nucleotide" has been given by Levene to the nucleic acid unit, *i.e.* the unit formed from one molecule of each of the three constituents—phosphoric acid, carbohydrate, and base; and an obvious division presents itself into simple nucleotides and complex nucleotides in which as many as four of these units may be combined, as, for example, in yeast nucleic acid. The nucleotides are again classified according to the nature of their carbohydrate group: in some the structure present is that of d-ribose; in others the exact nature of the carbohydrate is still uncertain. By some workers it is regarded as a hexose, but Prof. Feulgen brings forward evidence showing that it gives the reactions of a true aldehyde and in its behaviour shows marked differences from a hexose. A further differentiation is based on the nature of the nitrogenous base present.

By splitting off phosphoric acid from the nucleotide, a compound of base and carbohydrate is formed, for which the term nucleoside is used—*e.g.* inosin and guanosin. It is unfortunate that the name cytosin was used by Kossel for the pyrimidin base isolated from thymonucleic acid, the termination suggesting a false analogy.

Though our knowledge of the chemistry of the nucleic acids has been very materially increased during recent years, our ignorance of the part played by them in cell metabolism has not been enlightened. Like the lipins, the nucleins are widely distributed and are present in most animal and vegetable cells; phosphoric acid and a nitrogenous base are constituents of both lipins and nucleins, combined in the former with a carbohydrate group, in the latter with a glyceryl ester. In spite of many attempts to throw light on their functions, no convincing evidence definitely connecting them with any stage of cell metabolism has been brought forward. The enormous preponderance of nucleins in the spermatozoal cells has given rise to the suggestion that the nucleic acids may play some part in the transmission of inherited properties, but here we are outside the region of evidence and in the domain of speculation only. Certainly, one of the outstanding problems demanding solution at the present time is the function of these complex phosphorous compounds and the part they play in the life of the cell. Such books as Prof. Feulgen's monograph are especially helpful in gathering together all that is known in a readily accessible form and revealing how large a field there is for further inquiry.

A chapter on the pathology of purin metabolism by Frieda Feulgen-Brauns forms a welcome addition to the book.

H. MACLEAN.

Early Chinese Pottery and Porcelain.

The Art of the Chinese Potter from the Han Dynasty to the End of the Ming. Illustrated in a Series of 192 Examples, Selected, Described, and with an Introduction by R. L. Hobson and A. L. Hetherington. Pp. xx+21+153 plates. (London: Ernest Benn, Ltd., 1923.) 147*s*. net.

THOUGH this important work, by two of our foremost authorities and connoisseurs of Oriental ceramics, is more concerned with artistic results than with the somewhat uncertain history of scientific progress in porcelain-making, the work is still of considerable interest from the technical point of view. It describes the achievements of the workers at the most important Chinese pottery-centres during the period when fine porcelain, as we know it, was first in process of evolution, and then the orderly progress from the earlier varieties of earthenware and stoneware with which pottery-making begins in every region of the world where it has ever flourished.

In many respects the movement which is here brought under review was of vital importance in the history of one of the most ancient handicrafts practised by man. An admirable exposition is given of the successive stages of discovery, based on faithful observation and technical and artistic skill of the highest order, which brought to fruition the artistic aims of the fine craftsmen whose work is such a distinguished feature of the Chinese artistic workmanship of the period.

As in so many other regions where the potter's art has flourished from far-distant ages, the earliest Chinese examples that are known to us are a kind of earthenware, made from a light-burning, calcareous clay, so that it resembles to some extent the eighteenth-century "Delft-wares" of Holland and other European countries. This art appears to have flourished, principally, in Northern China, where there was the most direct contact with the western nations, and it is obvious that many years, probably many centuries, elapsed before the production of a true porcelain. In the meantime, it is certain that the Chinese had manufactured various kinds of hard-fired stoneware, some of which, as is evident from the specimens that have descended to us, approach porcelain in whiteness and hardness and may even attain to a limited degree of translucence.

Such considerations are, naturally, of secondary importance to the authors of this work, for their aim has been to illustrate and describe the important artistic use that was made of all the available materials, and especially the colour resources that were at the disposal of the pottery artists. The aim of the latter was invariably to produce new chromatic effects of subtle delicacy or astounding glory, such as were absolutely unknown to any other race of potters at the time. In this direction, too, both chance and skill played their parts, for it would seem that sometimes knowledge was imperfectly transmitted or supplies of essential materials became exhausted until fresh sources of supply could be discovered. This seems the most probable explanation of the fact that certain colour or glaze effects, after a long spell of successful production, fell into disuse, and when they reappear, in some cases after the lapse of centuries, present new features, which seem to have been the result of changed methods of manufacture. The celadon glazes and the various copper-red glazes afford ample evidence on such paints, to mention only the outstanding examples. The extensive use of iron-red, over the glaze, in many of the colour schemes employed by the porcelain decorators of the closing reigns of the Ming dynasty was, probably, brought about in some such way, and may have led to the summary execution of a good deal of the painted porcelain of that period.

The illustrations, whether in colour or in half-tone, are excellent; and as many of the examples which have been so skilfully reproduced are of the first importance, they form one of the most valuable features of a worthy piece of work. Those collectors who find it difficult to pay the enhanced prices now obtained for good specimens of the earlier Chinese porcelains will find great delight, though perhaps not unmixed with envy, in the feast of fine things which is here presented. WILLIAM BURTON.

Radium, Beryllium, and Mercury.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 4: Ra and Ac Families, Be, Mg, Zn, Cd, Hg. Pp. x+1074. (London: Longmans, Green and Co., 1923.) 63*s.* net.

THE fourth volume of Dr. Mellor's "Comprehensive Treatise" is of particular interest on account of the fact that it contains, in addition to a description of the family of elements beryllium, magnesium, zinc, cadmium, mercury, a section on radium, which was held over from the earlier volume in which the lower homologues of this family were described, in order to receive the special treatment which its radioactivity demands. The present volume of the "Treatise" therefore contains, in addition to the "systematic" sections, three chapters of a general character dealing with "The Structure of Matter," "Radium and Radioactivity," and "The Architecture of the Atom."

This section of the work is, as in previous parts, packed with information, and the lists of references are even longer than in some other sections. These three chapters probably provide, however, one of the most difficult of the tasks confronting the author of a "comprehensive treatise," since the writer of a work of 7000 pages is handicapped most severely, in comparison with the writer of a monograph of 200 pages, when dealing with a field of research in which the rate of progress is just now at a maximum. It need not, therefore, be regarded as a depreciation of the work of the author to say that in this branch of chemistry a reader will derive more pleasure from the recent writings of Bohr or of G. N. Lewis than from the comprehensive abstract of the work of many writers which is here presented.

In the next chapter, on beryllium or glucinum, the special characteristics of the "Treatise" immediately appear again to full advantage. Pliny's description of the emerald, and the short note which records the action of a forgotten editor in imposing the name "glucine" upon the discoverer of a new earth which he wished to call "la terre de béril," are not likely to be rendered

obsolete by any new discovery of Rutherford or Bohr; indeed, this particular topic is of special interest to-day, when there is at least some probability that the authors of chemical papers will again be allowed to write "beryllium" without having it altered in the proofs of their papers to "glucinum."

The elements zinc and cadmium are conveniently described together in one chapter; but the element mercury occupies a separate chapter of 350 pages, one section of which, on "The Physical Properties of Mercury," is followed by 12 consecutive pages of references. The suggestion, on the last page of the text, that "there may be a missing member between cadmium and mercury, since cadmium is much more closely related to zinc than it is to mercury," was probably written at a date prior to the introduction of atomic numbers, and has escaped the correction which later views as to the number of missing elements would make necessary.

In conclusion, the new volume is likely to be of a value equal to that of those which have preceded it, and the author is to be congratulated on the completion of another stage of his monumental task.

Pictorial Ornithology.

Game Birds and Wild-Fowl of Great Britain and Ireland. Written and illustrated by A. Thorburn. Pp. vii + 79 + 30 plates. (London: Longmans, Green and Co., 1923.) 105*s.* net.

MR. THORBURN is without a peer, one may almost say without a rival, in the delineation of birds. He succeeds in combining fidelity of detail with breadth of handling which must satisfy at once the most scrupulous ornithologist and the most fastidious art critic. His latest work lies before me to prove that his hand and his eye act together as cunningly as ever; but he indicates in his preface that, being weary of producing "scientific plates of species," in the present volume he has aimed at representing birds in their natural surroundings. The result is not uniformly satisfying. While in some of this sumptuous series of plates the landscape is subdued in tone and provides a quiet setting or background for the birds (as in Plate 14, representing brent and pink-footed geese on a tidal ooze), in some other plates it tends to overpower them. The artist secured happier effect in the charming vignettes with which he illustrated the late Lord Lilford's "British Birds," the natural environment of the species being delicately, but effectively, rendered by little more than a suggestion of landscape. Further, the effect of a snowy background in Nature must be to obliterate both colour and detail, the birds relieved against it appearing in dark silhouette; whereas the black grouse in Plate 2 and the pheasants in Plate 7 are painted in hues as vivid as they would appear if the birds had sat for their portraits in Mr. Thorburn's studio.

In another respect the plan of representing birds in their natural surroundings falls short of being satisfactory. In order to include all our British wild-fowl and game-birds in a series of thirty plates, the artist has had to group together several species which do not naturally associate with each other. For example, it can scarcely have come within anybody's experience to witness goosanders, mergansers, and smews peacefully resting together as they are shown in Plate 25, and it must be very unusual for the pugnacious little quail to sit amicably beside a pair of red-legged partridges, as it appears to do in Plate 10. However nearly birds of one species may be related to those of another, according to human classification, it mars the effect of "natural surroundings" to represent them as keeping close company with each other.

In another respect these plates stand at a disadvantage when compared with those in Lord Lilford's volumes. The latter are reproduced in chromolithography from the originals, whereas those in the present volume are by three-colour printing, a process considerably less costly, but less scrupulously faithful to the artist's colouring. It is, however, an uncongenial duty that bids me pass any comment short of cordial approval upon what is an extremely handsome publication.

The text accompanying the plates consists of brief notes on each species, based, as we are told in the preface, upon the writings of recognised authorities, supplemented by the author's personal observations. Mr. Thorburn follows—indeed, he has no choice but to follow—the accepted classification of the red grouse, *Lagopus scoticus*, as a distinct species, exclusively confined to Great Britain and Ireland, although it is identical in anatomical details, voice, eggs, and general habits with the sub-Arctic ryper or willow-grouse, *Lagopus albus*. The sole distinction between them is that the willow-grouse, though closely resembling in summer plumage the red grouse, assumes white plumage in winter, which the red grouse does not, although the plumage of the latter is extremely variable. A similar seasonal change of colour in the pelage of the Continental ermine has not caused that little carnivore to be classed as a different species from the British stoat. Unlike other British game-birds, both red grouse and ptarmigan moult twice in the year, which in the former suggests a survival from the winter change to white.

Mr. Thorburn quotes the late Mr. Ogilvie Grant's opinion that the pheasant, which in a British environ-

ment is so opulently polygamous, is probably monogamous by nature, and that the change of habit in our semi-domesticated pheasants is the result of the practice of shooting cocks and sparing hens. But Mr. Grant admitted that the evidence of these birds pairing off when in a really wild state " is somewhat scanty."

Mr. Thorburn mentions the shape and colour of the bill as being a sure means of distinguishing between wild swans—*Cygnus musicus* and *C. Bewicki*—and the semi-domesticated mute swan, *C. olor*. That serves well enough when the birds are so near as to enable one to detect the difference ; but both the whooper and Bewick's swan can be recognised from a far greater distance when swimming by the attitude of their necks, which are always straight and erect, without the serpentine grace of the mute swan's.

HERBERT MAXWELL.

Diphtheria.

Medical Research Council. Diphtheria: its Bacteriology, Pathology, and Immunology. By Sir Frederick W. Andrewes, Prof. William Bulloch, Capt. S. R. Douglas, Prof. Georges Dreyer and A. D. Gardner, Paul Fildes, Dr. J. C. G. Ledingham, Dr. C. G. L. Wolf. Pp. 544+6 plates. (London : H.M. Stationery Office, 1923.) 12*s.* 6*d.* net.

THERE is no bacterial disease which has been illuminated as has diphtheria by the discovery of its cause and the subsequent experimental study of the bacillus identified by Klebs and Loeffler just forty years ago. Aetiology, diagnosis, clinical history, pathology, treatment, and prevention of the disease in man all reflect the exact knowledge which has been gained by bacteriological work. The general public know now that the discovery of the bacillus in the throat and the testing of its virulence are important aids to diagnosis, and that it is treated by giving antitoxic serum ; and if the work of Dr. Park in New York and the advocacy of Dr. O'Brien in Great Britain has its proper result, they will soon appreciate that the liability of children to catch the disease can be gauged with surprising accuracy by tricks based on the fundamentals of immunity, which furnish also a means of protecting those who are found to be susceptible.

There is, indeed, so little of empiricism left in diphtheria nowadays that a complete account of its bacteriology, pathology, and immunity, such as is given in the present volume, goes a good way towards being a complete account of the disease ; it seems a pity that the scope of the book has not been somewhat extended to finish off the subject by dealing with the purely clinical aspects and the epidemiology. Quite apart from its human interest and importance, however, the bacteriology of diphtheria is worth intensive study, for it was in this connexion that Behring in 1890 discovered that if an animal was inoculated with small doses of the poison produced by the bacillus, it would develop in its blood serum something which would neutralise the poison, and that the resistance to the poisonous action of the bacillus which it thus acquired could be transferred to a fresh animal by transferring the blood serum—one of the great discoveries of biology.

The book is the work of eight bacteriologists, and it has been written on the wholly admirable plan of all of them being responsible for the whole of it. How much better many books would be if the draft of the original author could be discussed in detail by seven constructive colleagues before publication rather than by seven critical reviewers later on ! It is a course which might also lead to a welcome reduction in the number of overlapping text-books. The authors began by making a detailed and critical survey of the whole of the existing literature : a bibliography containing only those papers which appeared to be of value runs to 103 pages with more than 3000 entries. From the abstracts of this mass the several chapters were made up by the collaborators individually, and then criticised and emended collectively. The result is not altogether uniform. Some of the sections, those for example on the history of the disease and on laboratory diagnosis, have been written and are readable as continuous wholes ; others, *e.g.* on antitoxin, have been compiled, and their discontinuity is accentuated to an irritating degree by reproducing in print the multiple paragraphing affected by illiterate typists. But whether in pleasant form or not, the whole book is stuffed with information, and forms probably the most complete account of any large bacteriological subject which has been published. It will be of great value as a trustworthy storehouse of fact and theory, and of still larger use as indicating the gaps which want filling in and the lines for further advance.

The anatomy and histology of the primary lesions in man are treated superficially : whether they are due to the unmixed action of the diphtheria bacillus or not, they constitute the base from which the disease starts ; and even in these days, when structure is so despised in comparison with function, they deserve fuller consideration. No clear explanation is given of why such importance is attached to getting preparations of toxin of high potency for immunising purposes. If it is " sufficiently true for practical purposes to regard " the ordinary preparation " as a pure solution of toxin " (p. 130), it is difficult to understand why it is worth much trouble to get a toxin of which the first dose for a horse is 0·01 rather than 0·1 c.c., each succeeding dose being twice as big. The name of His is misspelled on

p. 220, and Neisser's statistics (p. 240) are confused by an extraneous "or." In the bibliography a note by Woodhead (*Journ. Path.* 13, 123) on the stability of antitoxin is missing, and papers by two or more authors are catalogued only under the name of the first, an arrangement which is inconvenient for running down vague memories. The index is not full enough, though with the aid of the table of contents it seems possible to discover what one wants. These small defects are not easy to find, and the authors may rest assured that they will have the gratitude of all working bacteriologists for years to come. A. E. B.

The Timbers of Guiana.

Étude descriptive sur les bois utiles de la Guyane française. Par Herbert Stone. Pp. 416+7 planches. (Marseille: Faculté des Sciences, Musée Colonial, 1923.) n.p.

THIS study of the commercial woods of French Guiana is a sequel to "The Timbers of British Guiana," which was published by the Crown Agents for the Colonies in 1914. In both books Mr. Stone adds considerably to our knowledge of the forest products of South America, as many of the timbers described are also exported from Venezuela and Brazil. In the present work, more than 200 specimens are minutely described, and trustworthy information is supplied concerning the uses, the native names and the physical properties of the woods examined. The scientific names of many of the trees still remain uncertain, in the absence of authentic specimens of foliage and flowers; nevertheless, some outstanding problems of botanical nomenclature have been solved.

The timbers of Guiana are varied in character. Some have earned world-wide reputation for strength and durability, whilst others are esteemed mainly for their beauty; and a third class yield valuable drugs and dyes. The best known is greenheart (*Nectandra Rodiæi*), a hard heavy timber, said to be the strongest known. Its lasting qualities in air and under water are remarkable, and justify its extensive use in the construction of ships, bridges, and wharves. All the gates, piers, and jetties of the Liverpool docks are of greenheart. Nansen's ship, *The Fram*, and the Antarctic ship, *Discovery*, were built of this wood. Other species of Nectandra also furnish excellent timber, as that known to the natives as "Cirouaballi," corrupted to "Silverbally," which has been imported into London under the name of "Surinam mahogany." Mora, yielded by a tree of giant size, *Dimorphandra mora*, is rated at Lloyd's as one of the eight first-class timbers for shipbuilding. It is more durable than teak, and has been used for railway sleepers and street paving. Other Guiana woods are suitable for special uses, thus Tonga bean or Cumaru (*Dipteryx odorata*) is in demand for fishing-rods. Walking-sticks and umbrella handles are often made of letterwood or snakewood, so called because the surface is spotted over with blackish markings, resembling hieroglyphics or the skin of a snake. Its origin has been recently determined as *Piratinera guianensis* (Journ. Washington Acad. Sciences, Oct. 1922, p. 393). Partridge wood, used in turnery and for walking-sticks, is regularly imported from Brazil, but also comes from Guiana. In *Science*, March 10, 1922, Prof. Record identifies it with *Cæsalpinia Ebano*.

True mahogany is not met with in Guiana, but substitutes for it are occasionally put on the market, such as crabwood, *Carapa guianensis*. Spanish cedar, *Cedrela odorata*, used for making cigar boxes and racing boats, is confined to the West Indies and French Guiana. Other highly decorative woods occur in the colony, as the class known to the French as *satiné*, of which Mr. Stone described four varieties. One of these, distinguished as *satiné rubanné*, is considered by Prof. Record to be identical with the redwood of Brazil, *Brosimum paraense*. Surinam rosewood, which yields a fragrant essential oil, is derived from a species of Aniba.

The chemical and physical properties of logwood, which is the chief dyewood of commerce, are described in great detail by Mr. Stone. The tree which furnishes this valuable product, *Hæmatoxylon campechianum*, grows fast in Guiana and deserves to be more widely cultivated than it is at present. Quassia wood, famed for its bitter taste and extensively used as a vermifuge and insecticide, is yielded by two distinct trees, *Quassia amara* and *Picræna excelsa*; but only the wood produced by the latter is used in Great Britain. Mr. Stone points out their differences, and also describes an allied species, *Simaruba amara*, the wood of which, although almost tasteless, is sometimes substituted for the true Quassia.

Our Bookshelf.

Faune de France. 5: *Polychètes errantes.* Par Pierre Fauvel. (Fédération française des Sociétés de Sciences Naturelles: Office Central de Faunistique.) Pp. 488. (Paris: Paul Lechevalier, 1923.) 45 francs.

THERE is no doubt as to the welcome which this volume will receive at the hands of those who have occasion to study and identify specimens of Polychæta from the area in question or from neighbouring coasts. The author has liberally interpreted the limits of the French area, for he has included all the species of Polychæta

recorded from the southern part of the North Sea (including the coasts of England, Holland, and Belgium), the Channel, the Atlantic from the coast of Ireland to Gibraltar, and the whole of the Mediterranean, so that material has been drawn from an area well beyond the strict limits of France.

Prof. Fauvel has himself examined the majority of the species described, and has carefully studied the intricate synonymy, giving effect to the rule of priority so far as he considered this to be desirable in view of the long usage of certain names, and adding under each species a few references to the principal published accounts. The author has redrawn for this publication many figures from well-known memoirs and has added a considerable number of original sketches—the total exceeds 2000—and with few exceptions these clearly illustrate structural or systematic characters referred to in the text.

A brief introduction is devoted to the consideration of the external morphology—including the chætæ—of Polychæta, the anatomy of the principal systems of organs, reproduction, general biology, and methods of capture and preservation. The author warns the collector against the use of formalin, and recommends 70 per cent. alcohol as the only suitable preserving fluid.

The Errant Polychæta, with which this volume deals, are subdivided into fifteen families, and a key is given for their separation. Each family is concisely defined, and a key to the sub-families or genera follows. A definition of each genus is given, and, where there is more than one species, a key to these is added. Each species is the subject of a short description, at the end of which are noted the usual habitat of the species and the principal localities from which it has been obtained. The author places the Histriobdellidæ—represented by the single genus Histriobdella found in the gill-chamber and on the eggs of the lobster—immediately after the Eunicidæ, on account of the strong resemblance, recently pointed out by Mesnil and Caullery, of its maxillary apparatus to that of Eunicids.

We hope Prof. Fauvel will be able soon to complete the work by the issue of the second volume, which is to contain the description of the sedentary forms, the Archiannelida, and the Myzostomids.

Marine Products of Commerce. By Dr. Donald K. Tressler (with collaborators). Pp. 762. (New York: The Chemical Catalog Co. Inc., 1923.) 9 dollars.

THIS book is designed, the author says, for both the scientific and the practical man, and its general treatment indicates that the industrial aspect is that mainly envisaged by the writers. But the work merits a much wider circle of readers, and there are few students of marine zoology but will find it of extraordinary interest. Just as the older text-books of chemistry (such as Roscoe and Schorlemmer) gained enormously in attractiveness by their descriptions of commercial processes, so this book will supply material that has so far been sadly wanting, and will "brighten" the academic study of marine biology. Thus the descriptions of pearls, of the pearling industry, of the utilisation in industry of pearls and pearl shell, of the taking and treatment of the precious red coral, of the manufacture of "pearl essence" from the scales of fishes, of the ruthless and repulsive industries connected with the capture of whales and seals, are interesting in the extreme, and nowhere else have they been done so well.

In the main, however, the subject-matter of the book is the acquisition and utilisation in industry of products obtained from marine animals and plants. Five chapters deal with obtaining sodium chloride and other salts from sea water and algæ. The extraction and purification of sea salt is very well described, and there are careful accounts of the effects of impurities in the processes of fish preservation. The whole subject of the preservation of fish, crustacea, and molluscs by antiseptics, refrigeration, and canning methods is adequately treated. There are good descriptions of fish and liver oils. A great number of fish conserves and *delikatessen*, with their mode of preparation, are here described, within the same covers, for the first time. Not only is the treatment of the matter practical, but the scientific interest in all the processes is also kept in the foreground, and good bibliographies, including quite recent work, are given at the end of each chapter. One is impressed with the large amount of research that has been made, in the United States, into industrial processes under the auspices of the Bureau of Fisheries, and with the statement, in the last chapter, of the problems that await attention when Congress sees fit to "appropriate sufficient money to carry out the much-needed investigations" and make full use of the equipment that has apparently been provided. This book is very confidently recommended to practical men as well as to scientific workers engaged on fishery problems.

J. J.

Assyrian Medical Texts. By R. Campbell Thompson. (Reprinted from the Proceedings of the Royal Society of Medicine, 1924, vol. xvi. Section of the History of Medicine.) Pp. 34. (London: John Bale, Sons and Danielsson, Ltd., 1924.) 2*s.* 6*d.* net.

THE specimens of Assyrian medical texts which Mr. Campbell Thompson has translated are derived from Ashurbanapal's library of clay tablets, which was discovered in 1849 by Sir Austin Henry Layard during excavations at the mound Kouyunjik, near the site of Nineveh. Of the 80,000 fragments of the clay tablets that have found their way to the British Museum, it has been estimated that at least 800 consist of medical texts. The present pamphlet contains texts dealing with diseases of the head and diseases of the eyes only, which clearly illustrate the peculiar features of Assyrian medicine, especially the belief that disease is due to demoniac possession. In consequence of this, incantations and magic rites are interspersed with the remedies, many of which may be traced back to at least 2000 B.C. In some of the texts, incantations and magic rites play the most prominent part, while in others they are only of secondary importance. Although other methods of treatment, such as diet, rest, and massage, were not unknown, the principal part in Assyrian therapeutics was taken by drugs, derived first from plants, trees, and shrubs, of which the roots, twigs, leaves, sap, and seeds were employed; secondly, from mineral substances, including various alkalis and salts; and thirdly, from various stones, which were crushed and used as ingredients in concoctions and

particularly in ointments and salves. Concurrently with remedies likely to be beneficial to the patient, nauseous and foul-smelling substances such as human and animal excrement were employed with the object of driving out the demon, a practice frequently resorted to in the Middle Ages. Certain ceremonials were also carried out, such as the tying of knots in a cord to symbolise imprisonment of the demon after the disease had been expelled from the body. The study of these texts is of interest not only on their own account, but also because they show the influence of Assyrian medicine on the medicine of the Jews, in which the idea of demoniac possession in disease, incantations, and magic rites played so important a part.

The Subject Index to Periodicals, 1920. K: Science and Technology. Issued by the Library Association. Pp. 116. (London: Grafton and Co., 1923.) 25*s.* net.

WE congratulate the Library Association on the publication of this index of scientific papers published in 1920, being a continuation of similar work already done for previous years. The present list is quite up to the high standard which we have been led by previous issues to expect. It contains no less than 5092 entries taken from 304 periodicals. The greater part of the papers indexed are from British and American journals, but many important entries from German and French sources also appear.

The range of subjects dealt with under "Science and Technology" is naturally very wide. It includes in its scope such headings as anatomy, bacteria, birds, caviare, chemistry, crystallography, electric furnaces, flies, games and sports, geology, gunnery, mines, motor cycles, plants, and shipbuilding. The titles of the papers are indexed under appropriate headings such as these, but it may happen that the actual title fails to give a sufficient indication of the contents of a paper. In such cases the editors have added a few words of their own, within square brackets, to indicate the actual subject-matter of the paper. These concise notes are a great addition to the value of the compilation.

We observe that the Library Association has formed a Bureau of Information to enable subscribers to obtain, in advance of publication, copies of entries under any specified heading. It is at least three years since the articles now indexed were published, and even if rapidity of publication could be somewhat increased, there must be always a large number of papers that have appeared too late for inclusion in the last volume. If the Bureau is able to provide inquirers with anything approaching full particulars of recent work on any subject of inquiry, it will be doing exceedingly useful work. Hitherto, schemes of this kind have been impeded by financial considerations. Happily, the Library Association may surmount this difficulty.

Chemical Synonyms and Trade Names: a Dictionary and Commercial Handbook. By William Gardner. Pp. iv+271. (London: Crosby Lockwood and Son, 1924.) 25*s.* net.

THIS is an extremely useful volume, giving in alphabetical order a list of about 14,000 definitions and cross-references of chemicals and substances used in the chemical and allied industries, particularly alloys, commercial chemicals, drugs, dyestuffs, minerals, explosives, and pigments. The object is to provide a ready-reference book to the chemist and technologist for all the synonyms and trade names in more common use, giving at a glance their chemical constitution.

The author has certainly succeeded to a very remarkable degree in his difficult and laborious task, and we can recommend the book. Naturally, with such a vast subject, it is easy to find omissions or somewhat unsatisfactory definitions. Thus, to take a few examples at random, the description of "petrol" is very skimpy, and at least the boiling-point of the petrol fraction and the main hydrocarbon constituents should be given. There is nothing to be found, also, under the title "amido-naphthol sulphonic acids," although certainly "H. acid" and "Gamma acid" are under their respective headings.

The complicated dyestuff portion of the book is, however, as a rule excellent, although "benzidine," "dianisidine," and "tolidine" are missing.

The printing and the paper are good, but in a work essentially for hasty reference purposes the binding might have been better, with advantage.

Alternating Current Bridge Methods for the Measurement of Inductance, Capacitance, and Effective Resistance at Low and Telephonic Frequencies: a Theoretical and Practical Handbook for the Use of Advanced Students. By B. Hague. (The Specialists' Series.) Pp. xiii+302. (London: Sir Isaac Pitman and Sons, Ltd., 1923.) 15*s.* net.

DURING the last thirty years a very large number of papers has been published on alternating-current bridge methods of measuring inductance and capacity. For adjusting apparatus in radio work an accurate knowledge of these quantities is required. A large and continually increasing number of methods has also been evolved for measuring these quantities. Hence there is a demand for a book which will describe only the most suitable methods applicable to the various cases. To electricians with a sound knowledge of alternating-current work we can recommend this book, although in our opinion it could have been improved by omitting several of the methods and at least half the references.

We agree with the author that the word "capacity" must be very carefully used. When there are a series of insulated bodies, he uses certain coefficients which he calls the "earth-capacities" and the "intercapacities" respectively. They are not the same as Maxwell's capacity coefficients, but they are perhaps more convenient in practical work. A proof is given that any two of them have a "mutual" capacity coefficient. This proof, however, is merely another statement of the author's definition, itself founded on several electrostatic theorems which are not mentioned.

Time and Weather by Wireless. By W. G. W. Mitchell. Pp. xii+125. (London: The Wireless Press, Ltd.; New York: Wireless Press, Inc., 1923.) 3*s.* 6*d.* net.

GREAT advances have been made recently both in distributing the correct time and in distributing meteorological data by broadcasting. In addition, Greenwich time can be obtained with a maximum

inaccuracy of the quarter of a second by the ordinary rhythmic signals—the time vernier of General Ferrie—sent out several times every day from the Eiffel Tower and many other stations. The Eiffel Tower signals (10 and 10.45, A.M. and P.M.) can be received on a crystal set, and practically all the other European stations on a two-valve set. The principal American stations can all be received on a three-valve set. The stations sending out time signals employ a musical note, so it can generally be easily picked out, even when "harmonics" and atmospherics are troublesome. In a few of the world stations, hand signals are employed, so their accuracy may be doubtful to the extent of one second. The ease with which clockmakers get the accurate time from the Eiffel Tower station has already greatly increased the accuracy of the clocks in Great Britain.

The latter part of this interesting little book is devoted to weather predicting. When the amateur has acquired a knowledge of slow Morse he can easily distinguish the different weather telegrams. With the help of a few meteorological hints he can thus with reasonable certainty anticipate the weather in his own locality.

Butterfly Lore. By Dr. H. Eltringham. Pp. 180. (Oxford: Clarendon Press; London: Oxford University Press, 1923.) 4*s.* 6*d.* net.

WE do not recall ever having read any popular book on insects, of equally limited compass, so attractively written and so accurate and original in its facts as this little work by Dr. Eltringham. Its author is known among entomologists as an enthusiastic and skilful investigator of Lepidoptera, and in writing this popular manual he has brought into it that "freshness" and breadth of outlook that only comes as the result of first-hand inquiry. He treats of butterflies and moths as living organisms, and relates how they live in their different stages and maintain themselves in the struggle for existence. It is not easy to pick out one chapter as being better than another, but perhaps the most suggestive and original are those on the urticating hairs and secretions of caterpillars and on the sense organs of the perfect insects. The concluding chapter, it may be added, gives a very good summary of current views respecting the significance of coloration in butterflies. Almost all the illustrations are original, and many could only have been the product of one who is thoroughly familiar with biological technique. Dr. Eltringham's book deserves a wide circulation, and we hope the publishers will see their way to issue similar manuals on the other and less familiar orders of insects.

A. D. I.

Economic History of American Agriculture. By Prof. E. L. Bogart. Pp. x+173. (London: Longmans, Green and Co., 1923.) 6*s.* net.

PROF. BOGART'S book, although an independent volume, is in the main comprised of the relevant chapters from his "Economic History of the United States," and is primarily intended for agricultural teachers and students. It is an extremely readable and fascinating account of a subject that can only too easily be made dull. The prime necessity of a book that serves as a general introduction to a subject is that it should maintain a fair perspective. This is never an easy task, least of all in agriculture, owing to its position as the fundamental industry of mankind, on which, in the ultimate analysis, all civilisation is based. The difficulty is further accentuated in the case of American agriculture owing to the rapid growth of every phase of that country's activities. Prof. Bogart has successfully overcome these formidable obstacles. Whether he is dealing with the application of machinery to agriculture, the great Westward movement, or the system of land tenure, he leaves the reader with a clear and unbiased idea of the essential facts. His conclusions are presented in a final chapter that abounds with terse comments, of which the following is typical: "There is finally an inconsistency, not to say a danger, in a society which is politically democratic, but economically plutocratic." B. A. K.

A Bibliography of British Ornithology from the Earliest Times. Supplement: A Chronological List of British Birds. By H. Kirke Swann. Pp. xvii+42. (London: Wheldon and Wesley, Ltd., 1923.) 5*s.* net.

As a supplement to "A Bibliography of British Ornithology," by W. H. Mullens and H. Kirke Swann, the latter author has now published "A Chronological List of British Birds," consisting of references to the earliest authorities for the generic and specific names of British birds. These researches into the literature of the subject bring valuable aid to the systematic ornithologist. One hopes, however, that the immense labour devoted to them has now brought about something approaching finality in the nomenclature of familiar species. Nomenclature is merely a scientific convenience and not an end in itself, and, however desirable adherence to the rules of strict priority may be, it must be admitted that the recent resuscitation of early and still earlier names for well-known birds has been for the moment the reverse of convenient. If greater uniformity results in the future, when the revised names have become more widely accepted and familiar, there will have been a substantial gain: to such an end a work like this is a useful contribution.

British Hymenoptera. By A. S. Buckland, L. N. Staniland, and E. B. Watson. Pp. 48+8 plates. (London: E. Arnold and Co., 1923.) 9*s.* net.

THE introduction to this book states that the aim is to assist any one who may want "a volume more accurate than the popular romantic books and less technical than a systematic book." The Hymenoptera are a difficult group to treat in this form, and to produce a handbook of real use, and at the same time non-technical in character, is not an easy task. The present work suffers from over-compression: the actual descriptive letterpress only runs to 34 pages, which, it may be added, have exceptionally wide margins, and the result is that some of the superfamilies are dismissed in but a few lines. At the end of the book are eight clearly executed half-tone plates illustrating typical Hymenoptera and insects which resemble members of that order. The beginner who uses the book should note that the family headings of Figs. 25 and 26 and of Figs. 59 and 60 have been transposed.

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.*]

The Food of Dolphins.

THE letters on this subject which have been published in NATURE (December 22, 1923, p. 902; March 1, p. 310) are of great interest as revealing among dolphins a voracity which few zoologists are likely to have suspected. I venture to urge the importance of recording carefully the species investigated.

In his letter which started this correspondence, Dr. Johs. Schmidt explicitly refers to the common dolphin (*Delphinus delphis*), but the term "porpoise" might be misread as an equivalent of "common porpoise." "Porpoise" is generally understood by zoologists to refer to Phocæna, and it is so defined in Webster's Dictionary. Although it has been employed with a wider significance, it seems desirable to accept its present restricted meaning, and to use "dolphin" as a general term for any cetacean of small or moderate size, particularly if it belongs to the family Delphinidæ.

The letters at present published are concerned entirely with the common dolphin. In quoting M. Legendre, Dr. Schmidt (March 1, p. 310) does not indicate the species, but this point can be ascertained by consulting the original paper. The correspondence shows (1) that the stomach of a *Delphinus delphis* may contain at one time the remains of more than 7000 teleostean fishes; (2) that this species may eat Octopus.

The toothed whales are sometimes divided, according to the nature of their food, into ichthyophagous and teuthophagous kinds, but the distinction is by no means absolute. The dentition of most dolphins, consisting of a long row of more or less numerous teeth on each side of both jaws, is usually considered to be an adaptation to fish-eating habits. The sperm whale and the beaked whales (Ziphiidæ) come in the second group of cuttlefish-eaters, a habit associated with the reduction or loss of teeth, which are usually confined to the lower jaw, and, with the exception of the sperm whale, are only two or four in number.

The practice of eating cuttlefish is not confined, however, to these groups. Among the true dolphins (Delphinidæ) the caa'ing whale (*Globicephala melæna*) and Risso's dolphin (*Grampus griseus*), both with more or less reduction of their teeth, are known to subsist, partly at least, on cuttlefish; and the same statement may be made of the narwhal (*Monodon monoceros*) and the white whale (*Delphinapterus leucas*). It is none the less surprising to learn that an oceanic species like *Delphinus delphis* may consume the same kind of food. Feeling misgivings on this subject, I wrote to M. Legendre to ask him whether he used "Octopus" to include cuttlefish in general, and particularly genera like Loligo and Sepia, which are more or less pelagic in habits. M. Legendre assures me, in reply, that the food found in the dolphins' stomachs consisted definitely of Octopus; and it thus appears probable that this dolphin may feed on or near the ground. He makes the suggestion, which seems highly probable in the circumstances, that the dolphin varies its food according to its position near the coasts or in the open ocean.

The possibility that dolphins may on occasion be ground-feeders does not seem to have been sufficiently taken into account. Records exist, however, which point to the conclusion that this actually happens, in certain cases. In a paper on Tasmanian Cetacea (Roy. Soc. Tasmania, Papers and Proc., 1920, p. 4), Messrs. H. H. Scott and C. E. Lord describe the behaviour of certain dolphins, regarded by them as *Delphinus delphis*, which were observed playing in the surf, and avoiding being thrown on shore by diving through the crests of the breakers. The stomach of one of these animals was found to contain large quantities of the spines of the echinoderm Spatangus; and in this case the food would appear to have been obtained, not merely on the surface of the ground, but by disturbing the sand in which this echinid is habitually buried. Reference may be made, in this connexion, to the disputed question of the function of the exaggerated tooth of the male narwhal. The tooth has been supposed to be used for stirring up the bottom, in order to obtain food. The objection that a tusk is not developed in the females has been partially met by Winge, who points out (Meddel. om Grönland, xxi., 1902, p. 513) that as these Cetacea swim in schools including both sexes, the females could profit by the action of the males in disturbing the ground with their tusks. The Tung Ting Lake in China is inhabited by two widely different species of small Cetacea. One of these, *Lipotes vexillifer*, has a conspicuously long beak; while the other, *Meomeris phocænoides*, has a beakless head, like that of Phocæna. According to C. M. Hoy (*China Journ. Sci. and Arts*, i., No. 2, March 1923, pp. 154-157), Lipotes apparently feeds by stirring up the mud with its beak, in order to dislodge a species of fish which lives there. The Meomeris, on the contrary, feeds on fishes which it catches swimming in clear water.

The examples here given show that it is not out of the question that certain marine dolphins may be ground-feeders when in sufficiently shallow water. Further observations on the stomach-contents of any of these animals, both inshore and in the open sea, are much to be desired. SIDNEY F. HARMER.

British Museum (Natural History),
March 22.

Spectroscopic Evidence of Isotopic Elements.

SPECTROSCOPIC research on different elements is at present mostly confined to the discovery of series lines, while those not having regular distribution are left out of account. In most elements, the number of such lines far exceeds that of regular series, but no theory has as yet been advanced to account for the appearance of these lines.

As a consequence of our investigation of the rôle played by isotopes in giving out the satellites of mercury and bismuth lines, we assumed that there may be formation of pairs between atoms, especially in the ionised state, leading to the emission of spectral lines not belonging to series. If these lines are to be attributed to atomic vibrations, we have the means of calculating the difference of wave-length due to isotopes.

When two atoms are quasi-elastically connected and set in vibration, the frequency will be given by $\sqrt{f/\mu}$, where f is a constant depending on elastic connexion, and $\mu = \frac{m_1 m_2}{m_1 + m_2}$, m_1, m_2 being the masses of atoms forming the pair. The quantising of such vibrations has been treated by Born and Hückel (*Phys. Zeit.*, No. 1, 1923). Since f is of electromagnetic origin, the gravitational part being negligibly small, we can have pairs formed of different nuclei connected by the same value of f in the case of isotopes. For elements consisting of two isotopes,

as neon and chlorine, the vibrations of two symmetric pairs (m_1, m_1) and (m_2, m_2) and an asymmetric pair (m_1, m_2) can be compared, on the supposition that f remains the same. The difference in wave-length $\delta\lambda$ between two symmetric pairs is easily found to be

$$\delta\lambda = \left(1 - \sqrt{\frac{m_1}{m_2}}\right)\lambda_2, \quad . \quad . \quad . \quad (1)$$

and for symmetric and asymmetric pairs

$$\delta\lambda = \left(1 - \sqrt{\frac{m_1+m_2}{2m_2}}\right)\lambda_2 \quad . \quad . \quad (2)$$

and

$$\delta\lambda = \left(\sqrt{\frac{m_1+m_2}{2m_1}} - 1\right)\lambda_1, \quad . \quad . \quad (3)$$

where $m_1 < m_2$, and $\lambda_1 < \lambda_2$, λ_2 denoting the wave-length due to the heavier pair. These expressions are only approximate, as the rotational term is not taken into account during quantising. The energy of rotation can sometimes become appreciable in the emission.

There may be some doubt as to the appearance of atomic pairs in metallic vapours, but Franck and Grotrian (*Zeit. f. tech. Phys.*, 3. 194, 1922) came to the conclusion that such must exist in mercury vapour. In fact, we found that nearly all the lines of mercury in the infra-red region, measured by McLennan and Shaver, can be arranged according to the present scheme.

In place of vibrations in pairs, we can have also tri- and polyatomic vibrations, which have not yet been tested.

From the table of spectral lines the existence of such pairs in isotopic elements was tested, and we found that most of the lines not belonging to series can be arranged in this manner. To show the order of coincidence, we give a few examples for isotopic elements:

Elements.	Pairs (m_1, m_2).	λ (Å.U.).	δλ (obs.).		δλ (calc.).	
Ne	Symm. (22, 22)	5052·93				
	(20, 20)	4817·64	235·29	121·99	235·26	121·74
	Asymm. (20, 22)	4930·94	113·30		113·31	
Cl	Symm. (37, 37)	3854·21				
	(35, 35)	3748·59	105·62	54·10	105·60	53·90
	Asymm. (35, 37)	3800·11	51·52		51·71	
A	Symm. (40, 40)	4400·25				
	(36, 36)	4174·20	226·05	117·22	225·80	117·35
	Asymm. (36, 40)	4283·03	108·83		108·38	
Cu	Symm. (65, 65)	2453·16				
	(63, 63)	2414·9	38·26	19·48	38·04	19·23
	Asymm. (63, 65)	2433·68	18·78		18·79	
Zn	Symm. (66, 66)	2442·18				
	(64, 64)	2405·23	36·95	18·64	37·24	18·86
	Asymm. (64, 66)	2423·54	18·31		18·43	
	Symm. (68, 68)	1790·4				
	(64, 64)	1736·5	53·9	27·5	53·46	27·3
	Asymm. (64, 68)	1762·9	26·4		26·12	
	Symm. (68, 68)	2478·60				
	(66, 66)	2442·18	36·42	18·28	36·72	18·57
	Asymm. (66, 68)	2460·32	18·14		18·16	
	Symm. (70, 70)	1915·9				
	(64, 64)	1832·0	83·9	43·0	84·0	43·4
	Asymm. (64, 70)	1872·9	40·9		40·6	

Paschen has successfully arranged about 900 lines of neon in series, by assuming a number of energy levels. It is questionable if, by considering the lines as due to atomic vibrations, there is not another way of ordering the lines, because we found 250 symmetric and 248 asymmetric pairs among the lines used by Paschen.

We have calculated roughly the values of $\delta\lambda$ for different elements, and have found up to now the following number of pairs in the spectra of isotopic elements:

Elements.	(m_1, m_2).	No. of Symmetric Pairs.	No. of Asymmetric Pairs.	Total No. of Lines examined.	Range λ (Å.U.).
Li	(6, 7)	3	2	28	8127-2359
Ne	(20, 22)	250	248	856	9840-2550
Si	(28, 29)	4	2	42	4191-2124
Cl	(35, 37)	35	25	201	5672-3277
A	(36, 40)	360	320	1124	7506-2050
Zn	(64, 66)	46	62		
	(64, 68)	61	43		
	(64, 70)	37	38	312	16500-1633
	(66, 68)	43	48		
	(66, 70)	42	16		
	(68, 70)	16	20		
Cu	(63, 65)	81	220	850	6381-1600
Br	(79, 81)	71	60	334	7820-3685
Rb	(85, 87)	4	4	46	4649-3199

We have reason to believe that the number of asymmetric pairs will be much increased on close examination of spectral lines, as many of them seem to be associated with only one of the symmetric pairs.

It is strange that so many pairs due to isotopes have remained unknown; perhaps spectroscopists were of opinion that, owing to the equality of electron distribution about the nucleus, the difference in wave-lengths was of the order of magnitude as found by Aronberg and Merton in ordinary and radio-lead, and paid no attention to pairs.

In boron, no pairs following the above formulæ are found; it is perhaps to be explained on the ground that we have not yet obtained proper means of exciting the lines. From a large number of observed pairs, it is clear that atomic vibrations play an important part in emitting non-series lines. For elements with atomic numbers 22 to 28, the spectral lines are so numerous that we can conceive of the existence of many isotopes in these elements. Aston, however, finds that they are simple, with the exception of the last one, which consists of two isotopes. We have reason to believe that the lines are mostly to be attributed to nuclear agitations, as will be discussed in another note.

The formulæ for calculating the difference of wave-length of vibrating pairs may be utilised for finding out the isotopes from known spectroscopic data, or checking the result of experiments. Calculations can be made for finding the unknown isotopes, as the approximate values of atomic weights can be suitably assumed, and tested from known wave-lengths. Trial calculation showed that calcium contains a small quantity of 44, sodium a trace of 21, and barium probably consists of 135, 137, 138, 139, of which the last three form the principal part. We are now searching for isotopes of elements such as tellurium. We thus have a new means of searching the isotopes from spectroscopic measurements. With high atomic weight, the value of $\delta\lambda$ becomes tolerably small, so that accurate values of wave-lengths must be given. The present method will be useful in testing the isotopes of metals of the rare earths, if we can get good spectroscopic data on pure samples.

It is to be noted that such calculations can only give approximate values. The atomic weight is assumed to be multiples of H-proton, but this is not rigorously true. The vibrating atoms contain electrons and nuclei, which are all charged; and the nuclei are conglomerates of positively and negatively charged particles. The inertia of a system of electrified bodies is not easy to calculate, but is generally greater than the sum of the masses of particles considered independently of each other. It depends on the electric configuration, so that minute examination

of $\delta\lambda$ may ultimately lead to the elucidation of the structure of the nuclei of different elements. On examining the table of atomic weights, we find the number of H-protons sometimes greater than the value given by taking O = 16; it may rest on imperfect experimental data, but probably there is also electro-magnetic ground to account for the discrepancy. It will be necessary, strictly speaking, to give more accurate figures to isotopes than whole numbers, as the structure of the nucleus becomes better known.

In connexion with the present note, we have to remark that, by using the expression for the quantised energy deduced by Born and Hückel for two vibrating atoms, and neglecting higher terms due to vibration, the frequency difference of two lines the quantum numbers of which differ by unity must be constant, if the term due to rotation remains unchanged. Many lines having this property and not belonging to series are found in argon, copper, tin, lead, arsenic, antimony, and bismuth. It is probable that these lines are due to atomic vibrations; moreover, many lines of lead belonging to this type show strong reversal, which can be explained from the same point of view. Some chlorine pairs above considered can also be arranged in a similar manner.

The present research is of special interest as affording a means of investigating the nuclear structure from the examination of spectral lines, and though our knowledge of the nuclei is still vague, fresh light can be shed on it by the extension of spectroscopic research. The excitation of many non-series lines will open a wide field of investigation, not only in searching for isotopes, but also in elucidating many unsolved problems of spectrum analysis.

H. NAGAOKA.
Y. SUGIURA.

Institute of Physical and Chemical Research,
Komagome, Hongo, Tokyo,
January 29.

Liquid Crystals, Soap Solutions, and X-Rays.

ORDINARY liquids when not subject to strain are isotropic and appear dark when examined between crossed Nicols, whereas most crystals are anisotropic and light up the field. Several hundred pure organic substances exist at suitable temperatures in an intermediate condition in which they are more or less fluid but are anisotropic.

Lehmann, who first recognised this state of matter, has been severely criticised for coining the descriptive term "liquid crystals" (or "crystalline liquids").

Lehmann, like most German and French authorities, accepted Bose's (1908) explanation of the effect as being due to parallel arrangement of long, thin molecules, which do not however form the regular space lattices of true crystals. In conformity with this, van der Lingen showed in 1913 that "liquid crystals" do not give a crystal X-ray picture, and all subsequent attempts have likewise given negative results.

Most solutions, whether of colloids or of crystalloids, are strictly isotropic: there are, however, a few colloidal sols, such as Freundlich's vanadium pentoxide, which are anisotropic whenever the anisotropic particles are oriented by stirring. Solutions of soap are almost unique in exhibiting the same spontaneous crystalline liquid properties as do pure organic substances.

There is a wide range of such colloidal soap solutions, and indeed all concentrated soap solutions whether at ordinary or higher temperatures are in this condition. All these anisotropic soap solutions are clear, transparent, soft, plastic fluids. These solutions likewise fail to give any indication of crystalline structure by X-rays. Good specimens for study at room temperature are afforded by all potassium laurate solutions over three times normal strength and by all solutions of oleate above once-normal; and commercial "neat soap" in the soap pan is typical of this condition.

Soap and its solutions can, however, exist in five other forms. If neat soap be cooled, a proportion of it may separate out as undoubted crystals or, alternatively, as the curd fibres familiar in household and hard white toilet soap. Both the undoubted true lamellar crystals and the curd fibres give X-ray spectra. Soap remaining in solution at room temperature is always transparent in each of the four following forms: there are three states of colloidal electrolyte, namely, anisotropic plastic liquid, isotropic jelly, or isotropic fluid; whilst dilute solutions in which hydrolysis has been suppressed contain only crystalloid.

Friedel in 1921 classified Lehmann's crystalline liquids into two groups, namely, "liquide à conique" and "liquide à fils," these names being taken chiefly from the appearance of the boundaries of different portions of the specimens when examined in polarised light. More recently Friedel (*Ann. de phys.* 1922, 9, 273) has withdrawn these names in order to call the first "smegmatic" (or "soap-like") and "nematic" (or "thread-like"). Surely "soap-like," with its six widely different forms, is about the last term that one would employ to characterise precisely a new state of matter. Why, again, employ an unspecified kind of soap solution to define the state of pure substances?

Friedel has introduced a further confusion in his classification by including soap curds among the "smegmas" or "liquides à conique," a procedure which to any one familiar with the behaviour of these two forms of soap would appear to be inadmissable. Not only so, but he has used the X-ray spectra obtained by himself and de Broglie with soap curds (proper details are lacking) to substantiate the structure which he has postulated for the "liquides à conique." My colleague, Mr. Piper (Proc. Phys. Soc. 1923, 35, 269), has (in my opinion mistakenly) followed Friedel's procedure without criticism (see also Annual Reports of Chemical Society for 1923, p. 243).

The fact is that so far, no one appears to have obtained an X-ray spectrum from any homogeneous "liquid crystal"; whereas, in direct contrast, the X-ray photographs of soap curds resemble those of the ordinary fatty acids which are definitely interpreted as crystalline (Annual Report, p. 244).

I would urge, then, the retention either of Lehmann's terms, which have been so long in use that they have ceased to mislead, or, alternatively, of the truly descriptive term "anisotropic liquids." I would emphasise that the renaming of the sub-groups "liquide à conique" and "liquide à fils" must lead and has already led to real confusion. Soap curds are too different from anisotropic soap solutions to belong to the same state of matter.

JAMES W. McBAIN.

The University, Bristol.

The Temperature of Reversing Layers of Stars.

THE question of the relation of the temperature of a reversing layer of a star to the star's effective temperature is raised by Dr. J. Q. Stewart in NATURE of March 15. In the investigation of mine to which Dr. Stewart refers (Mon. Not. R.A.S., 82, 368, 1922) it was shown that the temperature of an indefinitely thin layer in radiative equilibrium, subject on one side to black radiation of effective temperature T_1 and subject on the other side to no radiation, lies between T_1 and $\frac{1}{2}T_1$, whatever the selective absorption of the thin layer. As Dr. Stewart points out,

this result cannot be applied as it stands to a stellar atmosphere, for the atmosphere as a whole is not "optically thin." If we adopt for its lower boundary a surface at such a depth that the radiation incident on it from below is black (say of temperature T_1), a temperature gradient will exist between its lower and upper boundaries and produce absorption lines. On the ordinary thermodynamic theory of radiation it can then be shown that if the atmosphere is in radiative equilibrium, the temperature of its lower boundary must lie between T_1 and $\frac{1}{2}T_1$, but the temperature of its upper boundary may have any value whatever lying below that of the lower boundary, according to the selective absorption.

It is of interest to consider in more detail the assumptions underlying such calculations. The extension of the ordinary thermodynamic theory of radiation to matter which is not under the conditions of an ideal enclosure assumes that each element is radiating and absorbing as if it were in thermodynamic equilibrium at its own temperature. Implicitly, therefore, it assumes that the distribution of the atoms amongst their different stationary states is the same as in thermodynamic equilibrium. The success of the theory in accounting for the observed law of darkening of the sun's disc towards the limb shows that in the photospheric layers the assumption must be very nearly satisfied; it justifies the deduction that the outer photospheric layers (except in so far as they are kept hotter by the back radiation from the reversing layer) have the Schwarzschild temperature $T_1/\sqrt[4]{2}$. The same theory attributes the formation of absorption lines to the existence of temperature gradients, but here it is much less successful.

It is not necessary, however, to introduce temperature gradients in order to obtain an absorption line. What governs the residual intensity in an absorption line is not directly the temperature, but the relative numbers of atoms in the corresponding stationary states. The atoms at the greater depths deprive the outflowing radiation of the frequency which is capable of transferring an atom from its normal state (assuming for simplicity that we are dealing with a principal line) to an excited state. Consequently, in the higher levels there will be relatively fewer atoms in the given excited state, and the number may even be less than the number calculated thermodynamically from the temperature. This would lead to an absorption line in which the residual intensity was less than that of black radiation corresponding to the temperature of the highest levels. The velocity distribution of the atoms, the degree of ionisation, and the distribution amongst stationary states may all correspond to different "temperatures." In particular, the "temperature" corresponding to the distribution amongst stationary states may be different for different atomic species at the same level. At any level, the effect of collisions will be to exert a control in the direction of thermodynamic equilibrium; the effect of the flux of radiation from below will be to oppose the control.

Consider as a specific case the ionised calcium yielding the H and K lines in the solar spectrum. These lines are produced by transitions between the 1σ-state of the Ca^+ atom and the 1π-state. It can be shown that the handing-on of quanta from atom to atom, by successive absorption and re-emission, will set up a gradient in the ratio n_2/n_1, where n_1 is the concentration of atoms in the 1σ-state at any level and n_2 is the concentration of atoms in the 1π-state at the same level. The value of n_2/n_1 increases inwards. Calculations which I have recently been making show that the Ca^+ atoms at high levels will be expelled by radiation pressure unless the residual intensity in the lines does not exceed $8\nu^2\tau mg/c$, where ν is the mean frequency of the H and K lines, m the mass of the atom, g the value of gravity, c the velocity of light, and τ the "average life" of a Ca^+ atom in the 1π-state. Assuming the Ca^+ atoms at high levels are just supported by radiation pressure, an observed residual intensity of $\frac{1}{9}$ of the neighbouring continuous spectrum gives the value $\tau = 0{\cdot}6 \times 10^{-8}$ sec. It is then found that at high levels n_2/n_1 has the value $2\tau cmg/h\nu = 1{\cdot}3 \times 10^{-4}$, and that at the level where the outward stream of radiation has attained the photospheric value n_2/n_1 has increased seventeen times. No reference to temperature is required throughout the discussion. The theory assumes the existence of a local radiative equilibrium in the H-K radiation. Such a condition is strongly suggested by Schwarzschild's observation of the change of residual intensity in the H and K lines from the centre to the limb of the sun (*Berlin Sitz.*, 1914, p. 1198); the change corresponds to a coefficient of darkening of about $\frac{3}{5}$, which is close to the theoretical value. (These results will be communicated to the Royal Astronomical Society at an early meeting.)

In the solar chromosphere, the thermodynamic control must be very slight. In the reversing layer it will be greater. Indeed, the general agreement of the stellar temperature-scale deduced from the thermodynamic theory of high-temperature ionisation with the observed scale of colour-temperatures suggests that the *average* state of the reversing layer (averaged through its depth) is one not far removed from thermodynamic equilibrium. Increasing knowledge of the mechanisms of ionisation and excitation—of the laws of ionisation by radiation and ionisation by collision—will allow direct calculation to be made of the state of a stellar atmosphere without any appeal to thermodynamics.

E. A. MILNE.
Trinity College, Cambridge,
March 20.

A Small Measuring Microscope.

A DESCRIPTION of a small measuring microscope devised by us may be of interest to readers of NATURE. The optical elements are extremely simple, consisting of a Ramsden eyepiece having a scale, divided on glass, which is permanently fixed in the focal plane. As the device is intended mainly for the observation and measurement of opaque objects, a thin parallel plate of glass is inserted at an angle of 45° between the lenses (Fig. 1). This serves to reflect diffused light on to the object observed and interferes very little with perception and measurement. In an eye-

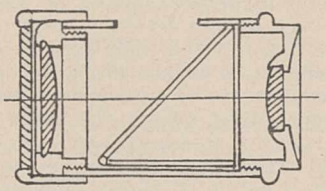

FIG. 1.—Optical system.

piece with a long working distance or using only an achromatic lens, the reflector may be interposed between the scale and the first lens. The instrument is, of course, equally available for the observation of transparent or aerial objects.

Possible uses are:

(*a*) Direct measurement of screw pitches.

(*b*) Measurement of Brinnell impressions in hardness tests.

(*c*) As an optical dynamometer.

(*d*) Measurements of botanical or other objects under low power.

The most obvious virtue is portability (waistcoat-pocket type).

Any scale may be employed. That actually in use is one of 10 millimetres divided into fifths of a millimetre. With estimation to a tenth of an interval a final reading to 0·02 mm. (=0·0008 inch) is obtained. The actual divisions are on the outer side of the glass graticule and so practically in contact with the object under examination. Parallax is so small as not to be observable.

If a Kellner type of eyepiece is used the graduations could be marked directly on the outer surface of the field lens. This gives a still simpler optical system.

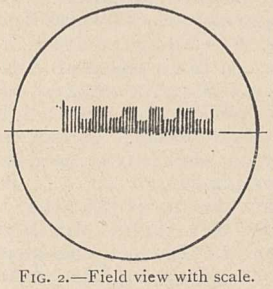

FIG. 2.—Field view with scale.

It is not claimed that this is a novelty, but it is certainly not well known.

The mechanical engineer of the India Store Department, Mr. A. L. Haas, while investigating Brinnell impressions, consulted us with reference to a very simple type of measuring device. The result is described above.

Any optical firm could make such a device. The original instrument was made, at the authors' request, by Messrs. W. Ottway and Co., Ltd., under the supervision of Mr. Wood, of the firm's optical department, who devised a scale in which alternate millimetre intervals were divided by long and short lines (Fig. 2).

T. F. CONNOLLY.
E. H. COUMBE.

Inheritance of Characters acquired by Grafting.

IN NATURE of February 2, p. 174, a brief account is given of L. Daniel's experiments in which an artichoke was grafted on a sunflower. The seeds of the transplanted artichoke yielded a series of plants differing from each other in several respects. This result is claimed by the author as a case of inheritance of characters acquired by grafting. Now artichokes very seldom set seed—personally, I have never seen a case; but as there exist several varieties of this species, it is highly probable that many, if not all, artichokes are heterozygous in many respects. Grafting very often causes the scion to produce flowers and seed; it seems very natural that the transplanted artichoke was influenced in that way—a physiological action of purely phenotypical nature without the slightest influence upon the genotypical constitution of the scion; the differences between the individuals of the progeny are here without doubt a consequence of the heterozygous nature of the scion.

I must confess that the great bulk of indications claimed as cases of the alleged inheritance of acquired characters show an astonishing lack as to critical judgment—creed in the place of science.

W. JOHANNSEN.

Copenhagen, March 10.

The Singing of Wires in a Wind.

THE following observation may be of interest in connexion with the singing of wires in a wind. A four-pronged toasting-fork was waved backwards and forwards through the air. It was found that if the plane of the prongs was in the direction of motion, a singing noise was produced, but that if the plane of the prongs was perpendicular to the direction of motion and the fork was moved at the same speed through the air, the singing was practically inaudible. The prongs were 8 cm. long, 0·25 cm. diameter, and they were spaced 2·2 cm. apart.

The resistance of a wire when it is moved through air, and also the singing noise produced by its motion, are both due to eddies which are formed in its wake. It seems curious, therefore, that when several wires are arranged so that they shield one another and thus reduce their total resistance, the singing noise is thereby greatly increased instead of being reduced.

G. I. TAYLOR.

Trinity College, Cambridge,
March 15.

Underblown Pipes.

As a result of careful experiments conducted by Messrs. G. Subrahmaniam and D. Gunnaiya, it has been found that the behaviour of underblown pipes presents many features of remarkable interest. The following is a brief account of the results obtained with four wooden pipes ranging over an octave (256, 320, 384, and 512).

The behaviour of the 256 pipe, which is the gravest of the set, is identical with that described by the late Lord Rayleigh (*Phil. Mag.*, 13, 1882); that of 320 showed a slight difference, while in the other two the difference became marked at least in one respect. In all the pipes a note distinctly lower in pitch as well as in intensity than the fundamental makes its appearance at a pressure of a few millimetres, and the minimum pressure to start this note increases with increase of pitch. The note gets considerably sharper than the fundamental as the pressure rises, and ceases at pressures which are also higher for higher pitches.

In the two lower pipes a note slightly lower than the octave starts a little before, or when, the fundamental ceases. In the higher pitches, however, instead of the octave, a period of silence ensues. In fact, this octave-tone is very feeble even in the 320 pipe and is obtained with difficulty. The periods of silence in the two higher pipes are followed by tones which are, to start with, a little flatter than the fundamentals. The pressures at which the normal tones commence are also higher for the higher frequency pipes.

In the lower pipes the octave-tones, which started as the underblown fundamentals disappeared, rise with pressure and cease, giving rise to normal tones immediately in the case of 256 pipe and preceded by a very short period of silence in the case of 320. The entire absence of the octave counterpart in the two higher pipes distinguishes their behaviour from the lower ones and that described by Lord Rayleigh. This suggests that the octave counterpart appears for pipes lower than a particular limiting frequency. The difficulty experienced in the case of the 320 pipe also suggests that it is very near the limiting frequency.

A. L. NARAYAN.

H.H. The Maharajah's Research Laboratories,
Vizianagaram.

Foot-and-Mouth Disease.

THE present epizootic of foot-and-mouth disease in England has once more directed attention to the enormous financial losses which a disease of this kind may entail. Up to the middle of March 96,429 cattle, 35,936 sheep, 44,445 pigs, and 119 goats had been slaughtered, and a total gross amount of compensation had been paid, or is payable, of 3,082,000*l.* in the efforts of the authorities to stem the tide of the invasion. At the same time, the estimated amount of administrative expenses runs into half a million pounds. The tragic thing, however, is that, this holocaust notwithstanding, the epizootic has not been stamped out or even effectively checked, and it is not improbable that it will have to be left to run out its course, as has happened on more than one occasion before.

Foot-and-mouth disease is generally regarded as the most contagious malady known. Its importance is, however, not due to the mortality which it inflicts, because this is usually trifling. The disease causes marked loss of condition, so that the market price of the recovered animals is greatly depreciated, while commerce and traffic suffer severe restrictions in consequence of legal enactments which have to be put into force to circumscribe the disorder. In England the official attitude has been that, as the recovered animals become worthless from the point of view of the sale or meat market, the cheapest and most expedient method of getting rid of the scourge is compulsory slaughter of all affected animals and contacts. To many persons this is a repellent procedure, and particularly so if it is not successful. In fact, the present epizootic has brought a good deal of criticism on the Ministry of Agriculture, and a war-cry has been sounded demanding a widespread inquiry into the disease. To appease the critics the Minister of Agriculture has appointed a committee of pathologists to suggest further lines of research on the disease. While investigation on foot-and-mouth disease is a political slogan which appeals to the laity, it is a vulgar error to suppose that nothing has been done in this direction. For more than thirty years some of the foremost pathologists of the time have laboured day in and day out to discover the cause of this disease and to formulate an efficient method for its prevention or cure. Some of the reasons why this has not been successful will appear below. It may be pointed out that, in common with foot-and-mouth disease, the causes of measles, scarlet fever, chicken-pox, and small-pox are at present unknown. Now these diseases leave behind them a high-grade and lasting immunity, whereas foot-and-mouth disease does not. It would appear particularly difficult to accomplish by art that which is not accomplished by the *vis medicatrix naturæ*.

Foot-and-mouth disease is an acute fever with a visible exanthem in the form of blebs or vesicles on the mouth and hoofs, chiefly in cattle, pigs, and sheep. Other animals and man are more rarely attacked. The virus which causes this remarkable disease has not been seen, apparently on account of its smallness, for it is known to traverse bacteriological filters which keep back visible germs with certainty. This highly important fact was discovered by Loeffler and Frosch in 1897, and has been abundantly confirmed by subsequent workers, among whom we may specially mention Nocard and Roux. The disease occurs in epizootics which may reach enormous dimensions and cause incalculable damage to agriculture. Thus in 1890 800,000 animals were affected in Germany, where, two years later, this number was advanced to 4,000,000. In England the first authentic record occurred in 1839, and was only part of a vast European epizootic which ultimately reached our shores. From this time until 1866 the disease never really disappeared, but up to 1870 was quiescent. In 1870–71 more than one million animals were attacked. The Contagious Diseases Act of 1878, and the repressive measures with which it was associated, were believed to have stamped out the mischief effectively, but again in 1883 half a million animals suffered. The country was free in 1886 and remained so until 1891. In 1892 the disease was again present, and new measures were taken prohibiting the importation of all cattle from countries affected by the disease. In spite of this precaution there have been many outbreaks, but until the present none on a really big scale, and it is remarkable that the sources of these outbreaks have not been run to earth, for no one believes that the disease arises *de novo*.

The fluid of the vesicles on the mouth and hoofs, although it contains no ordinary bacteria, contains the virus of the disease, and even when filtered is capable of setting up the malady when injected into cattle, sheep, and pigs. Loeffler and Frosch, the pioneers in this investigation, failed to transmit foot-and-mouth disease to guinea-pigs, rabbits, rats, mice, cats, dogs, fowls, or pigeons. Many experiments go to show that, contrary to what might be expected, the virus is a delicate one which can only be preserved outside the body for a short time, and even then with difficulty. Thus it is rendered inert within half an hour at body temperature, but may be kept alive on ice for a week or two. There is no evidence that it ever multiplies outside the animal body. Roux, Vallée, Carré, and Nocard, who carried out a long series of investigations between 1901–21, never succeeded in obtaining cultivations of the virus *in vitro*, although success in this direction has been claimed by Titze (1922) on a fluid medium the composition of which he has not disclosed.

Contrary to the negative results of Loeffler and Frosch, a number of writers, among whom we may mention Waldmann and Pape, Groh, Uhlenhuth and Ernst, and Gins and Weber, have recently shown that the disease is communicable to laboratory animals like guinea-pigs, which develop a rash on the feet after a latent period of two to three days. These successful results are particularly prone to occur after cutaneous application of the virus to the scarified skin of the hairless parts of the feet or ears. By this method a local lesion——the primary or inoculation aphtha—develops in twenty-four hours, attains a height in two days, and is followed in 2-5 days more by blebs on the legs, tongue, and ears, the virus having in the meantime become generalised all over the body. The experi-

mentally-produced disease is apparently non-contagious, for when healthy guinea-pigs are placed in the same cage with the experimentally infected, they do not contract the disease. After intravenous injection of virus guinea-pigs develop an initial fever, followed on the third day after inoculation by swelling and redness of the legs and vesicles on the feet and tongue.

The ordinary symptoms of foot-and-mouth disease in cattle need not detain us. In the naturally acquired infection the incubation period is 2-7 days, at the end of which time fever sets in with *malaise*, shivering, dulness, and loss of appetite. On the second or third day the characteristic rash occurs on the mouth and feet. The animal goes lame and rumination ceases. At first the vesicles have a clear colourless liquid, but soon burst and leave very painful bright-red erosions. A copious flow of saliva adds a characteristic touch to the picture of misery which the animal now exhibits. In milch cows the eruption may be very marked on the udders, and the secretion of milk is lessened or ceases altogether. In sheep and pigs the vesicles are mainly pedal, whereas in the horse they are mostly oral. A highly malignant form of foot-and-mouth disease with a mortality up to 95 per cent. is also recognised by many veterinary surgeons. The disease also occurs in man, and particularly in children, as was first shown by Sagar in 1764. The infection is conveyed by contact with sick animals or from milk, butter, or even cheese. The symptoms are fever and vesicles about the mouth, gums, and throat, but rarely on the feet or hands. In some cases death has ensued from generalisation of the rash. That foot-and-mouth disease of man is the same disease as in cattle has been shown by the successful reproduction by inoculation in cattle (Bertarelli) or guinea-pigs (Gerlach, 1924).

The transmission of the virus under natural conditions takes place directly or indirectly, and the latter is of great importance. The immediate infection occurs from contact with the sick in stalls, byres, meadows, cattle-markets, etc. Mediately, the disease is disseminated by virulent saliva or vesicular lymph or discharge infecting fodder, bedding, meadows, roads, railway wagons, drinking troughs, the hands and clothes of human attendants, and such like. When all these methods of infection have been excluded there seem to be others, unknown or unproven, which cause mysterious outbreaks. Some have incriminated rats as the carriers of the virus. Others have supposed that insular countries like England become affected by birds of passage. This idea, first suggested by Bang in Denmark, has recently been studied by Stockman and Garnett (1923), who have analysed the relations existing between the seasonal and geographical incidence of so-called *de novo* outbreaks and the known migrations of birds from the Continent to England. These investigators believe that the two things are correlated, although certain objections have been brought forward by Landsborough Thomson from the ornithological side (*vide* NATURE, January 12, 1924, p. 52).

Of great importance for the prophylaxis and cure of foot-and-mouth disease is the question of immunity, and it is unfortunate that the facts are not known with greater certainty. Some have asserted that no immunity is acquired by passing through an attack of the disease, while others say not only that it occurs but also that it may last 5 to 7 years. The great majority of observers believe that the degree of acquired immunity is neither high nor lasting. It is certainly nothing comparable to the immunity in man developed as a result of an attack of small-pox. We know that animals may have a second attack of foot-and-mouth disease at an interval of weeks after the first.

With regard to treatment, every kind of drug has been tried, but there is no scientific evidence that any of them have altered the course of the disease one whit. Laborious efforts have been made, extending over long periods, to develop a specific prophylaxis or cure following methods which have proved of great advantage in several other diseases. These methods may be classified in four groups: (1) the inoculation of the healthy with blood or milk from animals which have recovered from the disease. Loeffler and Frosch, and Nocard and Roux, proved the existence of immune substances in these fluids, but they are not in a concentration which makes this method a practical proposition; (2) passive immunisation by the serum of animals actively immunised with the virus. The objection to this is the cost of production, the large dose required, and the transient immunity produced. (3) Inoculation of virulent or attenuated virus has been suggested by Nosotti and practised on a considerable scale with doubtful results, apart from the danger of spreading the disease; (4) sero vaccination, in which living virus is mixed with immune serum to temper down its virulence. This combination, under the name of "seraphthin," has been carefully investigated, and is effective within limits, but seems to be impracticable on a big scale.

During last century much was written on the supposed protection against foot-and-mouth disease by cow-pox or vaccinia, and even in the present epizootic, vaccination has been strongly recommended upon very slender evidence. Experimentally the tradition that vaccination protects against foot-and-mouth disease receives no support, for Gins and Weber have recently shown that there is no cross immunity at any rate in guinea-pigs. Cutaneous vaccination of these animals with fresh cow-pox lymphs produces typical pustulation but does not influence the result of subsequent experimental infection with foot-and-mouth virus. The converse was also found to be true.

During epizootic periods "emergency inoculation," a method crude in its simplicity, has been advocated and employed. This consists in inoculation of stock with foot-and-mouth virus, and is intended to get over the bugbear of an epizootic as quickly as possible instead of allowing it to drag on as it often does in the natural way.

The outlook on the prevention and cure of foot-and-mouth disease is not very hopeful unless chemotherapy steps in with a remedy. In a country like England, where the disease can be restricted to a certain extent by efficient veterinary police work, early diagnosis of the disease, destruction of the sick and contacts, and proper disinfection of all infected materials, seem to be the most expedient. But even these will fail on occasion and the disease may get completely out of hand, a state which is not at all improbable in the present outbreak. W. B.

The Ancient River System of the Kalahari and the Possibility of its Renewal.

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

MANY arid countries contain wide mud-floored depressions which mark the sites of former lakes. This origin is so obvious that, as in western Australia, they are called lakes, although waterless. In South Africa they are known as vleis or pans. In a paper on the dry-lake system of West Australia in 1914, I pointed out that the steady descent in level from one of these mud-flats to the next and their arrangement on converging lines indicates that the lakes are isolated sections of an ancient river system, which was broken up as the dwindling streams failed to keep open their channels. The same explanation gives the clue to the distribution of corresponding basins in Libya. Prof. E. H. L. Schwarz has adopted the same idea for the great pans and vleis in the interior of southern Africa. He represents the Atosha Pan, the basins of Lake Ngami and Makarikari, and two lines of depression across the Kalahari desert, as remnants of one great river system which had its sources in the highlands of southern Angola. Its headstreams, including the Chobi and the Okavango, flowed south-eastward, parallel to the present course of the Upper Zambezi. The river was diverted southward by the highlands of southern Rhodesia and the Transvaal, and discharged to the Atlantic through the Orange River.

Prof. Schwarz holds it possible to restore the rivers in these depressions and thus refertilise the deserts between the Zambezi and the Orange River. According to his theory, the country has withered into desert by a process which is acting upon the whole of Africa. As the rivers cut their way through the rim of the African plateau they drain the interior, and thus cause the desiccation of the country. The rivers which are now the western tributaries of the Upper Zambezi have been cut off from the Kalahari region by a valley in line with the part of the Zambezi near the Victoria Falls. Prof. Schwarz's scheme is to build a weir across the Chobe Valley near its junction with the Zambezi and thus divert its water back through the old channels into Lake Ngami and Makarikari. These basins would become great lakes with an overflow across the Kalahari and through the Malopo to the Orange River. It is claimed that this change would render possible the irrigation of large tracts of country and profoundly modify the climate of South Africa. In a new paper, "The Kalahari Scheme as the Solution of the South African Drought Problem" (*South African Journal of Science*, xx., 1923, pp. 208-222), Prof. Schwarz directs attention to the support to his proposals given by some great floods since the publication of his book "The Kalahari."

As an explanation of the distribution of the ancient lake basins of South Africa, Prof. Schwarz's theory seems fully trustworthy; but the evidence he adduces for the recent desiccation of Africa is doubtful, and the meteorological foundations of his estimates as to the practical results of his proposed weir are highly speculative. The old river system was perhaps much earlier than Prof. Schwarz considers, and the building of a 100,000*l.* dam across the Chobe Valley might not revolutionise the climate of South Africa. Prof. Schwarz estimates, especially from observations on the Tarka River, that 75 per cent. of the South African rainfall is derived from evaporation on the land, and only a quarter of it comes in from the ocean. As most of the South African rain occurs between October and March, when the prevalent winds are from the south-east, and most of it falls on the eastern half of the country, this estimate of the proportion of rain derived from the oceans appears unduly low. The benefit of the scheme to the South African climate is based partly on the effect of water lost from lakes by seepage; for it is suggested that the water which percolates into the ground around the lakes would travel for long distances and raise the level of the ground-water throughout South Africa, and give that region a more humid climate.

Some of the meteorological facts are inconsistent with the generally accepted records. Thus it is said "that in the Fens, which are the wettest portion of England, the rainfall ranges from 15 to 12 inches a year." Unless the term wet is used here in some special sense, the statement would be denied in the Lake District, while Spurn Head and mid-east Essex, rival claimants for the minimum British rainfall, would unite in scepticism of the reported 12-inch rainfall in the Fens. Another statement that may excite meteorological incredulity is the explanation of the rainfall around the Great Lakes of America by the fact that "every household pours immense volumes of water-vapour into the air from kettles and pots, and steam-engines and railway engines do the same; all this is available for precipitation as rain when atmospheric conditions are favourable." Equally uncertain is his argument from the classical Silphium. According to Prof. Schwarz, all Africa has undergone recent desiccation, and he accepts the view that northern Africa has become much drier since classical times. He dismisses the evidence from the distribution of the vine and the fruiting of the date-palm against any material climatic change around the eastern Mediterranean during the historic period, on the ground that these plants have been artificially preserved. He attaches more weight to the dubious plant Silphium, the evidence of which would be more trustworthy if it had not been artificially exterminated. He accepts its identification as *Thapsia garganica*, and holds that it has changed its habitat with the spread of desert vegetation over the once fertile fields of Cyrenaica.

If Silphium be *Thapsia garganica*, the plant has changed its secretions, which are very poisonous to camels and yield a powerful irritant. Silphium was highly prized as a universal medicine, as a condiment, in perfumery, and was a favourite food. It was probably exterminated by over-collecting. Pliny stated that it was extinct in Cyrenaica, the last plant found there being sent as a curiosity to the Emperor Nero. *Thapsia garganica* has been identified with it as the local plant most similar to the representations of Silphium on the Greek coins. The identification accepted by Prof. Schwarz, however, is directly opposed to his conclusions. His case is that Silphium now

grows in the Garden of the Hesperides, whereas in ancient times it grew only in the far southern deserts, the flora of which has therefore spread northward. Pliny, however, mentioned the plant as found in the Garden of the Hesperides, and *Thapsia garganica* grows abundantly in the very area where the main supply of Silphium was found. Hence the identity of these plants would support the view that there has been no climatic change and no shift of vegetation in Cyrenaica since classical times.

The weakness of some of Prof. Schwarz's arguments does not necessarily invalidate his scheme, and it is to be hoped that they will not prevent its full investigation. He draws a gloomy picture of parts of the Karroo and southern Free State, which he says "are becoming depopulated owing to droughts"; thousands of children are growing up under semi-starvation, and he predicts that fifty years hence, when the minerals have been depleted, "the enormous debt of the country will fall upon the shoulders of the impoverished sons of the soil, the Poor Whites will form the greater part of our population, and the country will be ruined." He attributes these changes to "a dwindling rainfall, a country becoming uninhabitable from droughts." Whether the Chobe Dam would directly improve the climate of the southern Free State and Cape Colony seems doubtful; but it might be of great benefit to the northern regions if there be adequate population to till the irrigable land. It is probable that some of the flood water which flows wasted down the Zambezi could be diverted westward into the now arid basins of Ngamiland; but the data are inadequate to show how far south its influence would extend. In the interests of the northern arid areas of the Union of South Africa, it is to be hoped that study of the problem will be continued to demonstrate the extent of the area which would benefit by Prof. Schwarz's ingenious scheme.

Obituary.

PROF. W. JACK, LL.D., D.Sc.

PROF. WILLIAM JACK, whose death on March 20, at his residence, 5 St. John's Terrace, Hillhead, Glasgow, was announced in NATURE of March 29, was born at Stewarton, Ayrshire, on May 29, 1834. As a pupil in Irvine Academy he showed marked ability, and when he passed on to Glasgow University he confirmed the promise of his schooldays by taking a leading position in all the classes of the Faculty of Arts. In the Scottish Universities of that day there was little specialisation; all the students in the Arts Faculty followed the same curriculum and, as they usually entered the University comparatively young, the education they received formed a good foundation for the specialised studies of later life. For such more advanced studies, however, there was little direct provision in the University, and Jack, after graduating in Glasgow, proceeded to Cambridge, where he entered at Peterhouse. In the Tripos of 1859 he was fourth wrangler, but though he missed the coveted position of senior wrangler, he won the distinction of first place for the Smith's Prize. In 1860 he was elected a fellow of Peterhouse. The sound general training of the Arts curriculum in Glasgow, followed by the specialisation at Cambridge, was an admirable preparation for a varied and successful career.

In 1860 Jack was appointed one of Her Majesty's Inspectors of Schools in Scotland; in the south-west district to which he was assigned he won the esteem of the schoolmasters, and he is gratefully remembered by the small band of survivors. In 1866 he resigned the inspectorship to take up the duties of the chair of natural philosophy at Owens College, Manchester. There he took an active part not merely in the work of the College but in the general life of the community, and he was gratified by the recognition of his services on the occasion of the jubilee celebrations in 1902, when the Victoria University conferred on him the degree of D.Sc.

It might have seemed as if Prof. Jack had withdrawn from educational work when in 1870 he accepted the position of editor of the *Glasgow Herald*; yet it is unquestionable that one of the chief reasons that induced him to accept that position was of a definitely educational kind. One of his main objects, as he told his staff, was to make the newspaper a "people's university," and in pursuance of this aim reviews of books received much more attention and the area of its news service was much extended. At the present day the *Glasgow Herald* holds a leading position for the quality of its literary articles. Jack continued as editor until 1876, when he beeame associated with the firm of Messrs. Macmillan and Co.

Prof. Jack's most notable services to the cause of education, however, were rendered during his occupancy of the chair of mathematics in the University of Glasgow, to which he was appointed in 1879. His accession was marked by a thorough reorganisation of the mathematical department. At the date of his election the curriculum for degrees in Arts made little provision for advanced study, the course of study was rather narrow, and too frequently the classes were overcrowded. While preserving the essential features of the recognised courses he greatly improved the efficiency of the teaching by well-designed subdivisions of the classes, introduced in certain cases the element of tutorial instruction, and, by the institution of higher courses, extended the range and raised the standard of the honours degree. A new spirit was awakened among the students, and showed itself not merely in the increased attendance on the advanced classes, but also in the importance attached to the work of the summer vacation. At that time there was no summer session in the Faculty of Arts, but under his direct encouragement, and with his substantial support, summer classes were formed for the study of branches of higher mathematics that could not be overtaken in the winter session, and these classes became a feature of the mathematical teaching. The great improvement of the position of mathematics in the schools and universities of Scotland that marked the closing years of last century was due in no small degree to Prof. Jack's labours.

Prof. Jack won the affection of his students. Even the dullest member of the junior class felt the influence of the genial nature that could not be curbed by the

formalism of abstract mathematics, and he cherished for his professor an affection that was not to be measured by his proficiency in algebra or his knowledge of Euclid.

The services of Prof. Jack in Senate and Court were highly valued by his colleagues, but they were also in demand outside his own University. He was an assistant commissioner on the Primary Education (Ireland) Commission of 1878, and he served on the Queen's Colleges (Ireland) Commission of 1882. His wide experience, sound judgment, and tactful manner were peculiarly fitted for the work of these Commissions.

In 1910, the year after his retirement, his numerous friends presented to the University his portrait, painted by Sir James Guthrie, P.R.S.A., together with the sum of 300*l.* for the institution of a prize, to be called the William Jack Prize, and to be awarded at intervals for the best thesis on a mathematical subject.

Prof. Jack married a daughter of Dr. J. P. Nichol, professor of astronomy, who predeceased him. He is survived by two sons, Dr. W. R. Jack and Prof. A. A. Jack, who holds the chair of English in the University of Aberdeen. GEORGE A. GIBSON.

DR. L. PÉRINGUEY.

WE regret to announce the death of Dr. L. Péringuey, Director of the South African Museum, Cape Town, which occurred suddenly on February 20. Dr. Péringuey, who was French by birth, had been connected with the Museum since 1884, was Assistant Director under Mr. W. L. Sclater, and became Director in 1905. Throughout this long period he had worked untiringly for the advancement of science in South Africa and of the institution with which he was so closely connected. He was a man of varied scientific interests. His greatest work was the "Descriptive Catalogue of the South African Coleoptera." During the past twenty years he laboured unceasingly at the problem offered by the prehistoric inhabitants of Southern Africa, and his volume on "The Stone Age in South Africa" remains the standard work on this branch of anthropological research. Coupled with this, Dr. Péringuey made a close study of the physical characteristics of the fast-vanishing groups of Hottentots and Bushmen; and under his direction the Museum accumulated its unique collection of plaster casts of specimens of those races, taken directly from the living subjects, and of skulls and skeletal remains.

During Dr. Péringuey's directorship the increase that was made in the collection of material for study and exhibition in every branch of natural science was immense, considering the limited funds at his disposal. The volumes of the "Annals of the South African Museum" testify partly to this fact. At the time of his death, he was actively engaged on a more comprehensive treatment of the anthropological material at his command, and also in an amplification of his Catalogue of Coleoptera.

In addition to his arduous duties as Director of a fast-growing institution, which included an historical annexe known as the Koopmans de Wet Museum, Dr. Péringuey was a trustee of the Michaelis Art Gallery, and chairman of the National Botanic Gardens Advisory Committee. He was for many years an official of the South African Philosophical Society, and was the first general secretary of the Royal Society of South Africa, for the incorporation of which by Royal Charter, he was an enthusiastic worker. He served as president of the Society from 1914 until 1918.

His death is a grievous loss to science, to South Africa, and to a large circle of friends and correspondents scattered over the world.

PROF. F. JEFFREY BELL.

THE death on April 1, following an accident, of Francis Jeffrey Bell, in his seventieth year, removes a familiar figure from the world of London zoologists and the rooms of the Athenæum. The eldest son of F. J. Bell of Calcutta, and a relation of Sir Charles Bell the anatomist, Bell entered Magdalen College, Oxford, in 1874, studied under Rolleston, and took honours in natural science in 1878. In that year he was appointed an assistant in the zoological department of the British Museum under Dr. Günther, a post which he held until his retirement in 1919. He was also professor of comparative anatomy at King's College, London, from 1879 to 1896, when he was made professor emeritus and a fellow of the College. In 1879 appeared his excellent translation of Gegenbaur's "Comparative Anatomy," still a valued work of reference, and in 1885 he published a "Manual of Comparative Anatomy and Physiology," which was in its time widely used by medical students.

At the British Museum, Bell had charge of the echinoderms and worms, and produced a long series of descriptive reports and papers chiefly on the former group; thus he described the echinoderms of the *Alert*, *Southern Cross*, and *Discovery* expeditions, and contributed to the reports of Herdman, Stanley Gardiner, Willey, and others. His "Catalogue of British Echinoderms in the British Museum" (1892) was of much service to British naturalists. His work was well arranged, his English was polished, his descriptions were neat; an occasional suggestion of deeper moment or a subtle phrase of sub-acid humour, marked his papers from the undistinguished crowd without disturbing their smooth rotundity of form. His exhibition gallery likewise was never overloaded, and its relatively few specimens were well displayed. One in whom the sense of "good form" was so strong made a useful editor for the Reports of the National Antarctic Expedition and for Bernard's Catalogue of Madreporaria. He edited the *Zoological Record* for a couple of years (1885–86), but was more at home in furnishing reviews to the *Athenæum* and abstracts to the Journal of the Royal Microscopical Society.

WE regret to announce the following deaths:

Sir Walter James Buchanan, K.C.I.E., formerly of the Indian Medical Service, editor of the *Indian Medical Gazette* for the period 1899–1919, on March 22, aged sixty-two.

Prof. August Ewald, professor of physiology in the University of Heidelberg, aged seventy-five.

Prof. C. Godfrey, late Headmaster of the Royal Naval College, Osborne, on April 4, aged fifty.

Prof. Gabriel Siegmund, for many years director of the Organic Department of the Chemical Institute of the University of Berlin, on March 22, aged seventy-two.

Prof. J. E. B. Warming, emeritus professor of botany in the University of Copenhagen, on April 1, aged eighty-three.

Current Topics and Events.

THE President and Council of the Royal Society have appointed Prof. O. W. Richardson of King's College, London, to be the third Yarrow Research Professor of the Royal Society. It is understood that Prof. Richardson will remain a member of King's College and will continue to carry out his researches in the Physics Laboratory of the College. He has both mathematical and experimental ability to a remarkable degree, and there are very few living physicists in whom the combination of talents is so strongly developed. Educated at Batley Grammar School and at Trinity College, Cambridge, he had a distinguished academic career and was elected to a college fellowship. After some years spent in research at the Cavendish Laboratory, he received an appointment as professor of physics at the University of Princeton, but returned to England in 1913 to take up the post of Wheatstone professor of physics at King's College, London. During the War, Prof. Richardson rendered important services to the Government in connexion with scientific research, more particularly with regard to instruments for the detection of hostile submarines. In 1920 he was awarded the Hughes medal by the Royal Society "for his researches on the passage of electricity through gases, and especially for those relating to the emission of electrons from hot bodies—a subject which Prof. Richardson has made his own and christened 'thermionics.'" The subject is of great industrial importance. Probably few of the many thousands who now use thermionic valves in the reception of wireless messages realise how much they owe to the work of such pioneers. From the scientific point of view the subject is of equal importance; by employing modern methods of obtaining high vacua, it is now possible to produce the pure electron discharge from white-hot metals of intensity great enough to convince the most sceptical that electrons are no mere figments of the physicist's imagination. Prof. Richardson's name is also associated with the gyromagnetic effect, the existence of which he predicted before it was experimentally verified. The observed change of angular momentum accompanying magnetisation is not, however, what might have been expected had negative electrons only been concerned in the process, and it is probable that the result has an important bearing on the structure of the atomic nucleus. Two important text-books by Prof. Richardson have now reached a second edition: one dealing with the theory of electrons mainly from a mathematical point of view; the other treating of the subject which is peculiarly his own—"The Emission of Electricity from Hot Bodies."

PROF. A. N. WHITEHEAD, whose appointment for a period of five years to a chair of philosophy at Harvard was recently announced, is fortunate in securing at the age of sixty-three the opportunity it presents of writing up the philosophy that has gradually been developing and maturing in his mind. Free from much of the routine administration and committee work of a busy university life, with which he is so fully identified, he will be able, save for a few lectures or "chats" per week on his own researches with his students, to devote his whole time to the expansion and publication of his work in certain realms of thought which he had made peculiarly his own,—the philosophy of science, mathematical logic, and generally the philosophical questions arising from it. On the philosophical side, he proposes to extend and systematise his recent work as embodied in his "Principles of Natural Knowledge," his "Concept of Nature," and "Principles of Relativity," and to consider the metaphysical questions suggested. On the logical side, he intends finishing the fourth volume of "Principia Mathematica," dealing with geometry and more generally with many termed relations. On account of his versatility and his manifold activities, Prof. Whitehead's departure from Great Britain will be felt as a great loss to many sections of the educational world, administrative and pedagogic. To the mathematical layman, he is perhaps best known for his "Introduction to Mathematics," probably his one successful book financially, and his collection of addresses, "The Organisation of Thought." Since his early days, Prof. Whitehead has been identified with a distinctively progressive attitude both with regard to the general philosophic basis of education and to the special technical facilities that demand development. On this account his loss to the Imperial College of Science and Technology, South Kensington, where he succeeded Prof. A. R. Forsyth as chief professor of mathematics and mechanics, and to the University of London, where he is chairman of the Academic Council, cannot be estimated. It is a severe commentary on the inelasticity of the British university educational system that it should be necessary for one of such eminence, charm of manner, and inspiring intercourse, to seek a period of five years in an educational establishment of another country in order at the close of an active career to find the opportunity of completing his research. Scientific thought undoubtedly stands to gain by this latest form of American enterprise.

SIR ERNEST A. WALLIS BUDGE, keeper of Egyptian and Assyrian antiquities in the British Museum, finally retired under the age limit on April 9, and has been succeeded by the deputy-keeper, Dr. H. R. Hall. Sir Ernest Budge had been continued in his office for a year beyond the ordinary term, in special recognition of his services to the Trustees during his keepership. With Sir Ernest, the British Museum loses one of its best-known figures. He had been keeper of his department for the almost unprecedented period of more than thirty years, having succeeded at an unusually early age. He was preceded in the keepership by Dr. Samuel Birch and Mr. Lepage Renouf. Sir Ernest has therefore been identified with the Egyptian Department of the British Museum in the minds of the public for more than a generation, and he has had ample time in

which to leave his mark upon it. His own interest being so largely directed towards the study and elucidation of Egyptian religion and funerary customs, especially of the later period, the arrangement of his department has naturally conformed to this interest, and he has been instrumental during his keepership in gathering a collection of mummies surpassed only by Cairo, and of funerary papyri surpassed by none. He has, of course, by no means confined his attention to this side of Egyptian archæology, and his purchases and the other additions made during his reign have probably doubled the size of the national collection as he found it. In addition to his official duties, Sir Ernest has found time to write the remarkable series of private as well as official, popular as well as scientific, works on Egyptology and kindred subjects which fill nearly two columns of "Who's Who." His industry is and always has been colossal: he is a very giant of book-production, and it is safe to say that, to the larger proportion of the public Egyptology means Sir Ernest Budge and his books. Egyptian studies have not claimed all his attention, however. He started as a Semitic scholar and Assyriologist, but has not published any cuneiform study for some years. He still, however, keeps up his interest in Coptic, Syriac, and Ethiopic, and quite lately has been bringing out a series of translations of Ethiopic religious legends. On all these tongues he is one of our greatest authorities; one of the most learned men that have ever laboured at Bloomsbury. His inevitable departure from the scene of his life-work must be a wrench, and without his well-known figure the Egyptian galleries will seem unfamiliar to many of us. Sir Ernest's energy, however, is not in the least likely to be lessened by the fact of his retirement, and we expect to hear of his further contributions to archæological knowledge for many years to come.

THE appearance of a supplement to the Pilot Chart of the North Atlantic Ocean for March, issued by the Hydrographic Office of the United States, entitled "The Ice Drift in the North Atlantic," directs attention to the fact that the iceberg season is once more upon us. The ice patrol has taken up its station off the Banks of Newfoundland to keep observation on the position and drift of bergs and to broadcast warnings of their presence to passing shipping. This patrol was instituted as a result of the *Titanic* disaster on April 14, 1912, when that ill-fated vessel was sunk on her maiden voyage by striking a berg just off the Grand Banks. In the following year an International Conference for the Safety of Life at Sea was convened in London, at which arrangements were made for the establishment of a regular patrol during the danger season from April to July. The duty was entrusted to the United States, other nations contributing their shares towards the cost. The primary object of the patrol is to distribute warnings, but much valuable information regarding the movement of ice is being collected and tabulated. From the records for the years 1911–1923, it is estimated that between 300 and 350 bergs are borne south of Newfoundland during a normal ice year; 14 per cent. of these, on the average, are carried westward past Cape Race, and 19 per cent. eastward, but the remaining 67 per cent. may be expected to make their way southward down the east side of the Bank. About 50 of these bergs drift south of the tail of the Grand Bank, but on the average only 3 get carried across the west-bound steamship track in 40° 30′ N. The total number of bergs sighted on the tracks south of 40° N. during the period 1913–1923 was 33, distributed as follows: April, 3; May, 25; June, 5.

IT is proposed to raise a memorial to the late Canon Theodore Wood—priest, teacher, and naturalist. Many readers of NATURE may have heard Canon Wood lecture, or have known his works on natural history, and may be glad to take part in perpetuating his memory. The form of the memorial will be: (1) The placing of marble steps and mosaic pavement in the sanctuary where he ministered for so many years; (2) The raising of a "Theodore Wood Memorial Endowment Fund" to augment the living of the church of St. Mary Magdalene, Wandsworth Common, which he held from 1902 to 1923. The present endowment is only 150*l.* per annum, and that this should be increased was Canon Wood's own great desire. Donations should be sent to either of the joint honorary treasurers: Mr. F. W. Reed, 34 Henderson Road, S.W.18; or Mr. H. C. Witherby, 20 Lyford Road, S.W. 18.

THE announcement by Mr. J. H. Thomas, Colonial Secretary, that the Imperial Institute galleries are to be maintained, and that Lord Cowdray has generously given a contribution of 5000*l.* per annum for their support, closes the period of anxiety as to the future of the Institute and its collections. Their increasing service in geographical education and as an illustrative and reserve collection of the economic materials of the Empire has been more widely appreciated in recent years. It is to be hoped that the Bill which has been announced for the reorganisation of the Imperial Institute will secure it a more effective executive council. We trust that its new Director will be a man combining both scientific distinction and interest in the economic applications of science. The Institute now has an opportunity of developing into a great Museum and Research Institution for the economic geology of the Empire overseas, and for various branches of economic biology of which the centres are not already established elsewhere.

WE are informed by our veteran zoologist, the Rev. T. R. R. Stebbing, that the great "Nomenclator animalium generum et subgenerum," inaugurated by Prof. F. E. Schulze in 1912, is now almost ready for publication, but stands in urgent need of the sum of 100*l.* The work contains all the generic and subgeneric names applied to animals, both recent and fossil, from 1758 to 1910, inclusive, with complete bibliographic references. The number of entries is more than 200,000. These have been brought together by specialists in nearly every civilised nation,

and have been edited under the direction of Schulze and a succession of distinguished zoologists, the present director of the undertaking being Prof. K. Heider, Invalidenstrasse 43, Berlin, N4. In spite of the difficulties caused by the War and the subsequent unsettled condition of Europe, the work has been carried on with great zeal and determination. The amount of labour that its publication would save to all working zoologists can scarcely be over-stated, and it would be indeed deplorable if all this devoted toil were, for lack of a relatively small sum, not brought to fruition. We therefore whole-heartedly support Mr. Stebbing's appeal, which he himself has backed with a fresh contribution of 5*l.*, and we are prepared to receive further sums and to forward the amount to Prof. Heider.

AN interesting informal discussion on transmission lines for very high pressures took place at the Institution of Electrical Engineers on March 10. Mr. Laspière appealed to English engineers to take part in the annual high tension conference which will shortly take place in Paris. He pointed out that in previous years the attendance of English engineers at these conferences was very disappointing although English was one of the two official languages spoken. He laid emphasis on the necessity for cheap power in France. Although they consumed 65 million tons of coal per annum yet they only produced 40 million tons. They imported 20 million tons of coal from England. To obviate the necessity of buying foreign coal they were utilising all the possible water power available. The water power on the Swiss frontier fails in the winter months, while that in the centre of France fails in the summer months. Hence the necessity of linking the two sources. The advantages accruing from the international linking of networks was pointed out. France, for example, is connected with Switzerland, with Spain through the Pyrenees, and with Germany at Freiburg. A line supplies Denmark from Sweden, crossing two miles of sea at a height sufficient to clear the tallest ships. It is interesting to note that the coal-fed stations of France at present cost only slightly more than those using hydraulic power. This is due to the fact that coal stations are situated in the centre of industrial regions, and the losses in the transmission lines are therefore much smaller than in the hydro-electric systems. In addition, the hydro-electric plants were installed since the War and so the costs of labour and material were excessive.

THE Royal Photographic Society, at 35 Russell Square, has on exhibition until the end of this month sixty photographs by Mr. Marius Maxwell, the result of "Stalking Big Game with a Camera in East Equatorial Africa." Admission is from 11 to 5 on presentation of visiting-card. The photographs are of elephants, hippopotami, flamingoes, giraffes, buffaloes, pelicans, and rhinoceros. Mr. Maxwell has photographed these animals in their native wilds exactly as the ordinary hunter would find them by careful stalking, that is, without any such artificial means as camera-shelters, blinds, perches, etc. The camera used was an ordinary reflex hand camera with lenses from 6 to 10 inches focal length, and the animals when photographed were from 8 to 30 yards distant. Some giraffes were taken from a Ford car travelling at 32 miles an hour. The animals are shown both in the bush and in the open, running and standing still; in some their attention is attracted by the disturbance caused by the presence of the photographer, and one shows four young bull elephants uniting their efforts to push down a tree. The character of the photography could scarcely have been improved if the animals had been tame and trained to pose, for some of the enlargements of about 30 × 20 inches are practically sharp. Mr. Maxwell's sport cannot have been less exciting than if he had set out with the intention of killing, and he has the great satisfaction of knowing that he has done nothing towards hastening the extinction of his subjects, and a great deal towards demonstrating their habits and characteristics.

SEISMIC disturbances were experienced in the border districts of Nottinghamshire and Derbyshire on Friday and Saturday of last week. According to the *Times*, considerable damage was done to houses in the Alfreton district and particularly at South Normanton, while tremors are reported from Nottingham, Mansfield, and Sutton-in-Ashfield. Mr. J. J. Shaw's instruments at West Bromwich recorded a shock at just before 10.45 P.M. on Friday, followed by earth tremors lasting about 5 minutes. The first movement was from the east.

SIR EDWARD SHARPEY SCHAFER, professor of physiology in the University of Edinburgh, has been elected a corresponding member of the French Academy of Medicine.

THE Research Department, Woolwich, invites applications for an assistant to the directorate of ballistical research. Candidates must have had experience in research and possess an honours degree in physics. The work will consist of physical research on problems connected with internal ballistics.

A SENIOR research chemist is required by the South Metropolitan Gas Company, 709 Old Kent Road, S.E.15. Applicants should have had experience in carrying out technical investigations as to the carbonisation of coal, and send their applications to reach the Secretary of the Company on or before April 15.

AN assistant examiner is required in the Standards Department of the Board of Trade, whose duties will be mainly in connexion with the control of standards, and with the examination of weighing and measuring apparatus. Applications for the post must be received not later than April 16 by the Principal Establishment Officer, Board of Trade, Great George Street, S.W.1.

THE president and council of the Royal Society have received from a donor, who has desired to remain anonymous, a gift of 10,000*l.* for the prosecution of original research in medicine for the prevention of disease and relief of suffering, with special attention to tropical diseases in British possessions and to

cancer and tuberculosis. They have also received from Messrs. Brunner, Mond and Co. a gift of 500 guineas to be used for the publication of the results of scientific research in chemistry, physics, and similar sciences.

MR. E. K. CHAMBERS, Second Secretary, Board of Education; Sir F. W. Mott, formerly Fullerian professor of physiology at the Royal Institution; and Prof. C. S. Terry, professor of history in the University of Aberdeen, have been elected members of the Athenæum under the provisions of Rule II. of the club, which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

THE Ministry of Health announces that a Royal Charter has been granted for the incorporation of the governing body of the London School of Hygiene and Tropical Medicine. The establishment of the School, the result of a donation of 2,000,000 dollars by the Rockefeller Foundation, was referred to in NATURE of July 28, 1923, p. 149, and it was announced afterwards that Dr. Andrew Balfour had been appointed Director.

ACCORDING to a new bye-law of the Institution of Electrical Engineers which was adopted at a special general meeting held on February 28, and was allowed by the Lords of His Majesty's Most Honourable Privy Council on March 20, "Every Member and Associate Member is, and is entitled to describe himself as, a Chartered Electrical Engineer, and in using that description after his name shall place it after the designation of the class in the Institution to which he belongs, stated in accordance with the following abbreviated forms, namely, M.I.E.E. or A.M.I.E.E. as the case may be."

REPLYING to a question in the House of Commons on April 3, Mr. Acland, as representing the Forestry Commissioners, stated that the Secretary of State for the Colonies and the Forestry Commissioners are collaborating with the University of Oxford to set up, as recommended by the British Empire Forestry Conferences of 1920 and 1923, a Central Institute at Oxford for post-graduate and specialised training in forestry. The Institute will be assisted from the Commissioners' Forestry Fund. It is not proposed to alter the existing system of aiding forestry schools in universities from the Forestry Fund.

AN International Mathematical Congress will be held in Toronto on August 11-16 under the auspices of the University of Toronto and the Royal Canadian Institute. The Congress, which will thus overlap slightly the British Association meeting (August 6-13), will meet in the following sections:—Section I.: algebra, theory of numbers, analysis; section II.: geometry; section III.: (*a*) mechanics, mathematical physics; (*b*) astronomy, geophysics; section IV.: (*a*) electrical, mechanical, civil and mining engineering; (*b*) aeronautics, naval architecture, ballistics, radiotelegraphy; section V.: statistics, actuarial science, economics; section VI.: history, philosophy, didactics. Prof. J. C. Fields is chairman and Prof. J. L. Synge, Royal Canadian Institute, 198 College Street, Toronto, Canada, secretary of the organising committee.

THE Oxford University Press announces the appointment of Principal J. W. Bispham, of the Borough Polytechnic, S.E.1, and Principal A. R. Sage, of the L.C.C. School of Building, as general editors of their technical books. It is intended to pay particular attention to the needs of technical schools and colleges in addition to general engineering and scientific literature.

Our Astronomical Column.

NEW COMET.—The first cometary discovery of 1924 was made on March 30, at $6^h\ 7{\cdot}7^m$ Greenwich M.T., by Mr. William Reid, of Rondebosch, Cape Town; the position was R.A. $2^h\ 58^m\ 19{\cdot}8^s$, S. Decl. 33° 38′ 16″; daily motion $+3^m\ 28^s$, N. 30′. The magnitude is not stated. Mr. G. Merton notes that the position permitted the possibility of identity with De Vico's Comet of 1846. This, however, could only be the case if the actual northward motion was considerably more rapid than the value telegraphed. The Cape is now taking the lion's share of cometary discovery. There are evidently very few workers in this field in the northern hemisphere, and it is likely that several comets have been missed in consequence.

One inaccuracy in the daily papers should be corrected. Mr. Reid is not on the staff of the Cape Observatory; he is simply an amateur, but naturally the Cape Observatory is always ready to obtain accurate positions of the comets that he discovers.

DISTANCES OF CERTAIN STARS.—The British Astronomical Association's Journal for January contains papers by F. C. Leonard and P. Doig on this subject. The former finds 815 light-years for the trapezium in the Orion nebula, the latter finds 700 light-years as the mean distance of the group of bright B stars in Orion. These accord well with the estimates of Kapteyn and others.

Leonard and Doig agree in fixing the distance of the Double-Double ϵ-Lyræ as 160 light-years. Their results point to all four stars being connected, and in revolution about the common centre of gravity. They are based on the methods of spectral parallax of double stars, comparing the magnitudes and spectral types of the two components and estimating their absolute magnitudes from their assumed status as giants or dwarfs, depending on their difference in type and brightness.

PHOTOGRAPHING THE ZODIACAL LIGHT.—It is by no means easy to obtain a photographic image of this faint diffused illumination. Some successful exposures were obtained by Douglas at Flagstaff in 1901, others by M. Quénisset in 1904. M. Jean Dufay publishes in *L'Astronomie* for March a photograph obtained on May 17, 1923, the exposure being from $9^h\ 2^m$ to $9^h\ 7^m$ P.M. A lantern lens of focal length 9 cm., and aperture about the same amount, was used. In spite of the bright twilight the trails of numerous stars are shown, and the upper boundary of the light is fairly well defined. The plates were intensified with chloride of mercury, and carbon paper was used for the prints.

A continuous series of such photographs taken in the tropics, so as to obtain the northern and southern boundaries equally well, would be of great value in adding to our knowledge of the exact median plane of the light and the amount of variation, both in position and intensity, to which it is subject.

Research Items.

BLOCK PRINTS FOR INDIAN TEXTILES.—An increasing interest in primitive and Oriental design shown by professional designers, draftsmen, and manufacturers in the United States has led to the institution of a new series of publications entitled the "Design Series," to be issued by the Department of Anthropology of the Field Museum of Natural History, Chicago. The first number of the series, by Mr. A. B. Lewis, deals with Indian block prints for stamping decorative designs on cotton and other textiles. The designs, which vary considerably according to the locality in India from which they come, are first drawn on paper and then pasted on wood. The pattern is then cut with a crude engraving tool to a depth of about one-third of an inch. Holes are often cut through the block to avoid air bubbles in printing. The old vegetable dyes, which had, to a great extent, been displaced, are still used, and indeed in many places, especially since the War, are again taking the place of anilines. Blacks, reds, and blues are the most common and permanent of the colours, and wax is sometimes stamped on the cloth, especially in Southern India. The blocks used for this publication were obtained by Dr. G. A. Dorsey at Ahmadabad in the Bombay Presidency.

"BIOS."—An address, given before Section C of the American Association for the Advancement of Science by Prof. W. Lash Miller upon the subject of that mysterious growth-promoting substance "bios," which was first discovered and described by Wildiers in Louvain in 1901, appears in *Science* for February 29. As a result of finding a method for measuring accurately and readily the rate of growth of yeast, Prof. Lash Miller and his colleagues have been able to make a much more quantitative study of the behaviour of bios. As a result of experiments to isolate bios, it was early discovered that it was apparently a compound substance, one part of which was carried down by baryta from solutions containing the right proportions of alcohol while the other remained dissolved. Either of these constituents alone gives no increased growth for yeast, but the two combined have an effect equal to the original bios. Bios I. is the name given to the active substance carried down by baryta; bios II., the other constituent, is sorbed by charcoal, and is soluble in acetone. In most plant tissues bios I. is present in physiological excess; mushrooms, white of egg, and malt combings contain a large excess of bios II. Barley grains contain an excess of bios II., but after sprouting, an excess of bios I., although both substances increase in amount upon germination. Careful experiments showed that, although they were obtained from similar plant material, neither bios I. nor bios II., nor both, can replace vitamin B in the diet of pigeons and rats. Bios I. is now being made on a considerable scale from tea dust, and it seems possible that later Prof. Lash Miller and his co-workers may be able to give us information upon the chemical nature of this interesting substance. It may be pointed out in conclusion that the work of Fulmer Nelson and White (*Journal of Biological Chemistry*, 57, p. 397, 1923) disposes of the extreme claim that bios is indispensable to the growth of yeast, but that the new work makes it clear that beyond question bios contains auximones materially promoting the otherwise slow growth of yeast in synthetic media.

IMPROVEMENTS IN THE PREPARATION OF INSULIN.—An improved method for the preparation of insulin of considerable purity, which gives a large yield, has recently been described by H. W. Dudley and W. W. Starling (*Biochem. Journ.*, vol. 18, 1924, p. 147). The process consists essentially in carrying out the extraction with alkaline alcoholic solution instead of with neutral or acid ones; the alkali used is sodium bicarbonate. After treatment with more alcohol, neutralisation and evaporation *in vacuo*, fat is removed by light petroleum, and the active principle precipitated by addition of absolute alcohol. The average yield of insulin by this method is about 400 "rabbit units" per kilo, as compared with about 90 by the old method of extraction (neutral alcohol) and 260 by acid extraction. The crude insulin can be purified by conversion into a picrate, addition of hydrochloric acid, and precipitation of the insulin hydrochloride by addition of acetone. After washing away excess of picric acid by acetone followed by dry ether, the pure hydrochloride is dried *in vacuo* over sulphuric acid. The insulin is thus separated from about 90 per cent. of the impurities present in the original preparation. As little as 0·2 mg. of this may contain one rabbit unit, *i.e.* the amount of insulin necessary to cause hypoglycæmic convulsions in a fasting 2-kilo rabbit within four hours of its subcutaneous administration.

FLUORESCENT PLANT PIGMENTS.—Prof. F. E. Lloyd, in his presidential address to Section G (Botany) of the American Association for the Advancement of Science, gave a valuable résumé of the progress recently made in the method of studying the fluorescence of plant pigments and other cell inclusions, which has been published in *Science* for March 14. Prof. Lloyd has developed a method by which fluorescence can be studied in living objects under the microscope, the object being viewed at the apex of the light cone after it has been reflected from the cover-glass. (Trans. Roy. Soc. Canada, III. 17: 129, 1923, and NATURE, 112, 132, 1923.) Fluorescence has been observed in many bacteria, about twenty species of blue-green Algæ, in many green Algæ, and in the chloroplasts of a number of higher plants. The blue-green Algæ show a great variety of fluorescent colours; in general those containing phycocyanin are fluorescent red, those with phycoerythrin orange fluorescent. The heterocyst in the blue-green Algæ has never been found to contain any fluorescent pigment. Prof. Lloyd points out that the new method of examination may be of value to the taxonomist in difficult natural groups like the blue-green Algæ, as different species are probably characterised by definite pigment systems with characteristic fluorescence. Probably the taxonomist will prefer to await extended trials of the effect of cultural condition upon fluorescence before employing this new method with confidence, but it will be generally agreed that a new and difficult field is being opened up which is full of promise, and when physical chemistry provides a fuller knowledge of the meaning of fluorescence, the facts now accumulating may be found to have a much wider significance.

FISH EXHIBITS IN MUSEUMS.—This is the title of a paper read by Mr. C. Matheson at the last meeting of the Museums Association and published in the *Museums Journal* for March. While Mr. Matheson confined his remarks to methods of showing the economic uses of fishes, as now attempted at the National Museum of Wales, the discussion on his paper was almost entirely restricted to the methods of presenting the animals themselves. It is a mistake to assume that a plaster cast taken from a dead fish necessarily reproduces even the form of the living creature, and, as Major Flower insisted, the colours are so fleeting that it is almost impossible for the artist to catch them. Be that as it may, the plan of

approaching certain facts of structure and life-history in the animal and plant world by way of their importance to man is certainly calculated to increase public interest in our museums and to demonstrate the value of systematic study.

TROPICAL AMERICAN SPECIES OF PASSIFLORA.—Thirteen new species of Passiflora are described by E. P. Killip in the Journal of the Washington Academy of Sciences, vol. 14, No. 5, March 4, 1924. Four of these are based upon material received at the National Museum, Washington, from Mexico and Central America; the remaining species have been detected in the course of a revision of the Passifloraceæ of northern South America.

ACTION OF RENNET ON MILK.—Various theories have been from time to time advanced to explain the action of rennet preparations on milk. Chemical investigations, however, have hitherto failed to show that there is any difference between the caseinogen of the original milk and the casein which forms the clot. In order further to investigate these two substances and to find whether they differ chemically, N. C. Wright (*Biochem. Journ.*, vol. 18, 1924, p. 245) has studied the curves of racemisation of casein and caseinogen, when equal amounts of these were dissolved in half-normal sodium hydroxide and kept at a temperature of 37° C. At intervals, the optical rotations of the two solutions were observed, and were found to vary according to the same curve in each case. It was therefore concluded that caseinogen and casein are chemically identical, and thus that the action of rennet, in causing the conversion of one into the other, is of the nature of a change of the colloid state which facilitates a precipitation by divalent kations.

ALKALINE LAKES.—A memoir by Dr. G. de P. Cotter (Mem. Geol. Surv. India, vol. xlvii. pt. 2) gives an account of the alkaline lakes of the Sind desert, east of the distributing mouths of the Indus and north of the Rann of Cutch. The sand dunes in this area lie on a platform of alluvium and take the form either of large plateaux or of long ridges aligned in a general N.E.-S.W. direction, parallel to that of the strong winds which blow from the south-west in the hot dry weather and the subsequent rainy season. The alkaline lakes take the form of shallow evaporating basins between these sand ridges and are fed by relatively sweet water, which percolates from the bases of the hills near the junctions of the sand heaps and the underlying less pervious alluvium. Chloride, sulphate, and carbonate of soda are the predominating salts in the lake-water, and for an unknown time these have been recovered, mainly for the carbonate, by methods that are crude and with results extremely variable, for analyses of the marketable products show that the native workers rarely distinguish between the carbonate and sulphate. Efflorescent salts of roughly similar composition appear on the soil in various parts of Peninsular India, as they do in the "bad lands" of the Western United States, and Dr. Cotter attributes the formation of the carbonate to the action of anaerobic bacteria of a type not yet specifically identified, working on the organic matter contained in the basal alluvium. One of the most interesting of his observations records the existence of shapeless mounds of gypsum which has been deposited as crystals encrusting the twigs of the tamarisk bushes, and, by infilling between the branches, has grown into large irregular agglomerates of crystals of selenite.

OBLIQUE ILLUMINATION IN ULTRAMICROSCOPIC WORK.—The use of oblique illumination is discussed by Dr. A. Szegvari in the *Zeitschrift für Physik* of February 29. Owing to the Mie effect, the light diffracted by single particles is a maximum in the direction of the illuminating light, and this may produce the appearance of an azimuth effect, when the number of particles is large, so that particles in different layers interfere with one another. Ultramicroscopical preparations often contain coarser particles which scatter a large amount of light, and so interfere with the finer details; this scattered light contains a very large number of rays which are cut off when the aperture is not too large. The false azimuth effect can also be reduced by this means, so that it is advisable to employ an adjustable diaphragm in the objective, so as to obtain the most suitable aperture in each case. By employing adjustable azimuth and aperture diaphragms on the condenser and objective respectively, the Tyndal phenomenon can be investigated on single particles. In the same way the "spark" phenomenon can be made extremely sensitive, so that colloid particles with non-spherical shape can be detected. In consequence of the Mie effect, coaxial dark field condensers work better than those in which the directions of illumination and observation are perpendicular to one another.

IMPACT IONISATION IN GASES.—The issue of the *Physikalische Zeitschrift* for January 15 contains a communication from Dr. L. Heis in which a more complete theory of the part which the electrons play in the transmission of electricity through gases is given. The electrons are supposed to move in a uniform electric field, and an energy distribution function is assumed which gives the number of electrons with kinetic energies between certain limits passing through unit area at a given point in unit time. Electrons with energy exceeding a definite amount are capable of setting free electrons from the molecules they strike and of continuing their motion with any excess of energy above that amount they possessed. Electrons with energy less than this amount may either adhere to the molecule they strike or rebound from it. It is assumed that the fraction a of such impinging electrons is retained by the molecules. Basing his theory on these assumptions, the author shows that it is capable of reproducing both the results of Townsend for distances comparatively large and of Franck for distances comparatively small from the source.

EUCLIDEAN THEORY OF PARALLELS.—Dr. Thomas Greenwood (*C.R. Acad. Sc.*, Feb. 25, 1924) gives a set of axioms and a sequence of theorems to establish the Euclidean theory of parallels on the assumption, which he calls the postulate of null curvature, that if Q is any point between P and R on a line l, the distance of Q from any line m which does not cut l between P and R is between the distances of P and R from m. This assumption, which Saccheri detected in Nasiraddin at-Tusi's attempt to prove Euclid's postulate, is equivalent to Posidonius's definition of parallels by equidistance, with reference to which Clavius was perhaps the first to recognise the necessity of proving that the equidistant locus is straight. Since "distance" is among his indefinables and the closed line is automatically excluded by "between," Dr. Greenwood is scarcely dealing with the foundations of geometry. Moreover, since at this stage the complications which lengthen the passage from one theorem to another are unknown until the actual proof is attempted, and only a strictly formal treatment gives confidence that no possibility has been overlooked, the list of enunciations affords no means of judging to what extent Dr. Greenwood's work is an improvement on that of his predecessors.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

Cambridge University Press.—Plants Poisonous to Live Stock, H. C. Long, new edition. *J. B. Lippincott Company.*—Agricultural Mechanics, R. H. Smith. *Longmans and Co.*—Rhododendrons and the Various Hybrids, J. G. Millais, second series; The Agricultural Crisis, 1920–1923, R. R. Enfield. *Macmillan and Co., Ltd.*—Rice, Prof. E. B. Copeland; Outlines of Fungi and Plant Diseases for Students and Practitioners of Agriculture and Horticulture, F. T. Bennett. *Methuen and Co., Ltd.*—Modern Farm Machinery, D. N. McHardy. *University Tutorial Press, Ltd.*—Farm Calculations and Accounts, Dr. A. G. Ruston; Farm Measurements (Mensuration), Dr. A. G. Ruston.

Anthropology and Archæology.

D. Appleton and Co.—Human Origins, G. G. MacCurdy, 2 vols. *Macmillan and Co., Ltd.*—Men and Thought in Ancient India, Prof. Radhakumud Mookerji; Savage Life in Central Australia, Dr. G. Horne and G. Aiston; Ancient Hunters, Prof. W. J. Sollas, new edition. *Oxford University Press.*—Folklore of the Bombay Presidency, R. E. Enthoven; The Home of an Eastern Clan: a Study of the Palaungs of the Shan States, Mrs. Leslie Milne; Fossil Man in Spain, H. Obermaier, Translation, revised and brought up-to-date, and with an introduction by Prof. H. F. Osborn. *Williams and Norgate.*—Phœnician Origin of the Britons, Scots and Anglo-Saxons, Lieut.-Col. L. A. Waddell. *H. F. and G. Witherby.*—White and Black in East Africa, H. Norden.

Biology.

D. Appleton and Co.—Evolution: the Way of Man, Prof. V. Kellog. *John Bale, Sons and Danielsson, Ltd.*—Rats and How to Destroy Them, T. M. Hovell. *Cambridge University Press.*—Illustrations of British Waders, E. C. Arnold, with short notes on each bird describing his experiences of its habits and characteristics. *J. B. Lippincott Company.*—Chemical Dynamics of Living Matter, O. Meyerhof. *A. Melrose, Ltd.*—Science Old and New, Prof. J. A. Thomson. *L. Reeve and Co., Ltd.*—Flora of the Malay Peninsula, H. N. Ridley, Vol. III. *Sheldon Press.*—Chats on British Mammals, Dr. J. J. Simpson; Rivers and Lakes: the Story of their Development, M. A. C. Hinton. *Sidgwick and Jackson, Ltd.*—The Biology of Flowering Plants, Dr. M. Skene; The Biology of Insects, Dr. G. H. Carpenter.

Chemistry.

D. Appleton and Co.—The Story of Early Chemistry, J. M. Stillman. *Edward Arnold and Co.*—The Chemistry and Testing of Cement, Prof. C. H. Desch, new edition; The Rare Earths: their Occurrence, Chemistry, and Technology, S. I. Levy, new edition; The Principles of Applied Electro-chemistry, Prof. A. J. Allmand, new edition; Electroplating, W. R. Barclay and C. H. Hainsworth, new edition. *Ernest Benn, Ltd.*—Specific Heats of Gases, Prof. H. E. Partington and W. C. Shilling; Chemistry in the Twentieth Century: an Account of the Achievement and the Present State of Knowledge in Chemical Science, various authors; "The Chemical Age" Chemical Dictionary (Chemical Terms); Lime and Magnesia: the Chemistry, Manufacture and Uses of the Oxides, Hydroxides and Carbonates of Calcium and Magnesium, E. V. Knibbs; Synthetic Organic Compounds, Dr. S. P. Schotz; Organic Synthesis of Ring Compounds, C. Hollins. *Blackie and Son, Ltd.*—Manuals of Pure and Applied Chemistry Series, edited by Prof. R. M. Caven; Chemical Synthesis, Dr. H. Hepworth; Inorganic Complex Salts, W. Thomas; Structure of Matter, Dr. J. A. Cranston. *J. and A. Churchill.*—The Plant Alkaloids, Dr. T. A. Henry, new edition; Elementary Qualitative Analysis for Medical and Science Students, Prof. W. Caldwell; Quantitative Organic Microanalysis, W. Pregl, translated by Dr. E. Fyleman. *Gurney and Jackson.*—Lunge's Sulphuric Acid and Alkali, new revised edition: The Manufacture of Acids and Alkalies, edited by Dr. C. Cumming; The Manufacture of Sulphuric Acid by the Chamber Process, W. Wyld; The Concentration of Sulphuric Acid, J. W. Parkes; The Manufacture of Sulphuric Acid by the Contact Process, F. D. Miles. *J. B. Lippincott Company.*—A Short Handbook of Oil Analysis, Dr. A. H. Gill, new edition. Part 1: Physical and Chemical Tests. Part 2: Derivation, Description and Examination of Certain Oils; Automobile Gasoline: its Dangers and Tests, Dr. A. H. Gill; Hand Book of Industrial Organic Chemistry: for the Use of Manufacturers, Chemists, and all interested in the Utilisation of Organic Materials in the Industrial Arts, S. P. Sadtler, new edition. *Longmans and Co.*—A Comprehensive Treatise on Inorganic and Theoretical Chemistry, Dr. J. W. Mellor, Vol. V.; A Dictionary of Applied Chemistry, Sir Edward Thorpe, assisted by eminent contributors, new edition, Vol. V.; Spectroscopy, Prof. E. C. C. Baly, new edition, 2 vols.; The Simple Carbohydrates and the Glucosides, Dr. E. F. Armstrong, new edition. *W. B. Saunders Co., Ltd.*—Text Book of Physiological Chemistry, Prof. W. Morse; Chemistry for Nurses, L. J. Bogert. *University of London Press, Ltd.*—Aims and Future Work of the Ramsay Memorial Laboratory, Prof. E. C. Williams. *University Tutorial Press, Ltd.*—Chemistry for Agricultural Students, R. H. Adie.

Engineering.

Edward Arnold and Co.—Steam Turbine Design: with Especial Reference to the Reaction Type, and including Chapters on Condensers and Propeller Design, Dr. J. Morrow, new edition; Metal-Work, H. M. Adam and J. H. Evans, new edition; Applied Electricity: a Textbook of Electrical Engineering for "Second-Year" Students, J. Paley Yorke, new edition. *Ernest Benn, Ltd.*—The Modern Theory and Practice of Pumping: a Treatise on the Application of the Reynolds-Stanton Law of Viscous Flow to Modern Pumping Problems and the Flow of Liquids through Pipes, N. Swindin; Gas Engineers' Compendium; Modern Open Hearth Steel Works: their Planning, Erection and Operation, H. Hermanns, translated by W. Austin; Industrial Gaseous Firing, W. N. Booth; The Design and Construction of Ammonia Stills, P. Parrish; Progress in Engineering Production, C. M. Linley; Automatic Telephone Systems. Vol. III.: Systems for London, New York and other Great Cities: Semi-automatic Systems, etc., W. Aitken. *Chapman and Hall, Ltd.*—Alternating Current Rectification, L. B. W. Jolley; Tables for the Design of Reinforced Concrete Floors and Roofs, R. T. Morgan; Testing of High Speed Internal Combustion Engines, with Special Reference to Automobile and Aircraft Types, A. W. Judge; Merchant Ship Types: a Survey of the Various Units engaged in the Water Transport of People and Merchandise, A. C. Hardy; Electric Vehicles, C. W. Marshall; Coal and Oil Fired Boilers, Eng.-Comdr. F. J. Drover; Gas Engine Operation, Testing and Maintenance, W. A. Tookey; Motor Manuals, A. W. Judge: Automobile Engines; Carburettors and Carburation; Mechanism of the Car; The Ignition System. *Gresham Publishing Co., Ltd.*—Modern Mechanical Engineering, edited by Dr. A. H. Gibson and A. E. L. Chorlton, 6 vols.; Railway Mechanical Engineering, 2 vols.; Wireless Telephony and Broadcasting, H. M. Dowsett, 2 vols. *Crosby Lockwood and Son.*—Surveying, Whitelaw, new edition; Diesel Engine, Wells and Wallis-Tayler, new edition; Combustion in the Gas Producer and Blast Furnace, Korevaar; Saw Mills, Bale, new edition; Marine Engineering, Wheeler, Vol. I.; Electrical Engineering, Sewell, new edition; Small Houses for the Community, James and Yerbury; Carburation, Brewer, new edition. *Longmans and Co.*—Automatic Telephony, H. H. Harrison; The Principles of Irrigation Engineering, with Special Reference to South Africa, F. E. Kanthack; Structural Engineering, Prof. J. Husband and W. Harby. *Macmillan and Co., Ltd.*—Introduction to the Practice of Civil Engineering, E. E. Mann. *Oxford University Press.*—Switchgear for Electric

Power Control, E. B. Wedmore and H. Trencham; Simple Designs in Reinforced Concrete, Dr. O. Faber. *Sir Isaac Pitman and Sons, Ltd.*—Electrolytic Rectifiers, N. A. de Bruyne; Transformers for Single and Multiphase Currents, Dr. G. Kapp, new edition; Dictionary of Electrical Terms, S. R. Roget; Ball and Roller Bearing Handbook, A. W. Macaulay; Metal Workers' Practical Calculator, J. Matheson; Fuel Economy in Steam Plants, A. Grounds; Workshop Gauges, L. Burn and G. F. F. Eagar; Handbook of the B.S.A. Motor Cycle; Mechanical Refrigeration, H. Williams, new edition; Automatic Telephones, F. A. Ellson. *University Tutorial Press, Ltd.*—Junior Technical Electricity, R. W. Hutchinson; Text-Book of Wireless Telegraphy and Telephony, W. Greenwood. *Wireless Press, Ltd.*—Year Book of Wireless Telegraphy and Telephony. *H. F. and G. Witherby.*—The Use of Power in Colliery Working, J. Kirsopp.

Geography and Travel.

Christophers.—Human Geography: An Introductory Study based primarily on Man in Mediterranean Lands, Dr. Marion I. Newbigin. *G. G. Harrap and Co., Ltd.*—With Stefansson in the Arctic, H. Noice. *Longmans and Co.*—Through Central France to the Pyrenees, Maude Speed. *Macmillan and Co., Ltd.*—Big Game and Pygmies: the Experiences of a Naturalist in Central African Forests in Quest of the Okapi, Dr. C. Christy. with an Introduction by Sir Harry H. Johnston: Anatolica, H. C. Luke; Amurath to Amurath, Gertrude Lowthian Bell, new edition. *Oxford University Press.*—The Face of the Earth, Prof. E. Suess, translated by Hertha Sollas. Vol. V.: Index of Subjects and Index of Persons and Places.

Geology, Mineralogy, and Mining'

J. B. Lippincott Company.—Coal Mining: its History and Development, R. Z. Virgin. *Macmillan and Co., Ltd.*—A Long Life's Work: an Autobiography, Sir Archibald Geikie; Text-Book of Palæontology, Prof. K. A. von Zittel. Vol. III.: Mammalia, revised by Dr. Max Schlosser, translated under the direction of the late Dr. C. R. Eastman by Marguerite L. Engler and Lucy P. Bush, Dr. A. Smith Woodward completing the revision of the volume. *Methuen and Co., Ltd.*—Crystals and the Fine-Structure of Matter, Prof. F. Rinne, translated by W. S. Stiles; The Origin of Continents and Oceans, Prof. A. Wegener, translated by J. G. A. Skerl, with a Preface by Dr. J. W. Evans. *Thomas Murby and Co.*—Handbook of the Geology of Great Britain, Prof. P. G. H. Boswell, Dr. A. Morley Davies, Dr. C. Davison, Dr. A. Harker, Prof. O. T. Jones, Prof. P. F. Kendall, L. Richardson, J. Parkman, Prof. W. W. Watts, and Dr. J. W. Evans; Handbook of the Geology of Ireland, Prof. G. A. J. Cole and T. Hallissy.

Mathematical and Physical Sciences.

Ernest Benn, Ltd.—Atoms and Rays: an Introduction to Modern Views on Atomic Structure and Radiation, Sir Oliver Lodge. *Cambridge University Press.*—Hydrodynamics, Dr. H. Lamb, new edition; Matter and Change: an Introduction to Physical and Chemical Science, W. C. Dampier Whetham; On the Application of the Quantum Theory to Atomic Structure, Dr. Niels Bohr. Part 2: The Theory of Series Spectra; The Earth: its Origin, History, and Physical Constitution, Dr. H. Jeffreys. *J. and A. Churchill.*—Physics for Medical Students, G. Stead. *Longmans and Co.*—A Companion to Elementary School Mathematics, F. C. Boon; Analytical Mechanics: comprising the Kinetics and Statics of Solids and Fluids, Prof. E. H. Barton, new edition. *Macmillan and Co., Ltd.*—The Theory of Relativity, Dr. L. Silberstein, new edition. *Methuen and Co., Ltd.*—Einstein's Theory of Relativity, Prof. Max Born, translated by H. L. Brose; Relativity for Physics Students, Dr. G. B. Jeffery; A Survey of Physics, Prof. Max Planck, translated by R. Jones and D. H. Williams; The Kinetic Theory of Gases, Prof. E. Bloch, translated by P. A. Smith. *Oxford University Press.*—The Geometry of the Complex Domain, J. J. Coolidge; Mathematical Groundwork of Economics, Prof. A. L. Bowley. *Scott, Greenwood and Son.*—Calculus for Engineers, E. S. Andrews and H. B. Heywood, new edition. *Charles Scribner's Sons.*—The Depths of the Universe, Dr. G. E. Hale.

Medical Science.

D. Appleton and Co.—Blood Pressure, Drs. L. Barker and N. B. Cole. *Edward Arnold and Co.*—Crime and Insanity, Dr. W. C. Sullivan. *Ernest Benn, Ltd.*—Practical Surgery Illustrated, Dr. V. Pauchet, translated by Dr. F. R. H. Atkinson, 6 vols. *Cambridge University Press.*—Lectures on the History of Physiology during the Sixteenth, Seventeenth, and Eighteenth Centuries, Sir Michael Foster, reprint; An Introduction to the Study of Colour Vision, Sir J. Herbert Parsons, new edition. *J. and A. Churchill.*—Refraction of the Eye, including Physiological Optics, Dr. C. B. Goulden; Medical Hydrology, Outlines for Practitioners and Students, Dr. R. F. Fox. *Wm. Heinemann (Medical Books) Ltd.*—A Manual of Practical X-ray Work, J. Muir, in collaboration with the late Sir Archibald Reid and F. J. Harlow (being a third edition of the work by Arthur and Muir); Organic Substances, Sera and Vaccines, in Physiological Therapeutics, Dr. D. W. Carmalt Jones; Orations and Addresses, Sir John Bland-Sutton; Insulin in General Practice, Dr. A. C. Begg; Psycho-Analysts Analysed, Dr. P. McBride, with an Introduction by Sir Bryan Donkin; The Nature of Disease, J. E. R. McDonagh. *H. K. Lewis and Co., Ltd.*—An Introduction to Forensic Medicine, H. A. Burridge; The Leucocyte in Health and Disease, C. J. Bond; A System of Radiography, with an Atlas of the Normal, Dr. W. Ironside Bruce, new edition; A Handbook of Surgery, W. C. G. Bryan; Practical Forensic Medicine, C. G. Grant, new edition; Surgical Pathology, Dr. J. McFarland; Diseases of Women, L. G. Phillips; A Synopsis of Special Subjects, for the Use of Practitioners. *Longmans and Co.*—Principles of General Physiology, Sir William Bayliss, a new edition—the fourth—prepared by a committee of biologists, physiologists and chemists. *W. B. Saunders Co., Ltd.*—Abt's Practice of Pediatrics, 8 vols.; Bickham's Operative Surgery, 6 vols.; Circulatory Disturbances, Buerger; Fertility and Sterility in Human Marriages, Reynolds; Diseases of the Heart, Vaquez-Laidlaw. *University of London Press, Ltd.*—The Present Tendencies and the Future Compass of Physiological Science, Prof. A. V. Hill.

Metallurgy.

Chapman and Hall, Ltd.—Practical Microscopical Metallography, Dr. R. H. Greaves and H. Wrighton; Finishing Processes and Metal Colouring, S. Field and S. R. Bonney. *Crosby Lockwood and Son.*—Technical Methods of Metallurgical Analysis, Scott. *Oxford University Press.*—Industrial Metallography of Steel and Iron, Dr. T. Baker; Practical Non-Ferrous Metallography, Dr. L. Aitchison and L. W. Johnson.

Meteorology.

University of London Press, Ltd.—Weather Chart Exercises (British Isles and West of Europe), L. M. Odell, new edition.

Miscellaneous.

Edward Arnold and Co.—Practical Photomicrography, J. E. Barnard, new edition. *Cambridge University Press.*—Catalogue of Scientific Papers, compiled by the Royal Society, Vol. XIX. *Crosby Lockwood and Son.*—Inwood's Tables for the Purchasing of Estates, Schooling. *S. Rentell and Co., Ltd.*—Where to Seek for Scientific Facts, A. B. Eason. *H. F. and G. Witherby.*—Deerstalking in Scotland, A. I. McConnochie.

Philosophy and Psychology.

Cambridge University Press.—Quickness and Intelligence: an Inquiry concerning the Existence of a General Speed Factor, Dr. E. Bernstein (Supplement to *The British Journal of Psychology*). *Macmillan and Co., Ltd.*—Prolegomena to an Idealist Theory of Knowledge, Prof. N. K. Smith. *Methuen and Co., Ltd.*—Ethics and some Modern World Problems: an Inquiry into the Ethical Basis of our Civilization, Prof. W. McDougall. *Open Court*

Company.—Popular Lectures, Ludwig Boltzmann; Geometry, René Descartes, translated; Ausdehnungslehre, Hermann Grassmann, translated; A Memoir of the Life and Work of P. E. B. Jourdain; Precritical Essays on Space and Time, Immanuel Kant; Civilisation and Mechanics, Ernst Mach; Knowledge and Error (Erkenntnis und Irrtum), Ernst Mach; Principles of the Theory of Heat, Ernst Mach; The Aims of Scientific Method, and other Philosophical Essays, Dr. T. Percy Nunn; Essay on Non-Euclidean Geometry, Georg Reimann; American and English Pluralist Philosophers, Jean Wahl; Relation of Space and Time to Experience, Norbert Weiner; An Appreciation of Bhagavad Gita; The "Open Court" Classics of Science and Philosophy: Vegetable Staticks, Stephen Hales, edited, with notes, by Sir Francis Darwin; Arithmetica Infinitorum, John Wallis, translated and edited by J. M. Child; Carnot: Motive Power of Heat, edited by A. E. Heath; De Morgan's Formal Logic, edited by A. E. Taylor. *Oxford University Press.*—The Metaphysics of Aristotle, Prof. W. D. Ross, 2 vols.; An Essay concerning Human Understanding, John Locke, abridged and edited by A. S. Pringle-Pattison; Spinoza, Descartes, and Maimonides, L. Roth; Speculum Mentis or The Map of Knowledge, R. G. Collingwood; Theories of Memory, Beatrice Edgell. *University of London Press, Ltd.*—Personality, Dr. W. Brown. *University Tutorial Press, Ltd.*—Social Psychology, R. H. Thouless. *Williams and Norgate.*—Social Aspects of Psychoanalysis, edited by Dr. E. Jones: Man and the Individual, Dr. J. Glover; The Family, J. C. Flugel; Politics, Dr. M. D. Eder; Education, Miss Barbara Low; Vocation, Miss E. Sharpe.

Technology.

Ernest Benn, Ltd.—The Resources of the Empire Series, comprising twelve self-contained volumes dealing with the following industries: Food Supplies; Timber and Timber Products; Textile Fibres and Yarns; Fuel; Rubber, Tea, Cacao, and Tobacco, with Special Sections on Coffee and Spices; Leather; Chemicals; Ferrous Metals; Non-Ferrous Metals; Oils, Fats, Waxes, and Resins; Communications. *Chapman and Hall, Ltd.*—The Technology of Wood Distillation, Dr. A. Rule. *Methuen and Co., Ltd.*—Sugar Refining, Past and Present, J. L. Fairrie. *Sir Isaac Pitman and Sons, Ltd.*—The Button Industry, W. U. Jones; Bread and Bread Baking, J. Stewart; Weaving, W. P. Crankshaw; Woollen Yarn Production, T. Lawson. *Scott, Greenwood and Son.*—Art of Lithography, H. J. Rhodes, new edition; Drying by Means of Air and Steam, E. Hausbrand, new edition; The Manufacture of Paint, J. C. Smith, new edition.

Reflecting Telescope for Simeis Observatory, Crimea.

THE Imperial Russian Government in 1912 ordered from Messrs. Sir Howard Grubb and Sons, Ltd., a forty-inch reflecting telescope, and the preliminary designs for the instrument were made in collaboration with Dr. Belopolsky, the late Dr. Backlund, and Sir David Gill. In 1922 instructions were received from the Soviet Government to complete the instrument, and it is now undergoing tests at Messrs. Grubbs' works at St. Albans.

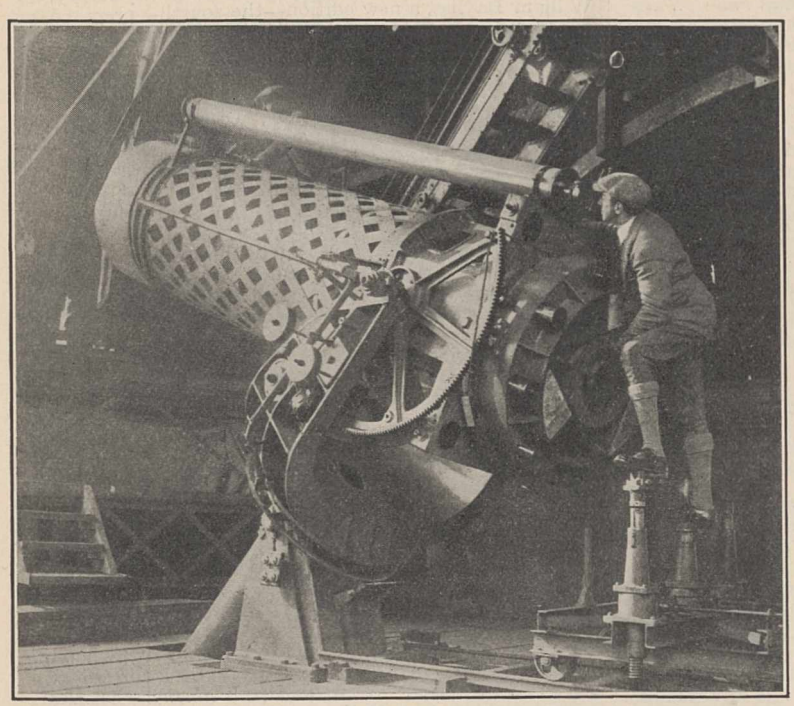

FIG. 1.—Forty-inch reflector for Simeis Observatory, Crimea. Constructed by Sir Howard Grubb and Sons, Ltd.

The telescope, which is shown in Fig. 1, has an aperture of 1 metre, and focal length of 5 metres, and is somewhat similar in form to the sixty-inch reflector at Mount Wilson, the tube being mounted in an overhung fork. The main part of the stand, below the level of the floor seen in the illustration, is of massive construction, and is made in five parts for convenience of transit; it contains the driving clock, and mouse feed, automatic and hand controls. The driving circle is six feet in diameter and mounted towards the lower end of the polar axis, connected to the Right Ascension clamp ring by a Clement Driver. The Right Ascension clamp is actuated by a solenoid, which is automatically locked when the clamp comes into action, a second and smaller solenoid being used to unlock it. These solenoids, as well as the motor for quick motion in Right Ascension, are controlled by push buttons mounted at the upper end of the tube, interlocking arrangements being provided so that the motor cannot be started while the telescope is clamped. They can also be operated by a hand controller from any convenient position.

The fork in which the tube is mounted is a massive steel casting, and is bolted to a flange formed on the upper end of the polar axis. Immediately below this flange is strung the Right Ascension Circle, which is 3 ft. 6 in. in diameter and driven by the driving clock, independently of the polar axis; this circle, as well as the Declination Circle, which is mounted inside the fork, can be read from both the upper end and the great mirror end of the tube. The centre portion of the tube, to which the trunnions are attached, is of cast iron, generally of octagonal cross section formed with a flange at the side on which an eyepiece or spectrograph can be mounted when the telescope is used as a Cassegrain. The lower portion has a circular flange to which the mirror cell is bolted.

The glass mirror, 40¼ inches diameter and 8 inches thick, weighs about 900 lb., and is mounted on a

system of levers so arranged as to cause an equal pressure on 9 out of 12 portions of equal area of the lower face of the mirror, the remaining 3 portions being supported on adjusting screws for squaring the mirror. Nine weighted levers mounted on universal joints compensate for the side pressure of the mirror, these levers being out of action when the tube is vertical, and gradually coming into action as the tube is moved towards the horizontal. These systems of levers are similar to those used in the sixty-inch Mount Wilson telescope.

The main part of the tube is built of flat tapered strips of duralumin laid in right- and left-hand spirals and stiffened inside at intervals with steel angle rings, the upper end of the tube having a flanged ring to which either of the two hoods provided can be attached. The first, or Newtonian hood, is provided with a handwheel, so that it can be rotated to bring the eyepiece into a position convenient for the observer, the diagonal mirror being supported by four thin steel bands five inches wide, placed edgewise. On the side of this hood is mounted a flange to which either a visual or photo breechpiece can be attached by a bayonet joint—while a little to one side is placed a finder having an aperture of two inches. The photo breechpiece is arranged to take plates 80 mm. × 80 mm., and is fitted with cross slides and guiding microscopes.

The second or Cassegrain hood has a box-shaped aluminium casting mounted in the centre and supported on four thin steel bands. The Cassegrain mirror of 12 inches diameter, with its focussing arrangements, is attached by a bayonet joint to the lower face of this casting, and the Newtonian photo breechpiece can be attached to the upper face, so that when the Cassegrain mirror mounting is removed, photographs can be taken in the prime focus. The mirror focussing gear is actuated by a handwheel mounted at the lower end of the tube. The rays reflected from the Cassegrain mirror are received on a small diagonal mirror mounted on four springs about twelve inches in front of the great mirror and reflected at right angles to the axis of the tube through the flange formed on the side of the centre casting, arranged to take the breechpieces or spectrograph.

The telescope is also arranged so that a fixed spectrograph can be used. For this purpose a plane mirror is provided which can be mounted on a hollow shaft passing through one of the trunnions forming the declination axis, this mirror being arranged to move at half the speed of the tube when the latter is moved in declination. This mirror directs the rays from the Cassegrain mirror down through the hollow polar axis. Fixed on one side of the tube is a guiding telescope of 7 inches aperture and about 13 feet focal length, fitted with eyepiece on cross slides.

The quick, quick-slow, and slow-slow motions in Right Ascension, as well as the quick motion in Declination, are all electrically operated and controlled by push buttons from any convenient position.

The telescope is mounted in a revolving dome of 32 feet internal diameter, carried on steel pillars 16 feet high, a floor being attached to the pillars 12 feet above the level of the ground. The dome has a double shutter giving an opening 11 feet wide at the bottom, 5 ft. 6 in. wide at the top, and extending 4 feet beyond the zenith. The observing platform is carried on rails mounted in the revolving portion of the dome, and has a transverse motion of about 4 feet parallel to the opening. This platform has a stairway attached to it, with rails on each side of the steps, at an angle of 45°, up and down which runs the observing carriage, controlled electrically, and fitted with cut-outs to limit the travel. The revolution of the dome can be controlled from this carriage, or any other convenient position.

A truck fitted with three screw-jacks is provided for removing the mirror cell and mirror from the tube, and for raising the mirror out of the cell, for the purpose of resilvering.

New Agriculture Building at the University of Leeds.

ON Friday, April 4, the Rt. Hon. Noel Buxton, Minister of Agriculture and Fisheries, laid the foundation stone of the new building for the Department of Agriculture at the University of Leeds. The proceedings were presided over by the Chancellor of the University (His Grace the Duke of Devonshire), and after the laying of the stone the Minister gave an address at a public meeting in the Great Hall of the University. There was a large company of landowners, farmers, and other friends of the University present, and much interest was manifested in the proceedings.

The building, which has been designed by Mr. Paul Waterhouse, will occupy a plot 190 feet long by 125 feet deep. The basement will be used for stores, and will also contain a students' common room, and a large machinery room and workshop, etc. On the ground floor there are two lecture rooms, a museum, library, and administrative offices. The Biological Department on the first floor will include a general laboratory, lecture room, research rooms, an advanced laboratory, one or two private rooms, preparation, sterilising, and store rooms, etc. The Chemical Section is provided for on the second floor, and includes a large students' laboratory, laboratories for chemical nutrition research, balance rooms, large and small lecture rooms, and rooms for microscopy and other special purposes. The roof surface will be adapted for out-of-door and greenhouse work. The new building will cost 60,000*l.*, towards which the Government have promised a grant of 15,000*l.*, and the Yorkshire Council for Agricultural Education 10,000*l.*, while there have been also some handsome donations.

At the meeting in the Great Hall of the University after the ceremony, the Duke of Devonshire, in extending a cordial welcome to Mr. Buxton, indicated the opportunity which the new building would afford to enable research work to be carried on under more comfortable, happier, and favourable conditions. He hoped this would only be an augury of further development.

Major Dent, chairman of the Yorkshire Council for Agricultural Education, spoke of the progress of the work of the Department of Agriculture of the University since its establishment in 1891, and of the principles which had guided the Council. There was one body responsible for agricultural education for the whole geographical County of Yorkshire, consisting of representatives of the three County Councils, the University, the Ministry of Agriculture, and a few additional members. He referred to the amicable relations that had existed amongst the various authorities, and how co-operation and interest had been secured with the Farmers' Union. Much had been accomplished from a small beginning in the domain of agricultural economics, and great extension had taken place in the advisory work of the Department.

Mr. Noel Buxton, in referring to the honour it gave

him to represent the Government, stated he was voicing the general feeling of the Cabinet when he said how deeply they appreciated the work that was being done by Yorkshire and by the University of Leeds in promoting the cause of agricultural education. What the Agricultural Department had hitherto lacked in the way of suitable accommodation had been made up by the zeal and energy of those connected with it. There was no more useful way in which the Ministry could spend money than on agricultural education, and a return from such expenditure was yielded which could not be expressed merely in cash. Schemes of agricultural education were also outside party controversy, and were therefore, he hoped, not likely to be diminished with any change of Government. Governments had realised the vital importance of ensuring that agriculture derived the maximum assistance which it was in the power of science to render.

Mr. Buxton said that in the agricultural education of a generation ago it was not sufficiently realised that the science of accountancy was one of the foundation stones of farming, which was essentially a business that must be judged by results. Consideration of costs, whether of materials or labour, must everywhere dominate the treatment of the subject. What had been done by the University in that respect was recognised throughout the whole country.

There remained the question of the technical education of the young labourers, a field of work which, Mr. Buxton felt, had not received sufficient attention. The Ministry of Agriculture Scholarships Scheme for sons and daughters of agricultural workmen and other rural workers established two years ago provided a great opportunity for the gifted ones, but the Scheme had not been taken up to such an extent as was desirable. It was obvious, however, that a scheme for taking farm labourers from their occupations and maintaining them at considerable expense to the State at residential colleges could not touch the root problem of how to raise the standard of knowledge generally among the three-quarters of a million workers engaged in agriculture. As the labourer could not go to the Institution, the teacher must go to the farm. Instruction must be given under the guidance of the best craftsmen the district can produce. This was a matter which the Yorkshire Council for Agricultural Education and the University might most usefully explore in co-operation with the National Farmers' Union on the one hand and the organisations of agricultural labourers on the other.

The Pro-Chancellor (Mr. E. George Arnold) proposed, and the Pro-Vice-Chancellor (Prof. Jamieson) seconded, a most cordial vote of thanks to the Minister for his speech.

University and Educational Intelligence.

BIRMINGHAM.—The following appointments have been made: Mr. W. Billington, to be joint-professor of surgery; Dr. H. Black, to be lecturer in radiology; Mr. J. Humphreys, to be honorary reader in medieval archæology, for a period of three years; Mr. C. G. Burton, to be secretary of the University on the retirement of Mr. G. H. Morley at the end of this year. Mr. Burton will begin his duties as deputy secretary on June 1, and will act in that capacity until Mr. Morley relinquishes office.

Negotiations with the War Office as to reparations to the Edgbaston buildings necessitated by their use as the 1st Southern General Hospital during the War have now been satisfactorily completed.

The late Miss Caroline Harrold, of Church Road, Edgbaston, has left the residue of her estate to the University of Birmingham for affording facilities for research in the faculties of science and medicine.

CAMBRIDGE.—Mr. Sidney Wynn Graystone, of Knightsbridge, formerly of White Lodge, Cheveley, Newmarket, who died on February 8 last, bequeathed to Downing College, of which he was a member, his collection of books, pictures, engravings, and etchings; also, on the death of his wife and brother, the ultimate residue of his estate, which will probably exceed 75,000*l*. The testator directs that the sum of 5000*l*. shall be devoted to scholarships, 5000*l*. to the erection of a chapel, 5000*l*. to the erection of a Graystone Library, and the remainder to the erection of additional college buildings to be called the Graystone Block. This munificent bequest, when it becomes available, will enable the governing body to provide the urgently needed additional accommodation for students within the college. The Graystone bequest is by far the most valuable benefaction which Downing College has received since its foundation at the beginning of the last century.

Mr. J. Barker, Trinity College, has been elected to the Frank Smart University Studentship in Botany.

LONDON.—The Presentation for Degrees will take place in the Royal Albert Hall, Kensington Gore, on Wednesday, May 14, at 2.30 P.M.

Applications are invited for the chair of mathematics tenable at Royal Holloway College. The latest date for the receipt of applications (to be sent to the Academic Registrar, University of London, South Kensington, S.W.7) is May 13.

OXFORD.—Lecturers or demonstrators are required at the Forestry Institute in the subjects of silviculture, mycology and pathology of trees, structure and properties of wood, economics of forestry (including statistical methods), and soil science. Further information can be obtained from the Secretary of the Institute, to whom the applications with testimonials and, if possible, copies of published writings should be sent by, at latest, July 15.

THE trustees of the South African Museum, Cape Town, invite applications for the directorship of that institution in succession to the late Dr. L. Péringuey.

THE National Union of Students of the Universities and University Colleges of England and Wales, established two years ago, has hitherto directed its efforts mainly to bringing together students of different countries and working towards broadening the basis and outlook of the Confédération Internationale des Étudiants, to which it is affiliated. The fifth number of its *National Union News*, a very creditable production, is almost wholly devoted to its international interests and activities, chiefly to accounts of international gatherings held last September in London and Oxford. These bear evidence of strenuous and apparently successful efforts to bring about an appeasement of international animosities and a substantial measure of practical co-operation between student bodies of the various countries represented. The leaders of the delegations unanimously agreed at Oxford to issue to all countries a manifesto declaring that it was the wish of the Confederation to become really international and to include the students of all countries. It was agreed that students of the late neutral countries should prepare the way for the admission of German students. Interesting descriptions are given of several "faculty" tours organised by the N.U.S.: of chemistry students in Czecho-Slovakia, of students of agriculture in Denmark, and of medical students in Holland, Germany, Czecho-Slovakia, Austria, Switzerland, and France. Mr. W. Randerson, the Albert Kahn fellow for 1923–24, has undertaken to contribute a series of articles on student life and activities in the countries visited by him in the course of his fellowship tour.

Early Science at the Royal Society.

April 13, 1664. Dr. Wallis gave his and Dr. Christopher Wren's judgment concerning three manuscripts of Mr. Horrox for the restitution of astronomy. Their joint opinion was that as to the English piece it would not be fit for publication, because it contained only broken incoherent things, set down by the author only for his memory, as they came into his mind, and brought for the most part into the Latin in their proper places, and sometimes with retractations and alterations upon second thoughts of what he had at first set down in English. But they looked upon the Latin pieces as the beginning and attempt of an excellent work for the restitution of astronomy, and which served to shew, how great a loss it was that Mr. Horrox died so soon, since it appeared from this and that concerning his observation of Venus.

1668. It was ordered—that the president be desired to signify to the society, that considering the want of experiments at their public meetings the council had thought proper to appoint a present of a medal of at least the value of twenty shillings to be made to every fellow, not curator by office, for every experiment, which the president or vice-president shall have approved of; and that the president be likewise desired to advise with Mr. Slingsby about the impress of such medals.

1681. Several debates arose about the use and abuse of snuff-powder, and several instances mentioned of the bewitching custom of taking snuff, tobacco, &c.

1687. Dr. Papin produced the model of his cyder-press, which was contrived to apply the weight of the atmosphere to a press; and the use thereof was shown to the satisfaction of the Society.

April 15, 1669. Sir Robert Moray produced the skin of a Moor tanned, which he said was offered to be sold for five pounds; and being thought proper for the repository, it was ordered that the treasurer should pay that sum for the purchase of it.

April 17, 1679. Dr. Croune gave an account of Mr. Reusden's book on bees; that the part of it about the education of bees contained many good observations well made and related.

April 18, 1672. Mr. Hook was ready to make an experiment by a prism, viz., to destroy all colours by one prism, which had appeared before through another: but there being no sun, as was necessary, the experiment was deferred.

1678. Discourse was made concerning several ways of sounding the depth of the sea. . . . It was moved, that some experiments should be made at the column [Monument] on Fish-street-hill, of the velocity of the descent of heavy bodies, and what the resistance of the air is to that motion.

April 19, 1665. Sir Robert Moray presented the society from the King with a phial of Florentine poison, sent for by his Majesty from Florence, on purpose to have those experiments related of the efficacy thereof, tried by the Society. It was ordered that most humble thanks should be returned to his Majesty by the president and Sir Robert Moray, in the name of the society, for this honour and favour; and that experiments should be immediately made with the said poison. . . . Accordingly a thread was dipped into it, and drawn with a needle through the skin of the neck of a pullet, which within two or three minutes was thereby so stupified, that it fell down, and remained in that condition for about half an hour; but then began to stir again, recovering at last perfectly before the society rose. There were other experiments.

Societies and Academies.

LONDON.

Optical Society, March 13.—Miss H. G. **Conrady**: A study of the significance of the Foucault knife-edge test when applied to refracting systems. An attempt to explain the various appearances observed led to the construction of accurate three-dimensional models of pencils of light afflicted with aberrations present singly or in pairs. These models were based on equations for the geometric interpretation of the Seidel aberrations. With the aid of these models the test appearances were explained.—B. K. **Johnson**: A reflecting spherometer. The optical spherometer described is one in which an auto-collimating method is used in conjunction with a microscope for determining the radius of curvature of convex and concave surfaces, both spherical and cylindrical.—R. **Kingslake** and L. C. **Martin**: The measurement of chromatic aberration on the Hilger lens-testing interferometer. An account is given of the experimental determination of the longitudinal chromatic aberration and secondary spectrum of telescope object glasses, using the Hilger lens-testing interferometer. The amount of mirror displacement necessary to give the same interference pattern for different wave-lengths of light is measured by a screw micrometer.—L. C. **Martin**: Note on a convenient bench for testing object glasses. The arrangement is suitable for the familiar auto-collimation star test. The bench is sloping so that comparatively large glasses can be taken, and the necessary plane mirror rests safely in its support under gravity and without strain. Fine mercury globules scattered into black velvet form excellent artificial stars when illuminated by condensed light from a pointolite or gas-filled lamp. The images are observed with a suitable positive eyepiece.

British Mycological Society, March 15.—Mr. J. Ramsbottom, president, in the chair.—Miss E. J. **Welsford**: Diseases of cloves. Clove trees in Zanzibar suffer from two diseases. The most serious is caused by a fungus attacking the fibrous roots, destroying them and passing into the thick lateral roots and the collar. Since the lateral roots of the clove lie near the surface and extend to a considerable distance, there is contact infection. Effective methods of eradication are (1) the cutting down of a diseased tree and burning stumps and roots; (2) isolating infected areas by means of ditches cutting through lateral roots; (3) dressing with 1 lb. of lime per square yard. The second disease is a "die-back" due to a member of the Mycosphærellaceæ. Entrance into the leaf is dependent on the presence of the epiphytic alga *Cephaleuros mycoidea*. The disease can be checked by spraying with Bordeaux mixture or copper acetate solution.—Miss M. **Brett**: A species of Sterigmatocystis normally producing large numbers of sclerotia and few conidia was investigated culturally. Conidial development is encouraged at the expense of sclerotial formation by exposure to light, increased osmotic pressure, acidity of the medium, a temperature above 35° C., and by carbon and nitrogen in the medium in unsuitable forms. A reduced form of conidial fructification is commonly formed under certain unfavourable nutritive conditions and the sclerotia remain immature or are totally inhibited.—J. **Peklo**: An account of the work of Kruis and Šatava on reduced forms of yeasts and the alternation of generations. Ascospores of yeasts if isolated and grown give rise to dwarf cells, which form colonies quite different from the normal cells in many ways and remain constant over a number of years: they do not form asci. When dwarf cells copulate they

give rise to the normal form. In certain species ascospores rarely conjugate at germination, and consequently only small-celled colonies are produced: in others conjugation frequently occurs during germination and normal cells result. The dwarf cells are regarded as the gametophyte generation, the normal cells as the sporophyte.—A. D. **Cotton**: A summary of the Ministry of Agriculture's plant-disease survey. This was commenced during the War period with the view of ascertaining the diseases exacting a toll on our staple food crops and the extent of the loss. Later the scope of the survey was widened to include diseases of all economic crops. A number of selected diseases were treated, showing some of the interesting and valuable information which had been acquired as a result of the survey.—E. **Clement**: A preliminary account of the germination of orchid seeds without fungal aid. The theoretical basis of experiments and a report of their success up to the stage of transplanting from the culture medium into fibre.

Royal Anthropological Institute, March 18.—Prof. C. G. Seligman, president, in the chair.—F. G. **Parsons**: The study of type contours of skulls. Superimposing the short contour of an average of 30 male European brachycephalic skulls on that obtained from 30 eighteenth-century Londoners, as seen from above, shows that the increase of breadth is largely confined to the region covered by the great muscle of mastication, the temporalis. When side views of type contours of Londoners, Anglo-Saxons, Swedish vikings, and Long Barrow skulls are superimposed on that of the short heads, the increase of length is, in every case, in the back part of the skull. A similar superimposition of the modern short-headed contour on that of the Bronze Age or Beaker folk shows the wonderful identity of the two, except for a flattening of the forehead, which seems a characteristic of certain short-headed, modern skulls, and possibly indicated a different racial origin from those more closely allied to the Beaker folk in ancestry. The busts of Roman emperors suggest that the patrician class in ancient Rome was not Nordic, but of brachycephalic, and probably the Levantine brachycephalic, type. The method of supplementing the study of individual skulls by that of type contours, which can be superimposed, reduces the risk of personal bias in favour of one or two arbitrary characteristics when contrasting skulls of different races.

Mineralogical Society, March 18.—Dr. A. E. H. Tutton, past-president, in the chair.—L. J. **Spencer**: Allopalladium from British Guiana. Three small grains with the appearance of native platinum, from the gold and diamond washings on the Potaro river, answered to micro-chemical tests for palladium; but the material is brittle and consists of a granular crystalline aggregate showing cleavages.—W. Campbell **Smith**, with analysis by G. T. **Prior**: On compact chlorite from Bernstein, Burgenland, Austria. Specimens of compact dark green stone provided by the Styrian Jade Company prove to be chlorite intermediate in composition between pennine and clinochlore of Tschermak's classification of the chlorites: "precious serpentine" from the same locality was analysed and identified as chlorite by Wartha in 1884.—H. C. G. **Vincent**: Chemical analyses of microgranite from Dufton, Westmorland, and of mica from Burma. Analysis of the microgranite with porphyritic mica from Dufton showed an excess of soda over potash; the mica from Burma had the composition of a phlogopite like that of Burgess, Ontario.

Zoological Society, March 18.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Leonard **Hill**: The atmospheric conditions at the Zoological Gardens, London.—W. J. **Phillipps**: On a new genus of ribbon-fishes.—B. N. **Schwanwitsch**: On the ground-plan of wing pattern in nymphalids and certain other families of the rhopalocerous lepidoptera.—F. Wood **Jones**: The status of the Kangaroo Island kangaroo (*Macropus fuliginosus*).

Royal Meteorological Society, March 19.—Mr. C. J. P. Cave, president, was in the chair.—V. D. **Blackman**: Atmospheric electric currents, normal and abnormal, and their relation to the growth of plants (March lecture). Soon after the experimental proof, in the middle of the eighteenth century, that the atmosphere was electrically charged in calm weather as well as during thunderstorms, the view began to be held that this electrification is of importance in relation to the growth of plants. No certain proof of this is yet available, though its truth is probable. A number of attempts to intensify the normal atmosphere electric current passing to plants by stretching over them fine wires charged to a high potential have been made since 1884, but with conflicting results. Experiments have been carried out from 1915 onwards in the laboratory, with pot-cultures, and in the field. These prove definitely that minute electric discharges increase the rate of growth of cereals, while somewhat larger ones retard the rate. Of twelve experiments with spring-sown cereals, ten gave positive results and two negative, the average increase being about 22 per cent. Pot-culture experiments show that the period of the discharge is of the greatest importance; an application for the first and second months being even more effective than one during the whole season. The effect is of the nature of a stimulus, since the additional plant material formed is out of all proportion to the insignificant amount of additional energy supplied.

Linnean Society, March 20.—Dr. A. B. Rendle, president, in the chair.—Teïzo **Niwa**: Japanese methods of dwarfing trees. For decoration, both herbs and trees are grown in Japan in pots. The trees may be arranged (1) for foliage, (2) for flowers, and (3) for fruit, and the products are usually proportionate to the size of the trees. They are grown from seed or by grafting, or from native places, but conifers are usually taken from wild specimens, or seed. When well-shaped branches occur, they are often layered, and when rooted the branch is severed and potted. Pine trees are kept in a dry and barren soil; during the first few years plants subjected to the dwarfing treatment retain the normal size of their leaves, then they diminish to the dwarf size. As a rule, dwarf plants must have a naturally dwarf character, but one of the cherries, *Malus floribunda* Sieb., is not a true dwarf, being kept small by pruning.

CAMBRIDGE.

Philosophical Society, February 18.—Prof. A. C. Seward, vice-president, in the chair.—H. F. **Newall**: Sun-spots.

March 3.—Prof. J. Barcroft, vice-president, in the chair.—M. L. **Anson**, J. **Barcroft**, H. **Barcroft**, A. E. **Mirsky**, and C. **Stockman**: The relation between the affinity for certain gases and the position of the spectral bands in the hæmoglobin of vertebrates. If A be, in Ångström units, the position of maximum density of the α band of oxyhæmoglobin, and B be that of CO-hæmoglobin, then $A-B$, or S, is the maximal displacement of the α band by CO. If K be the equilibrium constant of the reaction

$$K\frac{[O_2Hb]}{[COHb]}=\frac{[O_2]}{[CO]},$$

the following relation is found to hold for man, horse, mouse, sheep, cat, pigeon, fowl, rabbit, frog, tortoise, lizard, roach: $\log K = 0{\cdot}05\ S$.—J. T. **Saunders**: The relation of flagellates and ciliates to P_H. Ciliates and flagellates living in water tend to aggregate in regions of definite P_H. This preference is independent of the tension of either oxygen or carbon dioxide or of concentrations of dissolved salts.—J. **Gray**: (1) Note on the penetration of hydroxyl ions into gelatin. The presence of magnesium chloride in a gelatin jelly inhibits the rate of penetration of hydroxyl ions from NaOH, but not from NH_4OH. (2) The relation of cilia to oxygen. The cilia on the gills of Mytilus can beat for a considerable time in the absence of oxygen. The ciliary apparatus appears to consist of three parts: (i.) the breakdown of some chemical substance giving rise to an acid; (ii.) a motor mechanism; (iii.) the removal of the products of activity by oxygen. The first reaction is very sensitive to hydrogen ions, and to some extent to other monovalent cations. The motor mechanism is deranged by an absence of calcium or by high osmotic pressures.—C. Forster **Cooper**: On remains of extinct Proboscidea in the Museums of Geology and Zoology in the University of Cambridge. The specimens of *Elephas antiquus* from Haverhill and Barrington, as well as some fragments from Newmarket, show a small form differing in some particulars from other described mutations of the species and one which, from certain characters and in relation to the rest of the fauna, was probably as early as the Upper Pliocene period. Specimens from Whittlesea show a different type not distinguishable in general character from the typical form of *E. antiquus* but of great range in size. The fact that animals with this range of size lived apparently at the same time raises a question as to the time value of these mutations.—W. **Burnside**: Poncelet's porism for conics.—J. E. **Jones**: The equation of state of a gas.—J. A. **Wilcken**: The penetration of waves into a variable medium.—Tadahiko **Kubota**: The differential invariants of the Laguerre group.—R. **Hargreaves**: The electro-magnetic equations as basis of Einstein's quadratic form.

DUBLIN.

Royal Irish Academy.—Prof. Sydney Young, president, in the chair.—H. **Ryan** and M. J. **Shannon**: The condensation of aldehydes with butylacetoacetic ester. Butylacetoacetic ester, B.P. 226° C., was obtained from *n*-butyl iodide and the sodium derivative of acetoacetic ester. In the presence of alkalies it condensed with piperonal, anisaldehyde, and benzaldehyde to form respectively piperonylidene-, anisylidene-, and benzylidene-butylacetoacetic acid, together with piperonylidene-, anisylidene-, and benzylidene-butylacetone. Butylacetone condensed with benzaldehyde and with piperonal in the presence of hydrochloric acid to form crystalline substances apparently derived from three molecules of the aldehyde and one molecule of the ketone in each case.—H. **Ryan** and P. J. **Cahill**: The condensation of aldehydes with methylethylketone. Anisylidene-methylethylketone, M.P. 53° C., was obtained by the condensation of anisaldehyde with methylethylketone in the presence of dilute alkali. By the further action on it of anisaldehyde in the presence of alkali it was converted into dimethoxyphenyl-methyl-tetrahydropyrone, M.P. 95° C. In the presence of hydrochloric acid the aldehyde condensed with the ketone, forming a crystalline substance melting at 158° C.—H. **Ryan** and M. **Egan**: (1) The action of nitrous acid and nitrous fumes on urethanes and other bodies. The nitrating action of nitrous fumes, more especially in carbon tetrachloride solution, is similar to that of nitric acid. Phenyl-, *o*-totyl-, diphenyl-, phenylbenzyl-urethane, phenylbenzylether, and diphenylamine were converted into mononitro, and in some cases into dinitro derivatives. Nitrous acid exerted little nitrating action; phenyl- and *o*-totyl-urethanes and diphenylamine were converted into nitro derivatives. (2) The condensation of nitrosophenylurethane with toluylenedramine. *p*-Nitrosophenylurethane gives red colorations with the hydrochlorides of certain amines. The coloured compound formed by the condensation of the nitrosourethane with *m*-toluylene diamine appears to be identical with the hydrochloride of an indamine previously obtained by Bernthsen and Schweitzer. The hydrochloride consisted of dark blue prisms, but the free base was amorphous.

SHEFFIELD.

Society of Glass Technology, February 20.—Prof. W. E. S. Turner, president, in the chair.—E. A. **Coad-Pryor**: The use of pyrometers in glass works. The value of pyrometric equipment in a glass factory depends essentially on three factors: (1) The trustworthiness of the pyrometer itself, particularly, in the case of recording instruments, of the clockwork; (2) the skill which is expended on its maintenance; and (3) the attitude with which the management, foreman, and furnace operator regard the pyrometer. The real function of a pyrometer is to supply further information in order that a skilled operator may be able to get more out of his plant than had hitherto been possible. The range of temperature to be measured can conveniently be subdivided into three groups: (1) The range 0°-700° C., covering lehrs, stack temperature, producer gas, etc.; (2) 700°-1200° C., regenerator temperature, pot work; and (3) above 1200° C., the temperature of the melting furnaces. Two permanent pyrometers should be used on each furnace, in the case of a tank furnace, one on the refining end and the other sighting through a hole in the end wall at the melting end of the furnace.—W. M. **Clark**: Continuous high temperature measurements in glass works. In considering a pyrometer installation the glass manufacturer must balance the factors of what his demands for accuracy would be worth against the initial and operating costs of various systems. It is always advisable to instal both the indicating and recording type of instrument, side by side. The adoption of pyrometer control in a glass works results in economy and is important in showing each man a tangible effect of his operation on the thermal conditions. The producer man sees that good gas is necessary to maintain temperature, the furnace man sees the result of proper draught regulation, and the foreman of the finishing department can be satisfied that the ware is being properly annealed.—C. E. **Foster**: Practical applications of pyrometers to glass works. Luminous gas flames have the power of selective emission. A surface of molten glass viewed obliquely in a furnace does not realise "black body" conditions; its reflecting power as experienced in measuring with a total radiation pyrometer is relatively much less than the unoxidised surface of molten metal. Molten glass approaches a true "black body" more nearly than unoxidised molten metal.—R. S. **Whipple**: Recent advances in the design of temperature-measuring instruments, etc. One difficulty in connexion with disappearing filament pyrometers is to get two lamps which are interchangeable. In the United States great progress has been made in automatic temperature control. For example, at one works, lehr temperatures are controlled from 200° C. to 600° C. For

every kind of glassware a special cooling curve is followed. Various forms of controller were explained.—W. **Bowen**: Reflections on pyrometer design. Some of the standards which a good pyrometer should fulfil are: (*a*) Simplicity of design and operation; (*b*) robustness; (*c*) flexibility of apparatus to meet practical conditions; (*d*) long and stable life; (*e*) speedy response to temperature changes; (*f*) automatic action; (*g*) accuracy. These standards were discussed with reference to the new "Pyro" radiation pyrometer, an instrument compact in shape, extremely portable, and simple in operation.

PARIS.

Academy of Sciences, March 17.—M. Guillaume Bigourdan in the chair.—M. **Mesnager**: The elementary solution of the problems of elasticity in two dimensions and some consequences.—C. **Guichard**: System of spheres osculating the lines of curvature of two surfaces.—M. **Mandelbrojt**: The series of Eisenstein.—Léon **Pomey**: The determination of the prime numbers by the use of binomial numbers.—Charles **Platrier**: A fundamental problem relating to a study of the torsion of transmission shafts.—M. **Bochet**: Observation on the remarks of M. D. Berthelot relating to the communication of M. Bochet on the law of corresponding states of van der Waals.—Félix **Michaud**: The elasticity of jellies submitted to an electric deformation and the mechanism of muscular contraction.—H. **Chiport**: The geometrical discussion of optical activity in crystals.—M.M. **Comandon** and **Lomon**: The radiographic kinematography of the human heart. A film of the heart showing 50 images in 3 seconds has been obtained, but to take this, certain modifications of the Coolidge tube were necessary. Working at 100,000 volts, a current of 150 milliamperes gave a satisfactory result.—A. **Bigot**: The treatment of town refuse. The refuse of Paris (3000 tons), after sorting and sieving, is burnt (840 tons), giving 220 tons of ashes from which inferior bricks are made. The ashes can be improved by a second calcination and passage through a magnetic separator, after which they can be used for mixing with cement.—M. **Geloso**: The absorption of iron by manganese dioxide. Displacement of equilibrium.—Victor **Henri** and Henry de **László**: The ultra-violet absorption spectrum of naphthalene vapour. The activation and structure of the molecule. Mathematical expressions are given which completely express the fine structure of the bands from the point of view both of position and of intensity. The moments of inertia of the normal and activated molecules are calculated, and from the low value of the normal, it is deduced that the atoms of carbon are closely packed in the molecule, their distance being much less than that of the atoms of carbon in diamond or in graphite.—A. **Kling** and A. **Lassieur**: The detection of methyl alcohol in the presence of ethyl alcohol. The method of Denigès cannot detect with certainty less than 1 per cent. of methyl alcohol.—P. **Brenans** and C. **Prost**: A new iodosalicylic acid. The preparation and properties of the acid $(CO_2H) : (OH) : I$ in positions 1 : 2 : 4 are described.—Léon **Bertrand** and Léonce **Joleaud**: Some new facts relating to the Jurassic and Cretaceous strata in the west of Madagascar.—Paul **Corbin** and Nicolas **Oulianoff**: Relations between the massifs of Mont Blanc and the Aiguilles Rouges.—E. A. **Martel**: The abyss of Mas-Raynal (Larzac) and the subterraneous rivers of the Sorgues d'Aveyron.—Jules **Gabriel**: The periodicity of storms. There is a certain parallelism between the periodicity of storms and of rainy periods, the maximum of rain corresponding with the maximum of electrical manifestation.—Émile F. **Terroine**: An hypothesis on the law which governs the intensity of metabolism of homeotherms.—Marcel **Gompel**, André **Mayer**, and René **Wurmser**: Researches on the oxidisability of organic bodies at the ordinary temperature. In these experiments purified blood charcoal was used as a catalyst, gaseous oxygen as the oxidising agent. A series of organic substances, known to be capable of oxidation by living organisms, were also oxidised by gaseous oxygen, *in vitro*, in the presence of carbon at the ordinary temperature. The acidity of the medium affects the rate of oxidation.—Paul **Fleury**: The law of action of laccase: the influence of the concentration of the quaiacol and of the pressure of the oxygen.—Raphael **Dubois**: Pseudo-luminescence and the rôle of the cover in certain fishes.—P. **Mazé**: Improvements in the manufacture of cheese.

Official Publications Received.

Università degli Studi di Perugia. Annali della Facoltà di Medicina e Chirurgia (Organo Ufficiale dell' Accademia Medico-Chirurgica di Perugia). Vol. 27, 1922, serie 5, Vol. 2. Pp. 208. (Perugia.)

Calendario della Basilica Pontificia del Santissimo Rosario in Valle di Pompei, per l' anno 1924. Pp. 238+80. (Valle di Pompei.)

A List of Official Chemical Appointments compiled, by direction of the Council of the Institute of Chemistry and under the supervision of the Publications Committee, by the Registrar of the Institute. Fifth edition, revised and enlarged. Pp. 311. (London: Institute of Chemistry.)

Memoirs of the Indian Meteorological Department. Vol. 23, Part 7: Monthly and Annual Normals of Rainfall and of Rainy Days, from Records up to 1920. By Dr. Gilbert T. Walker. Pp. 243-411. (Calcutta: Government Printing Office.) 7.12 rupees.

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. 39, fascicule 8. Pp. 443-478. (Genève: Georg et Cie.) 5 francs.

Publikationer fra det Danske Meteorologiske Institut: Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1923. Pp. 34+5 maps. (København: G. E. C. Gad.)

Arkiv för Botanik utgivet av K. Svenska Vetenskapsakademien. Band 19, No. 3: On the Discontinuous Geographical Distribution of some Tropical and Subtropical Marine Algæ. By Nils Svedelius. Pp. 70. (Stockholm: Almquist & Wiksells Boktryckeri A.-B.; London: Wheldon and Wesley, Ltd.; Berlin: R. Friedländer & Sohn; Paris: C. Klincksieck.)

Egyptian Government Almanac for the Year 1924. Pp. viii+262. (Cairo: Government Publications Office.) 10 P.T.

New Zealand. Department of Mines: Geological Survey Branch. Palæontological Bulletin No. 10: The Fossil Cirripedes of New Zealand. By Thomas H. Withers. Pp. iii+47+8 plates. (Wellington, N.Z.: W. A. G. Skinner.)

Diary of Societies.

SATURDAY, APRIL 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Singer: Leonardo da Vinci as a Man of Science.

MONDAY, APRIL 14.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—D. Brunt: Climate Continentality and Oceanity.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Tumours of the Colon (Demonstration).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. R. Bedford and others: Discussion on Some Idiosyncrasies of Electrical Manufacturers.

INSTITUTION OF MECHANICAL ENGINEERS (London Graduates' Section), at 7.—A. H. Fuller: Mechanical Refrigeration for the Small User.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—D. F. Slothouwer: Modern Dutch Architecture.

FARADAY SOCIETY (at Chemical Society), at 8.—Report on an Investigation of the Chemical, Physical, and Explosive Properties of Oppau Ammonium Sulphate-nitrate, by Sir Robert Robertson and Dr. G. Rotter, with Appendices by Dr. H. H. Thomas, A. L. Hallimond, and Sir William Bragg.

TUESDAY, APRIL 15.

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

ROYAL STATISTICAL SOCIETY, at 5.15.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions made to the Society's Menagerie during the month of March 1924.—G. C. Robson: The Cephalopoda obtained in South African Waters by Dr. J. D. F. Gilchrist in 1920-1921.—Basanta Kumar Das: The Intra-Renal Course of the so-called "Renal-Portal" Veins in some Common Indian Birds.

INSTITUTION OF CIVIL ENGINEERS, at 6.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Lt.-Comdr. H. E. Rendall: One Exposure Tri-Colour Cameras.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—R. N. Salaman: An Analysis of Jewish Types.

WEDNESDAY, APRIL 16.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.

ROYAL MICROSCOPICAL SOCIETY, at 7.45.—Prof. E. W. Carlier: A paper by Mr. Rogers on Electric Methods of Staining the Radulæ of Mollusca.—Dr. T. Goodey: Recent Work on Nematode Life History.

RADIO SOCIETY OF GREAT BRITAIN (Transmitter and Relay Section) (at Institution of Electrical Engineers), at 6.30.—Discussion on Power Transformer Design.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.